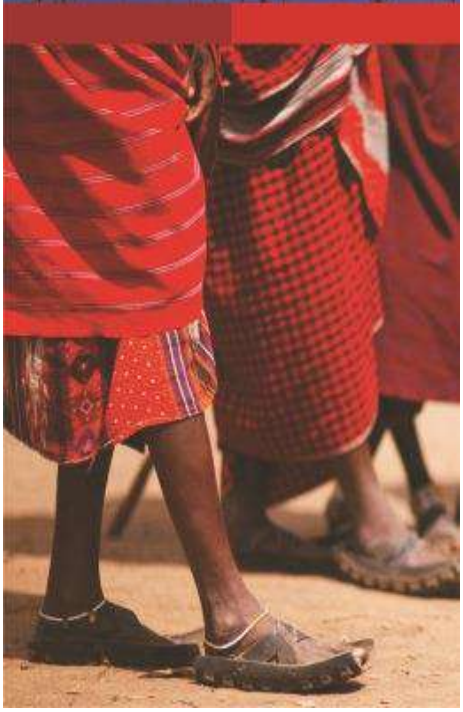

DIGBY WELLS
ENVIRONMENTAL

Environmental Impact Assessment for proposed Future Developments within the Sun City Complex

Specialist Wetland Report

Project Number:

SUN4642

Prepared for:

Sun International (Sun City Resort)

May 2018

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This document has been prepared by Digby Wells Environmental.

Report Type:	**Specialist Wetland Report**
Project Name:	**Environmental Impact Assessment for proposed Future Developments within the Sun City Complex**
Project Code:	**SUN4642**

Name	Responsibility	Signature	Date
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Kathryn Roy	Report Writer		28-02-2018
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EXECUTIVE SUMMARY

Digby Wells Environmental (hereafter Digby Wells) has been appointed by Sun City Resort to complete a baseline assessment of the freshwater resources in the vicinity of the Sun City Resort Complex (Sun City) and its various proposed infrastructure developments. Sun City is located near Rustenburg in the North West Province. The freshwater wetland assessment took place on 23rd, 24th and 25th January 2018.

Wetland Classification

Multiple wetland systems totalling 136.5 ha were identified within the proposed development areas (A, B and C). Seven freshwater features were identified on site and are broadly defined as follows:

- HGM Unit 1: An un-channelled valley bottom wetland situated on the western border of development area A;
- HGM Unit 2: An un-channelled valley bottom wetland on the eastern portion of development area A and originating in the western portion of development area B;
- HGM Unit 3: A large channelled and un-channelled valley bottom wetland drains the eastern portion of development area B from the north of the project area to the southern border of the Sun City Complex and consists of both channelled valley bottom and un-channelled valley bottom HGM units;
- HGM Unit 4: A seep, situated on the southern border of development area B;
- HGM Units 5 and 6: Two artificial wetlands on the southern border of development area C, likely formed as a result of ponding as a result of the compaction of soils in the road resulting in the inhibition of surface water runoff in the catchment; and
- HGM Unit 7: A channelled valley bottom system to the east of development area C.

Present Ecological State

The wetlands within the Project area exhibit a variety of PES values, ranging from *Largely Natural* (Category B) to *Largely Modified* (Category D).

HGM Unit 7 may be regarded as *Largely Natural* (Category B), with only minor impacts as a result of the recreational dam and the presence of some AIP species. HGM Units 1 and 4 may be regarded as *Moderately Modified* (Category C), with moderate impacts at HGM Unit 1 affecting vegetation and hydrological integrity as a result of the road crossing. Loss of natural vegetation and soil disturbance as well as compromised water quality contributed to the modified state at HGM Unit 4.

Two *Largely Modified (*Category D*)* wetlands are present in the Project Area (HGM Unit 2 and HGM Unit 3). The *Largely Modified* category is mainly attributed to habitat transformation and hydrological alterations due to the golf course as well as the dam and crocodile sanctuary as in the case of HGM Unit 3.

Ecological Importance and Sensitivity

Although the wetlands are modified, they do still provide predominantly *Moderate* to *Low* hydrological importance services (ranging between 0.5 and 1.9), such as erosion control and sediment trapping and assimilation of toxicants and nitrates.

The Ecological Importance and Sensitivity category ranges from *Moderate* (1) to *High* (2.4). This is largely due to proximity to the Pilanesberg National Park and the present of various protected species observed at the time of the assessment (*Sclerocarya birrea, Spirostachys Africana)*.

In general, the values are *Low* (0.7) to *High* (2.5) for 'Direct Human Benefits'. The wetlands provide tourism services specifically and some provide water and cultural services further downstream.

Impact Assessment and Conclusion

With specific reference to Development Area B, large impacts to the wetland and freshwater systems present have already occurred due to historical development activities, including the golf course, accommodation facilities, the valley of the waves, roads, etc. The natural flow regimes of the wetlands and aquatic systems present have been severely altered due to stream diversions and canals associated with the existing golf course areas. The various infrastructures have resulted in losses to catchment yields. Loss of natural vegetation is extensive throughout the area thus affecting surface water runoff patterns, flood attenuation and streamflow regulation services. As a result, a large loss in the natural biodiversity of the area has occurred. It is the opinion of the specialist, that in light of these existing alterations to the natural ecology, should the management and mitigation measures provided in this report be strictly adhered to, the proposed developments in Development Area B, are unlikely to further result in significant losses to the ecological sensitivity and functioning of the area. However, in terms of the proposed developments to Development Area A, the proposed activities are likely to result in further losses to habitat and biodiversity in the area as the natural habitat observed in these areas are deemed largely natural in extent. A slightly larger impact for the proposed activities (i.e. the Vacation Club Phase 4) is thus deemed likely, however, the results of the impact assessment indicate that should the appropriate management and mitigation measures be implemented for both Development Area A and B, impacts can be reduced and are likely to be minor and negligible for both project phases.

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GLOSSARY OF TERMS

Alien invasive vegetation	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome - usually international in origin.
Basal cover	The cross-sectional area of the plant that extends into the soil.
Base flow	Long-term flow in a river that continues after storm flow has passed.
Biodiversity	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Catchment	The area contributing to runoff at a particular point in a river feature.
Ecoregion	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Groundwater	Subsurface water in the saturated zone below the water table.
Intermittent flow	Flows only for short periods.
Indigenous vegetation	Vegetation occurring naturally within a defined area.

Perennial	Flows all year round.
Wetland	Defined according to the National Water Act, 1998 (Act No. 36 of 1998) (NWA) as: *"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."*

LIST OF ACRONYMS

AIP	Alien Invasive Management Plan
BRP	Bioregional Plan
CMA	Catchment Management Agencies
DMR	Department of Mineral Resources
DWA	Department of Water Affairs (currently the Department of Water and Sanitation)
DWAF	Department of Water and Forestry (currently the Department of Water and Sanitation)
DWE	Digby Wells Environmental
DWS	Department of Water and Sanitation
EC	Ecological Class
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMF	Environmental Management Framework
EMO	Environmental Management Officer
F	Facultative species
FD	Facultative dry-land species
FW	Facultative wetland species
GIS	Geographical Information System
GPGC	Gary Player Golf Course
Ha	Hectares
HGM	Hydro-geomorphic
LCGC	Lost City Golf Course

MPRDA	Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002)
MRA	Mining Right Area
NEM:BA	National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecosystems Priority Areas
NWA	National Water Act, 1998 (Act No. 36 of 1998)
OW	Obligate wetland species
PES	Present Ecological State
REC	Recommended Ecological Category
RQIS	Resource Quality Information Services
SANBI	South African National Biodiversity Institute
SFI	Soil Form Indicator
SWI	Soil Wetness Indictor
TUI	Terrain Unit Indicator
VC	Vacation Club
VOW	Valley of Waves
WMA	Water Management Areas
WRC	Water Research Commission
WUL	Water Use Licence

1 Introduction

Digby Wells Environmental (hereafter Digby Wells) has been appointed by Sun City Resort to undertake an Environmental Impact Assessment (EIA) in relation to proposed infrastructure developments within the Sun City Resort Complex located near Rustenburg (approximately 50km), North West Province. The proposed activities include the following:

- Resort Expansion Projects:
  - Develop an Eco-Lodge at at Gary Player Country Club Workshop;
  - Construct a road to connect the Driving Range at Lost City Golf Course (LCGC) to the Gary Player Golf Course (GPGC) via the Palace garden road and Valley of Waves (VOW) road;
  - Construct 20 additional Rustic Chalets at Kwena Gardens;
  - Construct an additional 150 simplex units, 2 and 3 bed units and associated infrastructure to expand capacity at the Vacation Club (VC Phase 3);
  - Construct an additional 150 simplex units, 2 and 3 bed units and associated infrastructure to expand capacity at the Vacation Club (VC Phase 4);
  - Expand the existing artificial beach at the Lake and construct an additional shallow swimming pool at Waterworld Beach;
  - Decommission the existing helipad, to make space for VC Phase 3, and construct a new helipad with increased bays closer to the Palace;
  - Construct an additional parking garage, Convention Centre and Hotel (250 rooms) including a bridge link from Sun Central to the new Hotel;
  - Develop 2 soccer fields at the Warehouse, on the old Motocross track.
- Utilities and Services Projects:
  - Install stormwater pipes / culverts at both Golf Course roads to allow freeflow of water and maintain road surface for fence inspections by security (prevent floods washing away the road);
  - Construct 2 x 10Ml reservoirs or alternatively 1 x 20Ml Reservoir on Telkom Hill next to existing Upper Reservoir, to supplement water storage capacity;
  - Currently there is an effluent transfer line (historical asbestos line) through Sunset Drive to Hole 2. Use of this line is to be discontinued, while remaining in place. A new line will then be installed against the fence of Letsatsing;
  - Construct a main water line from the Welcome Centre to Sky Train (pipe will be attached to skytrain route);

- Currently the sewer line running through Ledig (old asbestos line). Use of this line is to be discontinued, while remaining in place. A new wastewater treatment works (WWTW) will be established to manage sewage from VC and the Palace;
- Construct an additional pipeline for water supply to South Village; and
- Consolidate the generators throughout the site into one area for effective monitoring and control;

- Maintenance Projects
  - Vegetation clearance at perimeter fences to serve as maintenance roads and fire breaks (25 km); and
  - Clear the culverts under the road at Sun Park from debris and siltation. Construct maintenance road to facilitate future maintenance.

Activities that are listed in terms of the Environmental Impact Assessment (EIA) Regulations[1] require environmental authorisation prior to commencing. The proposed activities at Sun City constitutes Listed Activities in terms of GN R 983 (Listing Notice 1); GN R 984 (Listing Notice 2) and GN R 985 (Listing Notice 3) as amended.

This specialist Wetlands Report has been compiled in terms of Appendix 6 of the NEMA EIA Regulations, 2014, (as amended) in terms of the Scoping and EIA process, which is being followed in applying for Environmental Authorisation.

The requirements of Appendix 6 are presented in Table 1-1 and cross-referenced to the relevant sections of this Report.

[1] As published in Government Notices R982; 983; 984 and 985 on 4 December 2014, as Amended 7 April 2017.

Table 1-1: Structure of this report in accordance with the EIA Regulations

Regulatory Requirement for EIA Reports	Relevant Section of this report
1. (1) A specialist report prepared in terms of these Regulations must contain -	
(a) details of— (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Please refer to Section 2 and Appendix A of this Report
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Please refer to Section 2 of this report: Details of the Specialist
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Please see Section 3: Scope and Purpose of this Report
(cA) an indication of the quality and age of base data used for the specialist report;	Please see Section 4
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Please see Section 6: Existing Environment
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Please see Section 4
(e) a description of the methodology adopted in preparing the report inclusive of equipment and modelling used;	Please see Section 5: Methodology
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Please see Section 6.2: Sensitivity of the Site
(g) an identification of any areas to be avoided, including buffers;	Please see Section 6.2: Sensitivity of the Site
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Please see Section 6.2: Sensitivity of the Site
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Please see Section 7: Assumptions, Limitations and Gaps in knowledge

(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Please see Section 8: Impact Assessment
(k) any mitigation measures for inclusion in the EMPr;	Please see Section 8.3.2: Cumulative and Latent Impacts
(l) any conditions for inclusion in the environmental authorisation;	The freshwater resources of this catchment feed largely into the Elands River Catchment, which drains into the Crocodile River further downstream. Cumulative impacts include loss of catchment yields and surface water recharge to this system as a result of the hardening of surfaces as well as the loss of the ingress of water to the groundwater resources present. In addition, the freshwater resources in this area are increasingly subjected to water quality impacts as a result of mining activities and increasing pressure as a result of rural settlements and agriculture (livestock watering) activities within the

	greater catchment. Further losses to habitat and biodiversity as a result of the proposed development activities, with special mention of Development Area A, are deemed likely.
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Please see Section 9: Wetland Management Plan
(n) a reasoned opinion— (i) whether the proposed activity, activities or portions thereof should be authorised; (i) (A) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Please see Section 11: Reasoned opinion of the specialist
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Please see Section 12: Public Consultation
(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q) any other information requested by the competent authority.	No additional information was requested.

2 Details of the Specialist

This Specialist Report has been compiled by the following specialists (CVs of the Project Team are included in Appendix A):

Table 2-1: Details of the Specialist(s) who prepared this Report

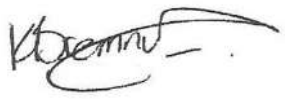
Responsibility	**Report Writer**
Full Name of Specialist	Kathryn Roy
Highest Qualification	MSc Restoration Ecology
Years of experience in specialist field	4
Responsibility	**Report Writer and Technical Review**
Full Name of Specialist	Kieren Jayne Bremner
Highest Qualification	MSc Aquatic Health
Years of experience in specialist field	10
Registration(s):	South African Council for Natural Scientific Professionals: *Professional Natural Scientist* (Reg. No. 119341 - Pending)

2.1 Declaration of the Specialist

I Kieren Jayne Bremner, as the appointed specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- in terms of the general requirement to be independent:
  - other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
  - am not independent, but another specialist that meets the general requirements set out in Regulation 13 have been appointed to review my work (Note: a declaration by the review specialist must be submitted);
- in terms of the remainder of the general requirements for a specialist, am fully aware of and meet all of the requirements and that failure to comply with any the requirements may result in disqualification;

- have disclosed/will disclose, to the applicant, the Department and interested and affected parties, all material information that have or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application;
- have ensured/will ensure that information containing all relevant facts in respect of the application was/will be distributed or was/will be made available to interested and affected parties and the public and that participation by interested and affected parties was/will be facilitated in such a manner that all interested and affected parties were/will be provided with a reasonable opportunity to participate and to provide comments;
- have ensured/will ensure that the comments of all interested and affected parties were/will be considered, recorded and submitted to the Department in respect of the application;
- have ensured/will ensure the inclusion of inputs and recommendations from the specialist reports in respect of the application, where relevant;
- have kept/will keep a register of all interested and affected parties that participate/d in the public participation process; and
- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.



Signature of the specialist:

Kieren Jayne Bremner

Full Name and Surname of the specialist:

Digby Wells Environmental

Name of company:

23-04-2018

Date:

3 Scope and Purpose of this Report

Digby Wells was appointed by Sun City to complete a baseline assessment of the freshwater resources in the vicinity of the Sun City Resort Complex (Sun City) and its various proposed infrastructure developments. Sun City is located near Rustenburg, North West Province .The following actions are required for this Scope of Work:

- The identification and the delineation of wetlands within 500m of the proposed future developments;
- A description and characterisation of the identified wetland areas;
- Determination of the wetland ecological health, importance and sensitivity;
- Assessment of potential impacts to the wetlands from the activities; and
- Discussion of recommended mitigation measures to be taken into account.

4 Details of the site visit

The wet season survey took place on 23rd, 24th and 25th January 2018. Development areas A, B and C, within Sun City were investigated, the localities of which are indicated in

Figure 4-1 and Figure 4-2.

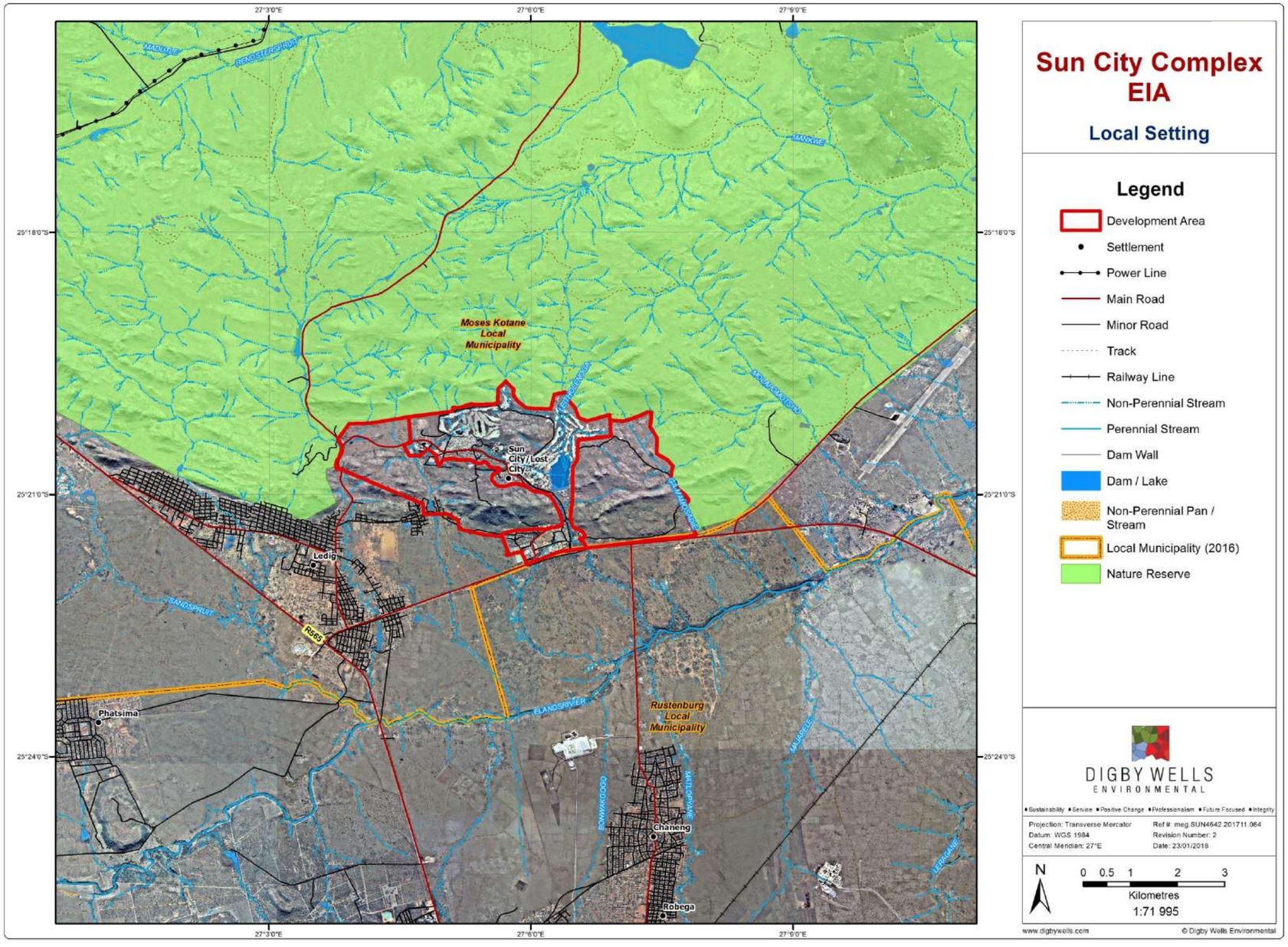
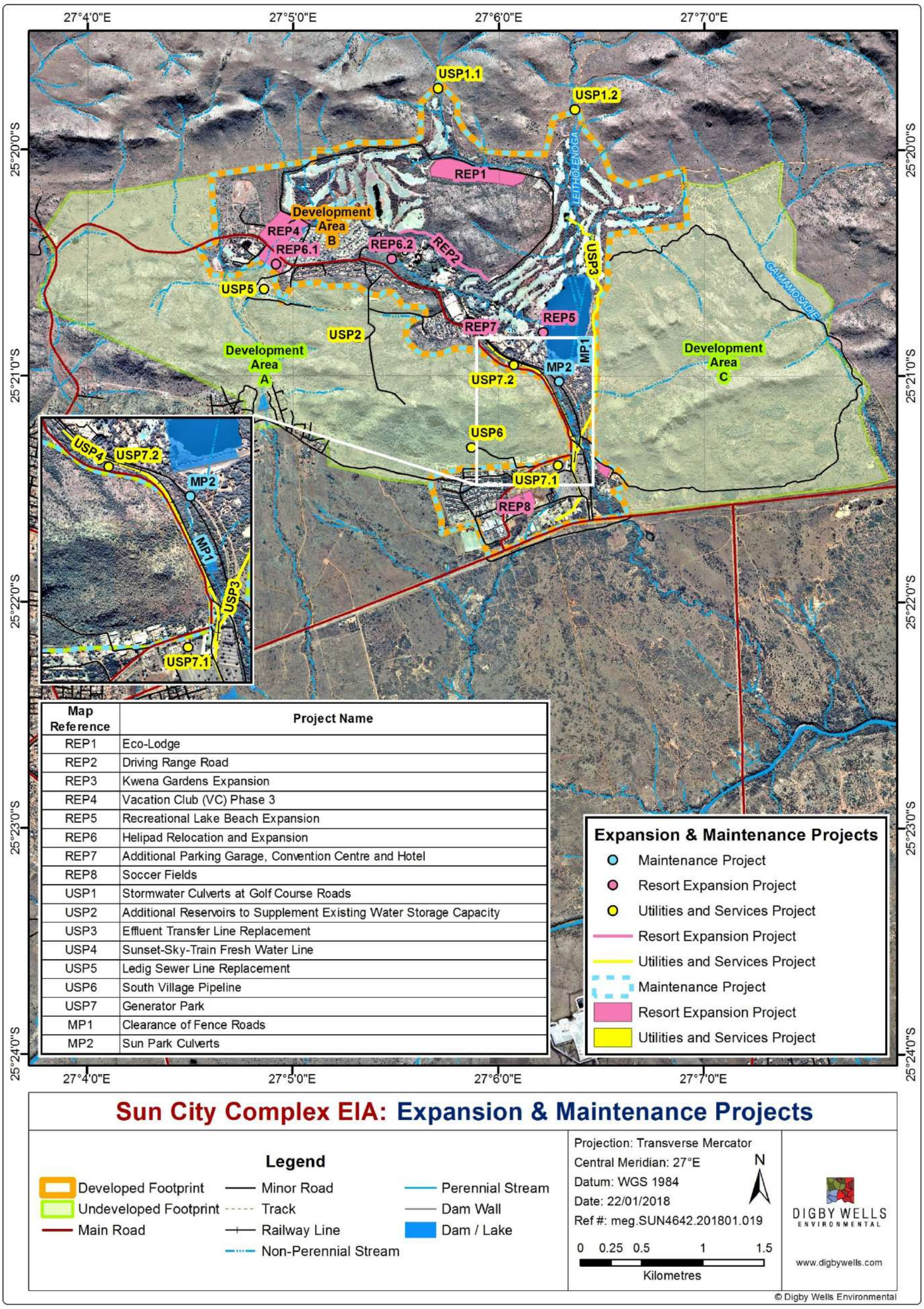


Figure 4-1: Locality



Map Reference	Project Name
REP1	Eco-Lodge
REP2	Driving Range Road
REP3	Kwena Gardens Expansion
REP4	Vacation Club (VC) Phase 3
REP5	Recreational Lake Beach Expansion
REP6	Helipad Relocation and Expansion
REP7	Additional Parking Garage, Convention Centre and Hotel
REP8	Soccer Fields
USP1	Stormwater Culverts at Golf Course Roads
USP2	Additional Reservoirs to Supplement Existing Water Storage Capacity
USP3	Effluent Transfer Line Replacement
USP4	Sunset-Sky-Train Fresh Water Line
USP5	Ledig Sewer Line Replacement
USP6	South Village Pipeline
USP7	Generator Park
MP1	Clearance of Fence Roads
MP2	Sun Park Culverts

Figure 4-2: Development Areas

5 Methodology

This section of the report describes the methodology adopted in determining the status quo of the wetland environment within the various development areas investigated. A description is then provided on the impact assessment methodology, the results of which are presented in Section 9.

5.1 Literature Review and Desktop Assessment

For the purposes of this Project, wetland areas were identified and preliminary wetland boundaries were delineated at the desktop level using detailed aerial imagery (Southern Mapping, 2015) along with 5m contours. Baseline and background information was researched and used to understand the area on a desktop level prior to fieldwork; this included but was not limited to:

- Policies and legal framework;
- NFEPA (Nel *et al*., 2011);
- Water Management Areas (WMA) and Quaternary Catchments; and
- North West Biodiversity Sector Plan.

5.1.1 Policy and Legal Framework

The wetlands assessment aims to support the following regulations, regulatory procedures and guidelines:

- Section 24 of the Constitution of the Republic of South Africa ,1996 (Act No. 108 of 1996);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA);
- Section 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- Department of Water and Forestry (DWAF) Guidelines for the Delineation of Wetlands (2005);
- Wetland Management Series (published by Water Research Commission (WRC, 2007);
- National Freshwater Ecosystems Priority Areas (NFEPA, Nel *et al.,* 2011); and
- SANBI, in collaboration with the DWS report on “Wetland offsets: a Best-Practice Guideline for South Africa” (Macfarlane, *et al.,* 2014).

5.1.2 National Freshwater Ecosystem Priority Areas

The NFEPA project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel *et al.* 2011). The spatial layers (FEPA's) include the nationally delineated wetland areas that are classified into hydrogeomorphic (HGM) NFEPA project types and ranked in terms of their biodiversity importance. These layers were assessed to evaluate the importance of the wetland areas located within the Project area.

Whilst being an invaluable tool, it is important to note that the NFEPA's were delineated and studied at a desktop and low resolution level. Thus, the wetlands delineated via the ground-truthing work done through this study may differ from the NFEPA data layers. The NFEPA assessment does, however, hold significance from a national perspective. As mentioned above, the NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity and Table 5-1 below indicates the criteria considered.

Table 5-1: NFEPA Wetland Classification Ranking Criteria

Criteria	Rank
Wetlands that intersect with a RAMSAR site.	1
▪ Wetlands within 500 m of an IUCN threatened frog point locality; ▪ Wetlands within 500 m of a threatened water-bird point locality; ▪ Wetlands (excluding dams) with the majority of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; ▪ Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and ▪ Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition (PES) AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition (PES) AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5
Any other wetland (excluding dams).	6

5.1.3 North West Biodiversity Sector Plan

The North West Biodiversity Sector Plan (NWBSP), completed in 2015, is a comprehensive revision of the 2009 provincial Biodiversity Conservation Assessment that incorporates the latest information on biodiversity and the environment in the North West province, and is now aligned with the national standards for developing biodiversity sector plans. The purpose of the NWBSP is to inform land use planning, environmental assessments, land and water use authorisations, as well as natural resource management, undertaken by a range of sectors whose policies and decisions impact on biodiversity. This is done by providing a map of biodiversity priority areas within the North West Province, referred to as Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), with accompanying land use planning and decision-making guidelines. Land use patterns indicate that approximately 35% of the province's natural ecosystems have been converted to other land uses. Consequently, increasing development pressures on biodiversity and the remaining natural ecosystems should be appropriately managed. The NWBSP is thus a useful tool for addressing the need to take biodiversity into account in land use planning and decision-making, in order to promote sustainable development (NWBSP, 2015).

5.1.1 Wetland Identification, Delineation and Classification

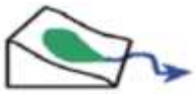
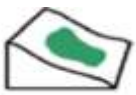
The wetland delineation procedure considers four attributes to determine the limitations of the wetland, in accordance with DWAF guidelines (now Department of Water and Sanitation (DWS) (2005)). The four attributes are:

- Terrain Unit Indicator – helps to identify those parts of the landscape where wetlands are more likely to occur;
- Soil Form Indicator – identifies the soil forms, which are associated with prolonged and frequent saturation;
- Soil Wetness Indicator – identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- Vegetation Indicator – identifies hydrophilic vegetation associated with frequently saturated soils.

5.1.1.1 Terrain Indicator

Terrain Unit Indicator (TUI) areas include depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of topographical maps, aerial photographs and engineering and town planning diagrams (DWAF, 2005). The Hydro-geomorphic HGM Unit system of classification focuses on the hydro-geomorphic setting of wetlands which incorporates geomorphology; water movement into, through and out of the wetland; and landscape / topographic setting. Once wetlands have been identified, they are categorised into HGM Units as shown in Table 5-2.

Table 5-2: Description of the various HGM Units for Wetland Classification

Hydromorphic wetland type	Diagram	Description
Floodplain		Valley bottom areas with a well-defined stream channel stream channel, gently sloped and characterised by floodplain features such as oxbow depression 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 characterised by the net loss of sediment. Water inputs from the 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 characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from the channel entering the wetland and also from adjacent slopes.
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterised by 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 that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.
Pan/Depression		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 subsurface water. An outlet is usually absent and so this type of wetland is usually isolated from the stream network.

5.1.1.2 Soil Form Indicator

Hydromorphic soils are taken into account for the Soil Form Indicator (SFI) which will display unique characteristics resulting from prolonged and repeated water saturation (DWAF, 2005). The continued saturation of the soils results in the soils becoming anaerobic and thus resulting in a change of the chemical characteristics of the soil. Iron and manganese are two

soil components which are insoluble under aerobic conditions and become soluble when the soil becomes anaerobic and thus begin to leach out into the soil profile. Iron is one of the most abundant elements in soils and is responsible for the red and brown colours of many soils.

Resulting from the prolonged anaerobic conditions, iron is dissolved out of the soil, and the soil matrix is left a greying, greenish or bluish colour, and is said to be “gleyed”. Common in wetlands which are seasonally or temporarily saturated is a fluctuating water table. This results in alternation between aerobic and anaerobic conditions in the soil (DWAF, 2005). Iron will return to an insoluble state in aerobic conditions which will result in deposits in the form of patches or mottles within the soil. Recurrence of this cycle of wetting and drying over many decades concentrates these insoluble iron compounds. Thus, soil that is gleyed and has many mottles may be interpreted as indicating a zone that is seasonally or temporarily saturated (DWAF, 2005).

5.1.1.3 Soil Wetness Indicator

In practice, the Soil Wetness Indictor (SWI) is used as the primary indicator (DWAF, 2005). Hydromorphic soils are often identified by the colours of various soil components. The frequency and duration of the soil saturation periods strongly influences the colours of these components. Grey colours become more prominent in the soil matrix the higher the duration and frequency of saturation in a soil profile (DWAF, 2005). A feature of hydromorphic soils are coloured mottles which are usually absent in permanently saturated soils and are most prominent in seasonally saturated soils, and are less abundant in temporarily saturated soils (DWAF, 2005). The hydromorphic soils must display signs of wetness within 50cm of the soil surface, as this is necessary to support hydrophytic vegetation.

5.1.1.4 Vegetation Indicator

As one moves along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas plant communities undergo distinct changes in species composition. Valuable information for determining the wetland boundary and wetness zone is derived from the change in species composition. A supplementary method for employing vegetation as an indicator is to use the broad classification of the wetland plants according to their occurrence in the wetlands and wetness zones (Kotze and Marneweck, 1999; DWAF, 2005). This is summarised in Table 5-3 below. When using vegetation indicators for delineation, emphasis is placed on the group of species that dominate the plant community, rather than on individual indicator species (DWAF, 2005). Areas where soils are a poor indicator (black clay, vertic soils), vegetation (as well as topographical setting) is relied on to a greater extent and the use of the wetland species classification as per Table 5-3 becomes more important. If vegetation was to be used as a primary indicator, undisturbed conditions and expert knowledge are required (DWAF, 2005). Due to this uncertainty, greater emphasis is often placed on the SWI to delineated wetland areas. In this assessment, where possible, the SWI has been relied upon to delineate wetland areas due to the high level of anthropogenic impacts characterising the wetlands and freshwater resources of the general

area. The identification of indicator vegetation species and the use of plant community structures have been used to validate these boundaries.

Table 5-3: Classification of Plant Species According to Occurrence in Wetlands (DWAF, 2005)

Type	Description
Obligate Wetland species (OW)	Almost always grow in wetlands: >99% of occurrences.
Facultative Wetland species (FW)	Usually grow in wetlands but occasionally are found in non-wetland areas: 67 – 99 % of occurrences.
Facultative species (F)	Are equally likely to grow in wetlands and non-wetland areas: 34 – 66% of occurrences.
Facultative dry-land species (FD)	Usually grow in non-wetland areas but sometimes grow in wetlands: 1 – 34% of occurrences.

5.1.2 Wetland Ecological Health Assessment (WET-Health)

According to Macfarlane *et al*. (2009) the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. A level 1 WET-Health assessment was done on the wetlands in accordance with the method described by Kotze *et al.* (2007) to determine the integrity (health) of the characterised HGM units for the Project area. Level 1 was selected due to the large size of the Project area as well as due to the restricted site access, and in turn, limited in-field verification. A Present Ecological State (PES) analysis was conducted to establish baseline integrity (health) for the associated wetlands. The health assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to or deviation from natural conditions.

Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; 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) as described above.

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial *extent* of the impact of individual activities and then separately assessing the *intensity* of the 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 5-4.

Table 5-4: Impact Scores and Present Ecological State Categories used by WET-Health

Impact Category	Description	Combined Impact Score	PES Category
None	Unmodified, natural.	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota has taken place.	1-1.9	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.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	F

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (Table 5-5).

Table 5-5: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓

Change Class	Description	HGM change score	Symbol
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland

5.1.3 Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) tool was derived to assess the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term. The methodology outlined by DWAF (1999) and updated in Rountree and Kotze, (2012), in Rountree *et al.* (2012) was used for this study

In this method there are three suites of importance criteria; namely:

- **Ecological Importance and Sensitivity:** incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWS and thus enabling consistent assessment approaches across water resource types;
- **Hydro-functional Importance:** which considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- **Importance in terms of Basic Human Benefits:** this suite of criteria considers the subsistence uses and cultural benefits of the wetland system.

These determinants are assessed for the wetlands on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. It is recommended that the highest of these three suites of scores be used to determine the overall Importance and Sensitivity category of the wetland system, as defined in Table 5-6.

Table 5-6: Interpretation of Overall EIS Scores for Biotic and Habitat Determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological ; Management Class
Very high Systems that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4	A
High Systems that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3	B
Moderate Systems that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2	C
Low/marginal Systems that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1	D

5.2 Baseline Environment

5.2.1 Drainage and Quaternary Catchment

The water resources of South Africa are divided into quaternary catchments, which are regarded as the principal water management units in the country (DWAF 2011). A quaternary catchment is a fourth order catchment in a hierarchical classification system in which the primary catchments are the major units. The primary drainages are further grouped into or fall under Water Management Areas (WMA) and Catchment Management Agencies (CMA). The Department of Water and Sanitation (DWS) has established nine WMAs and nine CMAs as contained in the National Water Resource Strategy 2 (2013) in terms of Section 5 subsection 5(1) of the National Water Act, 1998 (Act No. 36 of 1998). The

establishment of these WMAs and CMAs is to improve water governance in different regions of the country, to ensure a fair and equal distribution of the Nations water resources, while making sure that the resource quality is sustained.

Figure 5-1 indicates the water resource management classification associated with the Project area. The Project area falls within the Limpopo River Catchment (WMA1), and it is associated with primary drainage A. The quaternary catchment is A22F.

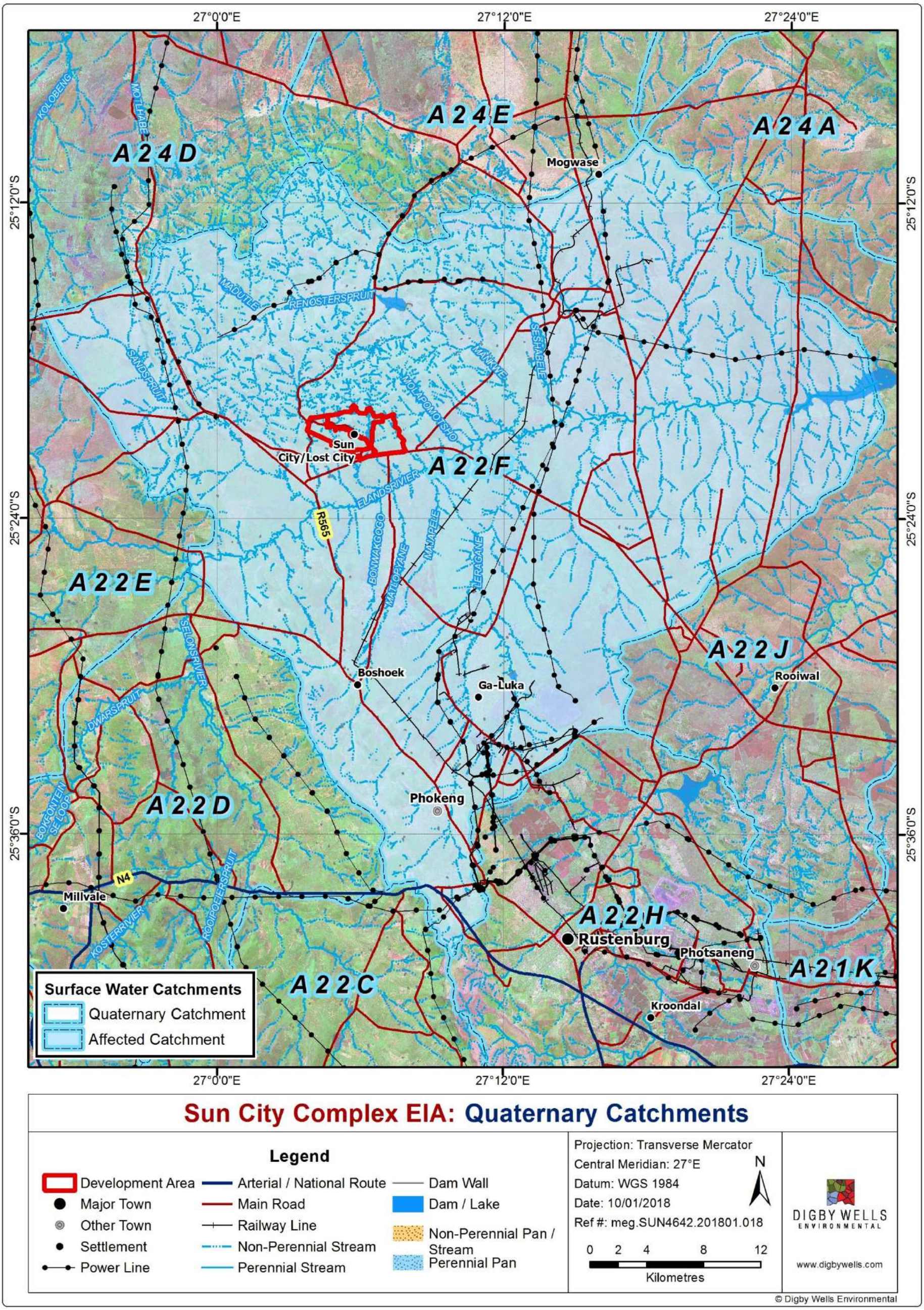


Figure 5-1: Quaternary Catchments

5.2.2 National Freshwater Ecosystem Priority Areas (NFEPA)

The NFEPA project provides information on wetland and river ecosystems for integrating into freshwater ecosystem and biodiversity planning and decision-making processes. The assessor considered the strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources contained therein to evaluate the importance of the wetland areas (Nel *et al.* 2011). Figure 5-2 demonstrates the distribution of NFEPA wetlands within the Project area. The wetland types that dominate the landscape are Valley Floor wetlands and seeps.

The NFEPA wetlands have been ranked in terms of importance in the conservation of biodiversity. The Project wetlands consist of Rank 5 and 6 wetlands.

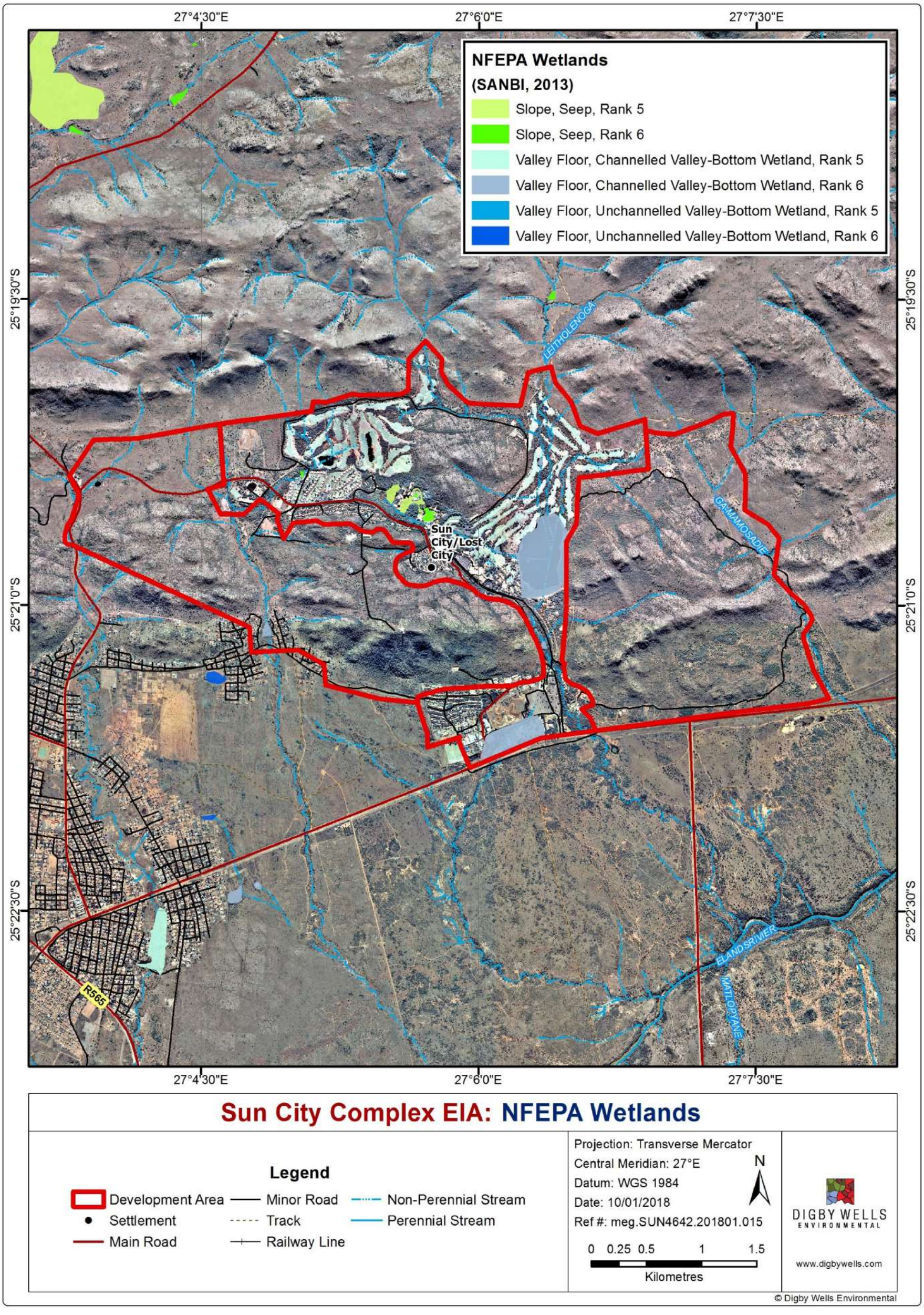


Figure 5-2: NFEPA Wetlands

5.2.3 North West Biodiversity Sector Plan

According to the NWBSP (2015) the Sun City development areas do not fall within any of the North West CBAs or ESAs.

5.2.4 Regional Vegetation

The proposed future developments fall within the Zeerust Thornveld (Figure 5-3) vegetation type (Mucina and Rutherford, 2012), which is characterised by deciduous, thorny woodland. *Senegalia* and *Vachellia* (both formally *Acacia*) species dominate the landscape with a predominantly grass-dominated herbaceous layer beneath. Zeerust Thornveld is considered 'Least threatened' but only 4% of it is statutorily conserved. Alien invasive species are scattered throughout and erosion is considered to be low.

Table 5-7 list the species characteristic of the Zeerust Thornveld.

Table 5-7: Plant Species Characteristic of the Zeerust Thornveld

Plant Form	Species
Tall trees	*Senegalia burkei (d), Vachellia erioloba (d).*
Small Trees	*Senegalia mellifera subsp. detinens (d), S. fleckii, Vachellia nilotica (d), V. tortilis subsp. heteracantha (d), Searsia lancea (d), Peltophorum africanum, Terminalia sericea*
Tall Shrubs	*Diospyros lycioides subsp. lycioides, Grewia flava, Mystroxylon aethiopicum subsp. burkeanum*
Low Shrubs	*Agathisanthemum bojeri, Chaetacanthus costatus, Clerodendrum ternatum, Indigofera filipes, Rhus grandidens, Sida chrysantha, Stylosanthes fruticosa. Rhus maricoana.*
Graminoids	*Eragrostis lehmanniana (d), Panicum maximum (d), Aristida congesta, Cymbopogon pospischilii.*
Herbs	*Blepharis integrifolia, Chamaecrista absus, C. mimosoides, Cleome maculata, Dicoma anomala, Kyphocarpa angustifolia, Limeum viscosum, Lophiocarpus tenuissimus*

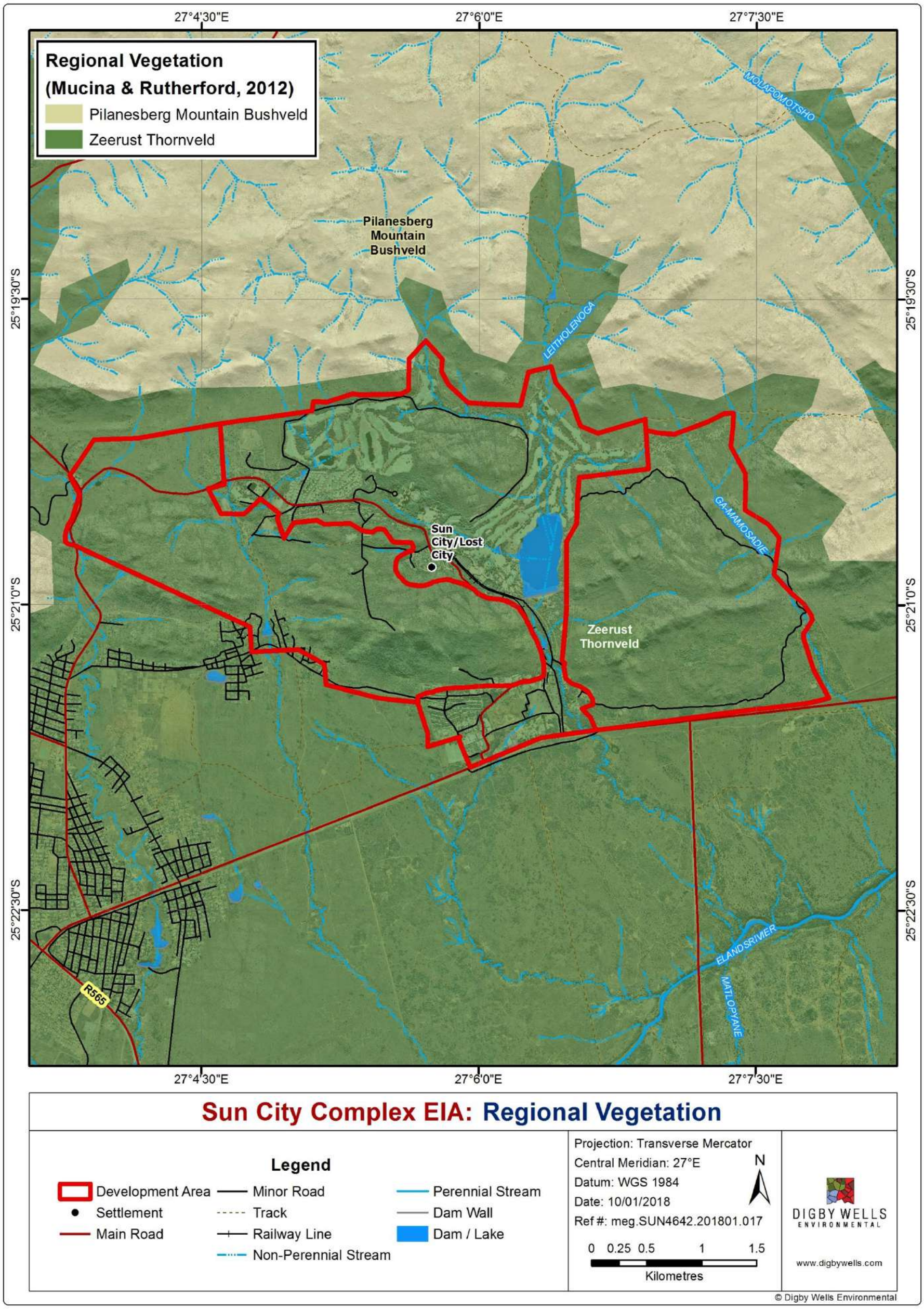


Figure 5-3: Regional Vegetation

5.3 Impact Assessment Methodology

Impacts and risks have been identified based on a description of the activities to be undertaken. Once impacts have been identified, a numerical environmental significance rating process will be undertaken that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a particular environmental impact.

The severity of an impact is determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact is then determined by the frequency at which the activity takes place or is likely to take place and by how often the type of impact in question has taken place in similar circumstances.

Following the identification and significance ratings of potential impacts, mitigation and management measures will be incorporated into the EMP.

Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below.

The significance rating process follows the established impact/risk assessment formula:

Significance = CONSEQUENCE X PROBABILITY X NATURE

Where

Consequence = intensity + extent + duration

And

Probability = likelihood of an impact occurring

And

Nature = positive (+1) or negative (-1) impact

The matrix calculates the rating out of 147, whereby intensity, extent, duration and probability are each rated out of seven as indicated in Table 5-9. The weight assigned to the various parameters is then multiplied by +1 for positive and -1 for negative impacts.

Impacts are rated prior to mitigation and again after consideration of the mitigation has been applied; post-mitigation is referred to as the residual impact. The significance of an impact is determined and categorised into one of seven categories (The descriptions of the significance ratings are presented in Table 5-10).

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, (i.e., there may already be some mitigation included in the engineering design). If the specialist determines the potential impact is still too high, additional mitigation measures are proposed.

Table 5-8: Impact assessment parameter ratings

Rating	Intensity/ Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
7	Irreplaceable loss or damage to biological or physical resources or **highly** sensitive environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and / or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur.>65 but <80% probability.

Rating	Intensity/ Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
5	Serious loss and/or damage to physical or biological resources or **highly** sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or **moderately** sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures / items of cultural significance.	Average to intense natural and / or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.

Rating	Intensity/ Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
3	Moderate loss and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local including the site and its immediat surrounding area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	**Minor loss and/or effects** to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited extending only as far as the development site area.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.

Rating	Intensity/ Replacability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

Table 5-9: Probability/consequence matrix

Significance																																						
-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

Table 5-10: Significance rating description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and / or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and / or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and / or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and / or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and / or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and / or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

6 Existing Environment

6.1 Wetland delineation and classification

Multiple wetland systems totalling 136.5 ha fall within the proposed development areas (A, B and C). Seven freshwater features were identified on site and are broadly defined as follows:

- An un-channelled valley bottom wetland situated on the western border of development area A;
- An un-channelled valley bottom wetland on the eastern portion of development area A and originating in the western portion of development area B;
- A large channelled and un-channelled valley bottom wetland drains the eastern portion of development area B from the north of the project area to the southern border of the Sun City Complex and consists of both channelled valley bottom and un-channelled valley bottom HGM units;
- A seep, situated on the southern border of development area B;
- Two artificial wetlands on the southern border of development area C, likely formed as a result of ponding as a result of the compaction of soils in the road resulting in the inhibition of surface water runoff in the catchment; and
- A channelled valley bottom system to the east of development area C.

The breakdown of the wetland types per area is detailed in Table 6-1 and illustrated in Figure 6-1.

Table 6-1: Wetland HGM Units

HGM Unit	HGM Unit Type	Area (ha)
1	Un-channelled valley bottom	21.6
2	Un-channelled valley bottom	23.4
3	Channelled and unchannelled valley bottom	71.1
4	Seep	4.8
5	Artificial	0.7
6	Artificial	0.2
7	Channelled valley bottom	14.7

The buffer zones relating to the wetlands are illustrated in Figure 6-2. Zones of Regulation of 32m around each wetland have been assigned according to NEMA (Act No. 107 of 1998).

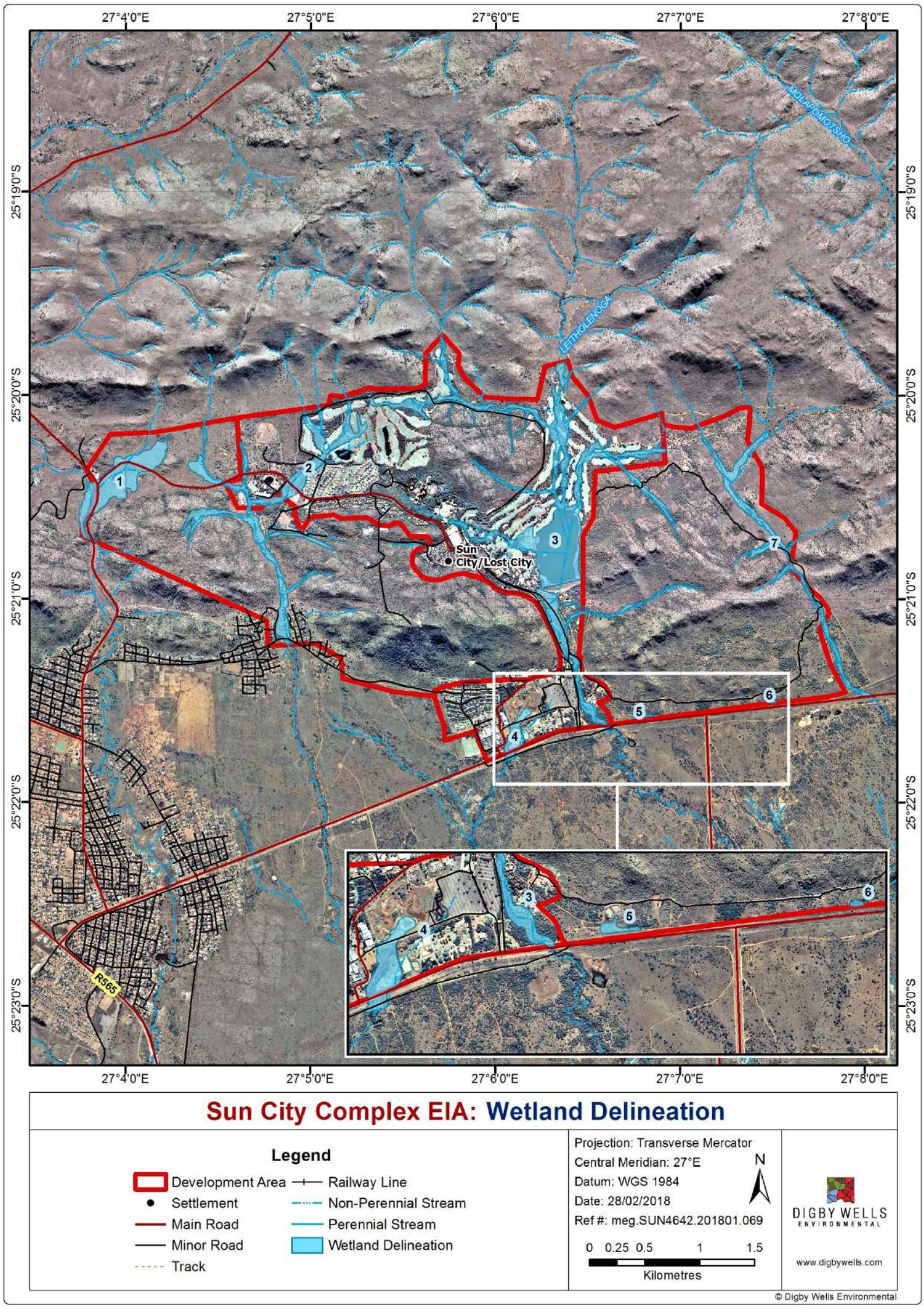


Figure 6-1: Wetland Delineation

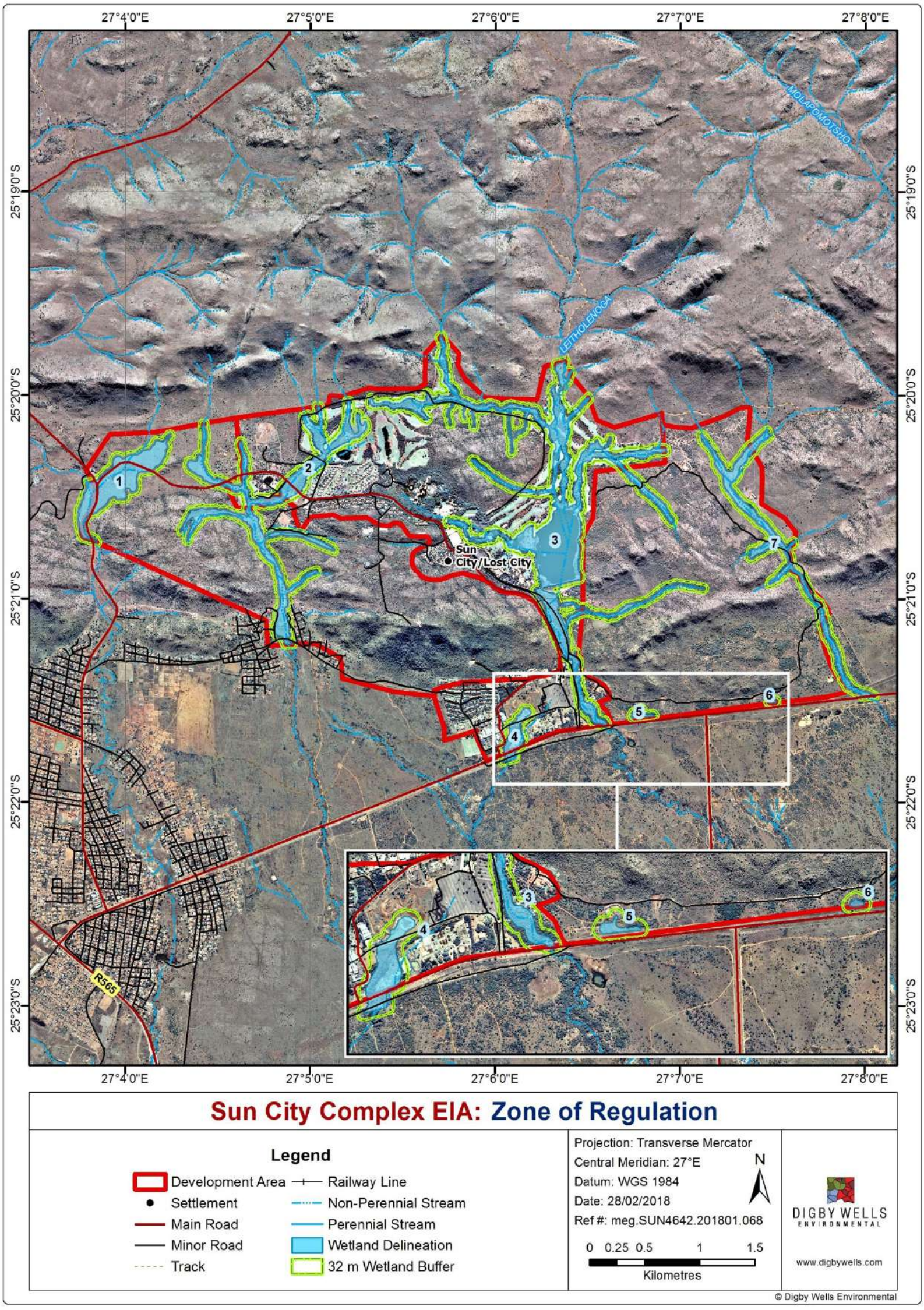


Figure 6-2: Wetland Zones of Regulation

6.1.1 HGM Unit 1

HGM Unit 1 is predominantly an un-channelled valley bottom system which covers approximately 21.6 ha. This wetland is characterised by a dominance of *Setaria* sp. and *Searsia lancea*. The water has been channelized towards the bottom of the wetland, where *Typha capensis* and *Cyperus sexangularis* are the dominant species. Protected species, *Sclerocarya birrea* (Marula), were noted within the wetland. See Figure 6-3 for a visual representation of the wetland habitat of HGM unit 1.

The major impacts to this wetland are the following:

- The wetland is intersected by a road which is the largest impact. However, culverts are present which allow for the free flow of water to take place;
- Slight disturbances occur within the wetland, such as excavation in the form of borrow pits;
- Invasive alien species are present in small patches, including *Verbena bonariensis.*

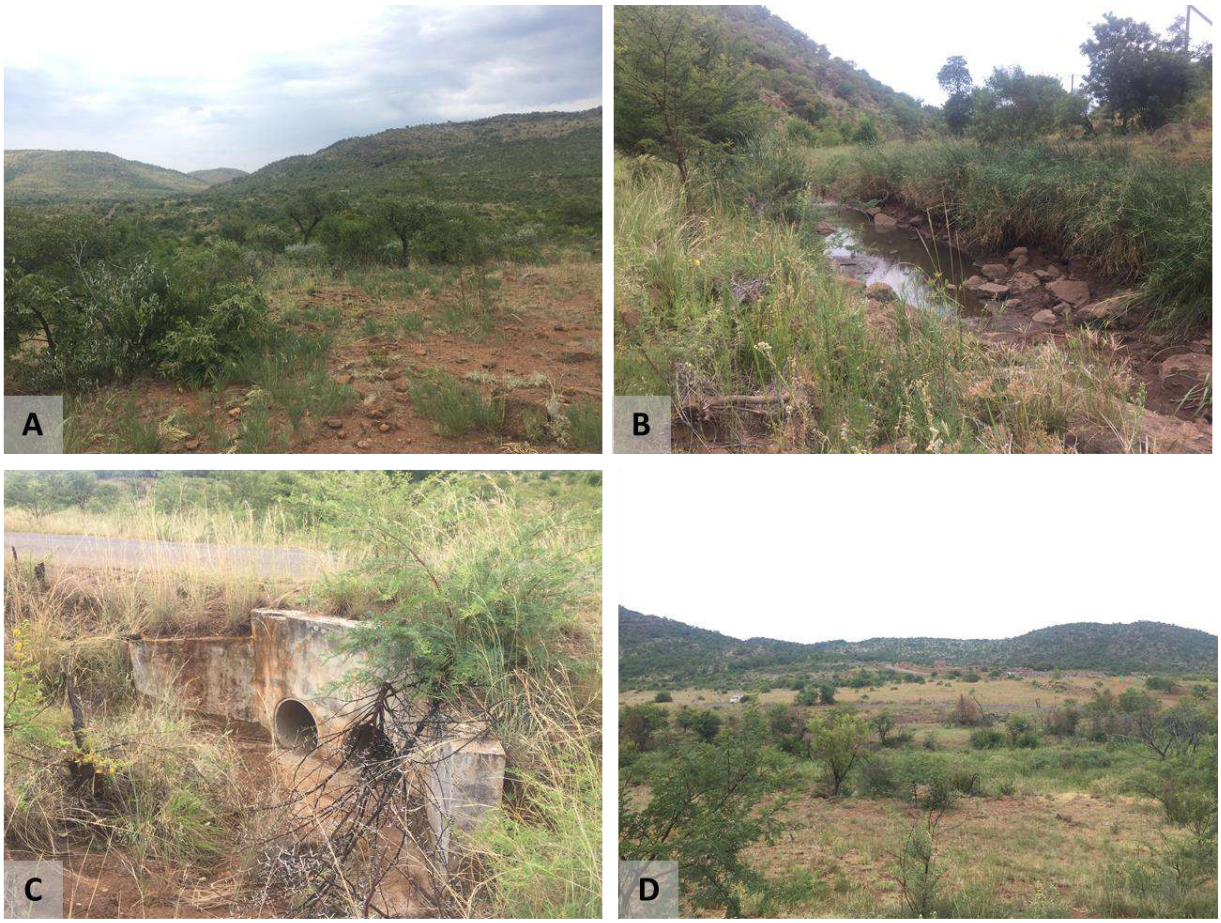


Figure 6-3: HGM unit 1

6.1.2 HGM Unit 2

HGM Unit 2 is a largely un-channelled valley bottom wetland which covers 23.4 ha. Dominant species include *Sporobolus africana*, *Bothriochloa bladhii*, *Cyperus sexangularis, Paspalum*, *Olea europeana* and *Searsia lancea.* See Figure 6-4 for a visual representation of the wetland habitat of HGM unit 2.

Major impacts to this wetland include:

- Dumping, which is prevalent within this unit, particularly in the southernmost portion;
- Impacts on the hydrology as a result of the golf course, which has affected the eastern arm of this wetland; and
- Various road crossings resulting in loss of flow and stream connectivity and fragmentation of the system,

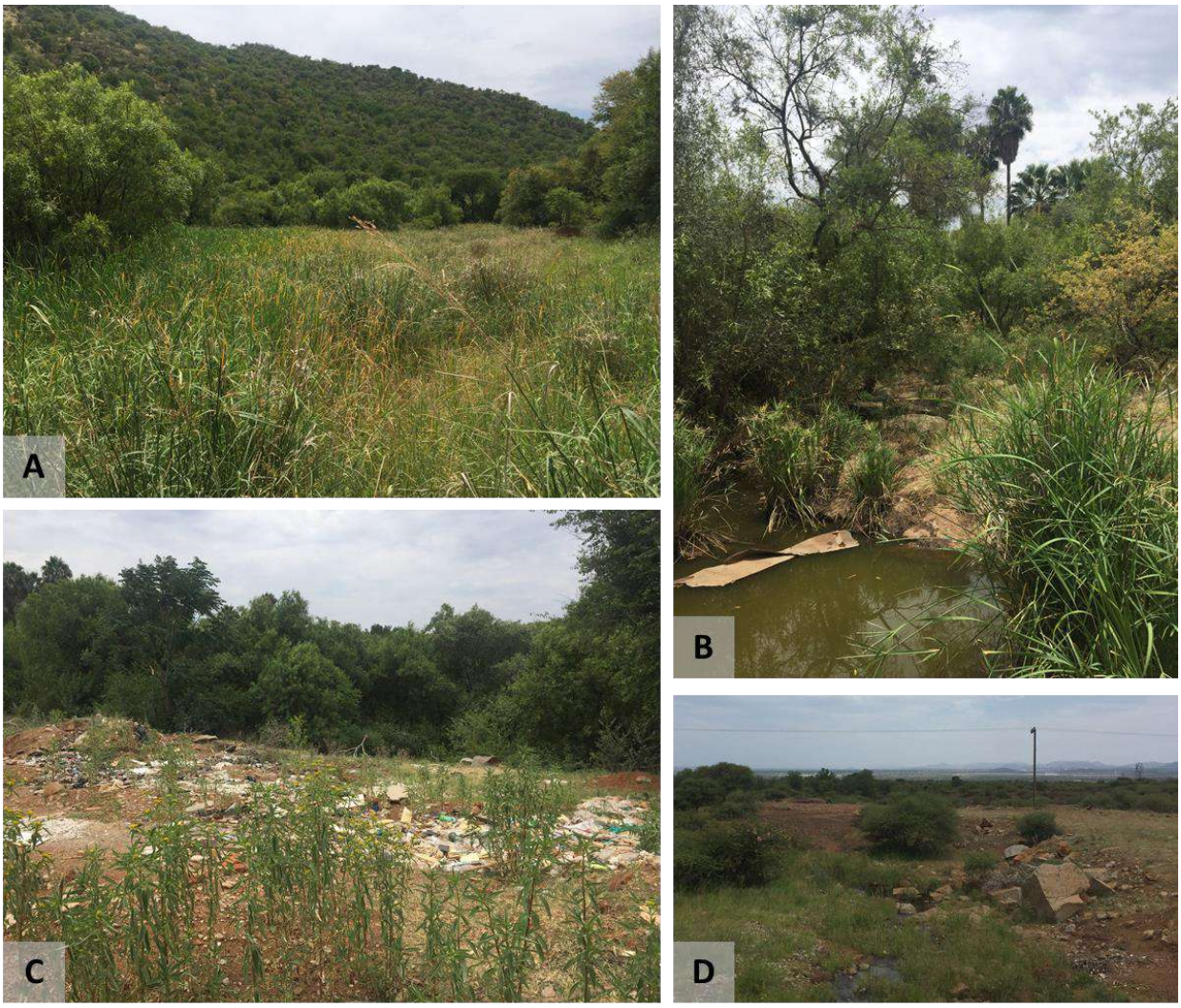


Figure 6-4: HGM unit 2

6.1.3 HGM Unit 3

HGM Unit 3 is a channelled and un-channelled valley bottom wetland which covers 71.1 ha. The wetland is transformed as it flows through the golf course, into a dam and then past the crocodile centre, which discharges dirty water into the wetland. The vegetation is characterised by closed canopy riparian woodland. See Figure 6-5 for a photographic representation of the wetland habitat of HGM unit 3.

The major impacts to this wetland are the following:

- The dam has impacted severely on the wetland ecological health and integrity of the site;
- Discharges of dirty water from the crocodile sanctuary are likely to negatively affect water quality in the southern portion of the wetland;
- Concrete walkways constructed in the riparian and wetland areas have resulted in fragmentation of the systems in some areas; ;
- Construction of the golf course and its greens have resulted in severe fragmentation of the system;
- Various drains and concrete channels and canals have been installed in the golf course to aid in drainage, and while serving a function in terms of hydrological connectivity, the natural geomorphology and hydrology of the system has been severely compromised;
- The construction of the golf course and various infrastructures has resulted in large impacts related to edge effects, with special mention of loss of wetland vegetation and habitat and the loss of appropriate buffer zones;
- Various pump stations and concrete weirs have been placed within the wetland, disrupting hydrology;
- The disturbance has resulted in high infestation of AIPs including *Solanum mauritiuanum*, *lantana camara*, *Arundo donax*, *Ricinus communis* and *Melia azedarach.*

Figure 6-5: HGM unit 3

6.1.4 HGM Unit 4

HGM Unit 4 is a seep wetland which covers 4.8 ha. A large portion of this area has been converted to a quad bike track resulting in severe impacts to vegetation integrity in terms of alien and invasive vegetation species, disturbance of soils and loss of cover. Dominant species include *Vachellia Karroo*, *Ziziphus mucronata*, *Searsia lancea*, *Dichrostachys cinerea* and *Typha capensis*. See Figure 6-6 for an overview of the wetland habitat of HGM unit 4.

The major impacts to this wetland are the following:

- The quad bike track has resulted in alterations to the topography, with depressions and slopes created. This has altered the geomorphology and hydrology of the wetland;
- Extensive disturbance has resulted in invasion by various AIPs such as *Verbena bonariensis* and *Lantana camara*, both categorised as Category 1b species according to NEM:BA and;
- Compromised water quality as a result of the activities of the adjacent sewage works.

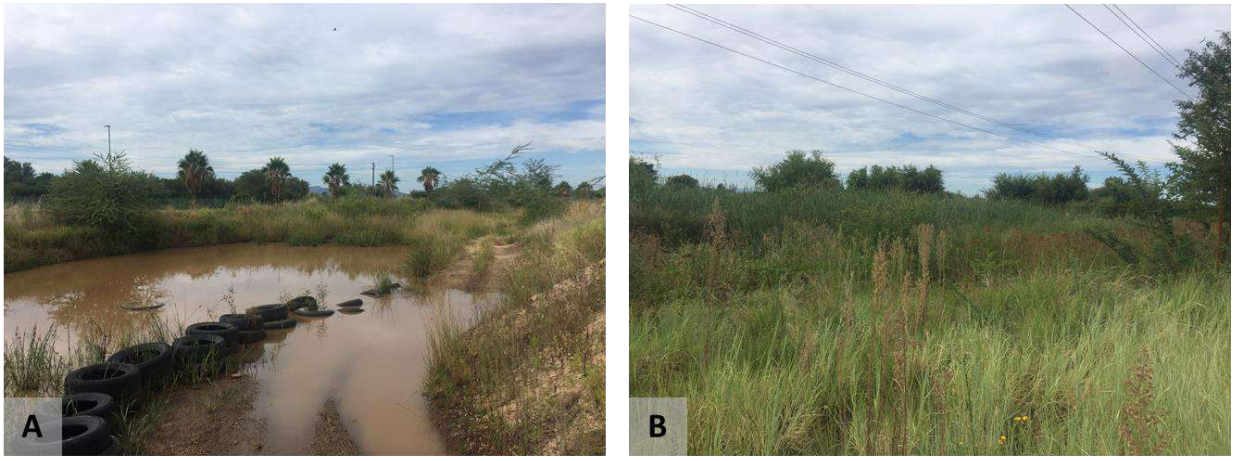


Figure 6-6: HGM unit 4

6.1.5 HGM Unit 5

HGM Unit 5 is an artificial wetland which covers 0.7 ha. This feature has been excavated to serve as a watering hole. A drainage pipe was observed at this point. Banks are bare, significantly increasing the potential for erosion at this point. Some portions are dominated by *Typha capensis* and the invasive species *Arundo donax.* See Figure 6-7 for an overview of the wetland habitat of HGM unit 5.

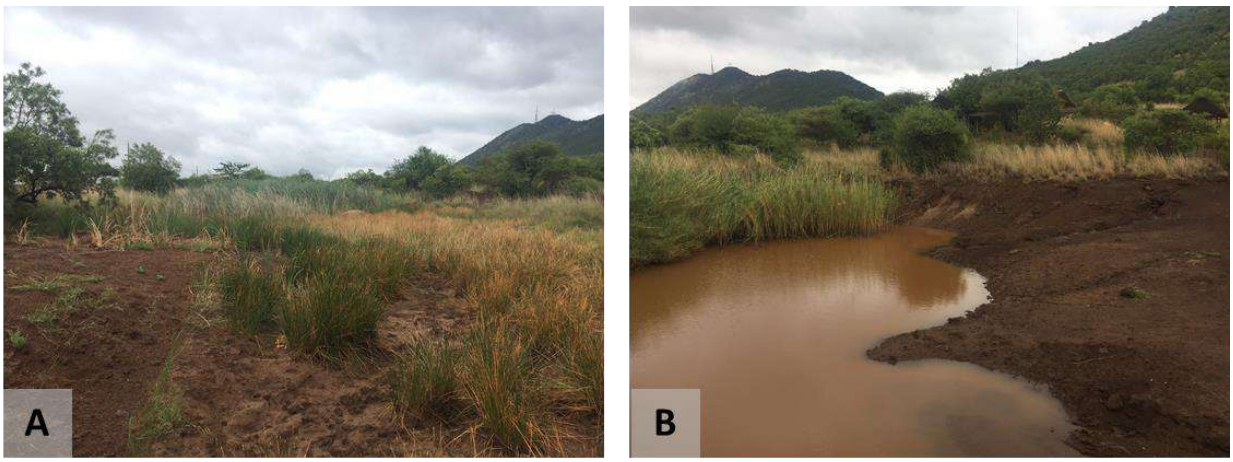


Figure 6-7: HGM unit 5

6.1.6 HGM Unit 6

HGM Unit 6 is an artificial wetland which covers 0.2 ha. Vegetation cover and abundance at this point is good, albeit low species diversity observed. It is dominated by *Typha capensis, Cymbopogon sp, Cyperus sp.* and *Eliocharis sp.* the road is the largest impact on this artificial wetland. See Figure 6-8 for an overview of the wetland habitat of HGM unit 6.

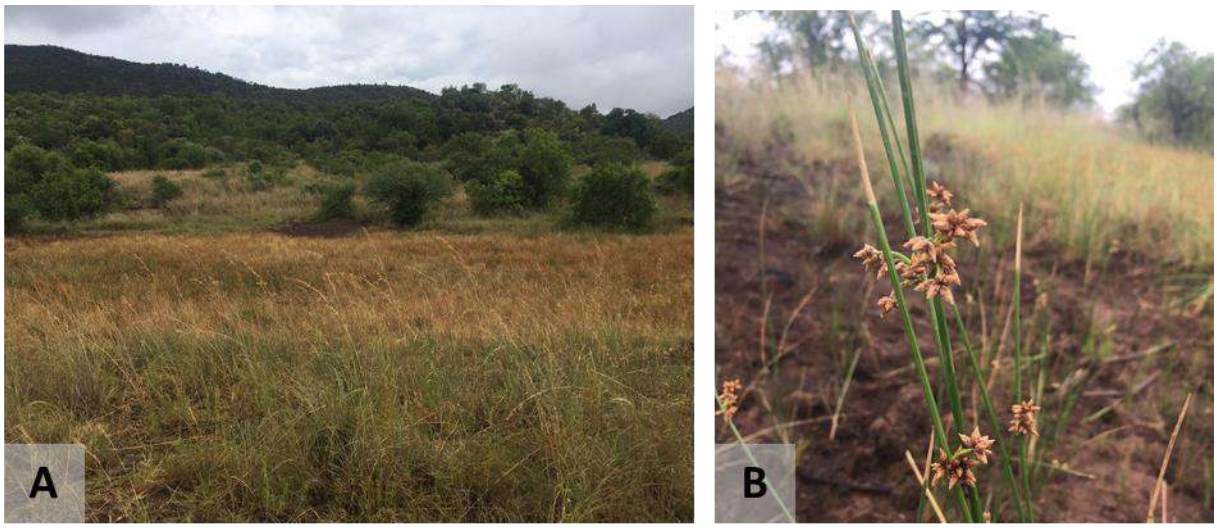


Figure 6-8: HGM unit 6

6.1.7 HGM Unit 7

HGM Unit 7, a channelled valley bottom wetland, is located on development area C and is 14.7 ha in size. The wetland is characterised by riparian woodland, dominated by *Olea europea, Searsia lancea, Ziziphus mucronata, Setaria megaphylla and Panicum coloratum. Typha capensis* and *Cyperus* species occurred where there was inundation. See Figure 6-9 for an overview of the wetland habitat of HGM unit 7.

The main impacts are the following:

- The damming of the wetland for recreational purposes, which has impacted on the wetland integrity of the site;
- Road crossings are present, resulting in the compaction of soils and increasing the potential for inundation and sedimentation, as well as loss of flow connectivity and fragmentation of the system; and
- Trampling and grazing by game stock have resulted in some loss of vegetation integrity of the northern portion of this system.

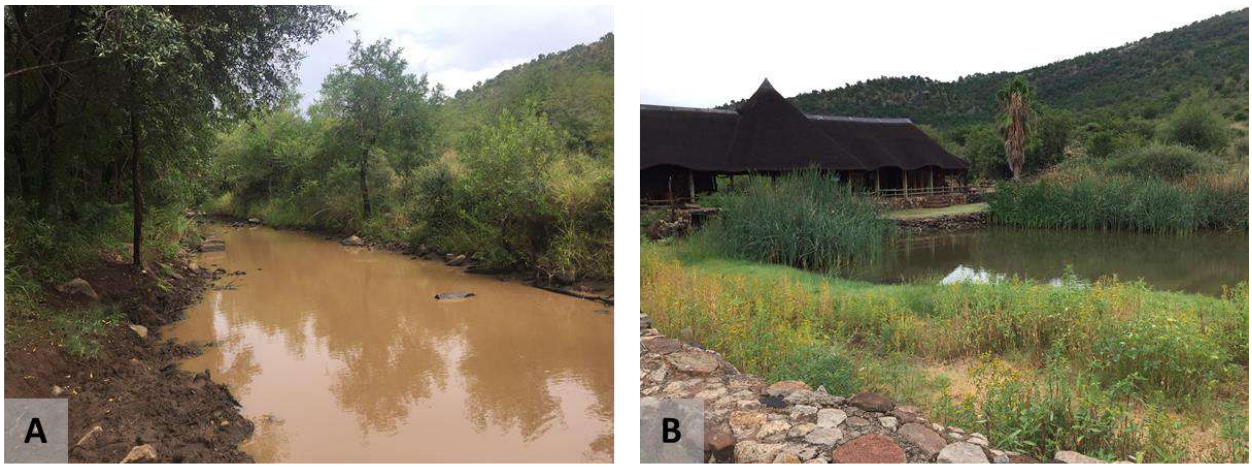


Figure 6-9: HGM unit 7

6.2 Sensitivity of the Site

6.2.1 Present Ecological State

Table 6-2 indicates the PES scores for the various HGM Units observed.

The wetlands within the Project area exhibit a variety of PES values, ranging from *Largely Natural* (Category B) to *Largely Modified* (Category D) (Table 6-2).

HGM Unit 7 may be regarded as *Largely Natural* (Category B), with only minor impacts as a result of the recreational dam and the presence of some AIP species. HGM Units 1 and 4 may be regarded as *Moderately Modified* (Category C), with moderate impacts at HGM Unit 1 affecting vegetation and hydrological integrity as a result of the road crossing. Loss of natural vegetation and soil disturbance as well as compromised water quality contributed to the modified state at HGM Unit 4.

Two *Largely Modified (*Category D*)* wetlands are present in the Project Area (HGM Unit 2 and HGM Unit 3). The *Largely Modified* category is mainly attributed to habitat transformation and hydrological alterations due to the golf course as well as the dam and crocodile sanctuary as in the case of HGM Unit 3.

Table 6-2: Present Ecological Health Scores

HGM Unit	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final Ecological Health Score	PES Score
1	2.0	0.2	5.2	2.4	C
2	6.5	1.6	6.3	5.0	D

HGM Unit	Hydrological Health Score	Geomorphological Health Score	Vegetation Health Score	Final Ecological Health Score	PES Score
3	7.5	0.3	8.8	5.8	D
4	3.5	0.6	8.1	3.9	C
5	N/A for artificial wetlands				
6	N/A for artificial wetlands				
7	1	0.2	4.6	1.8	B

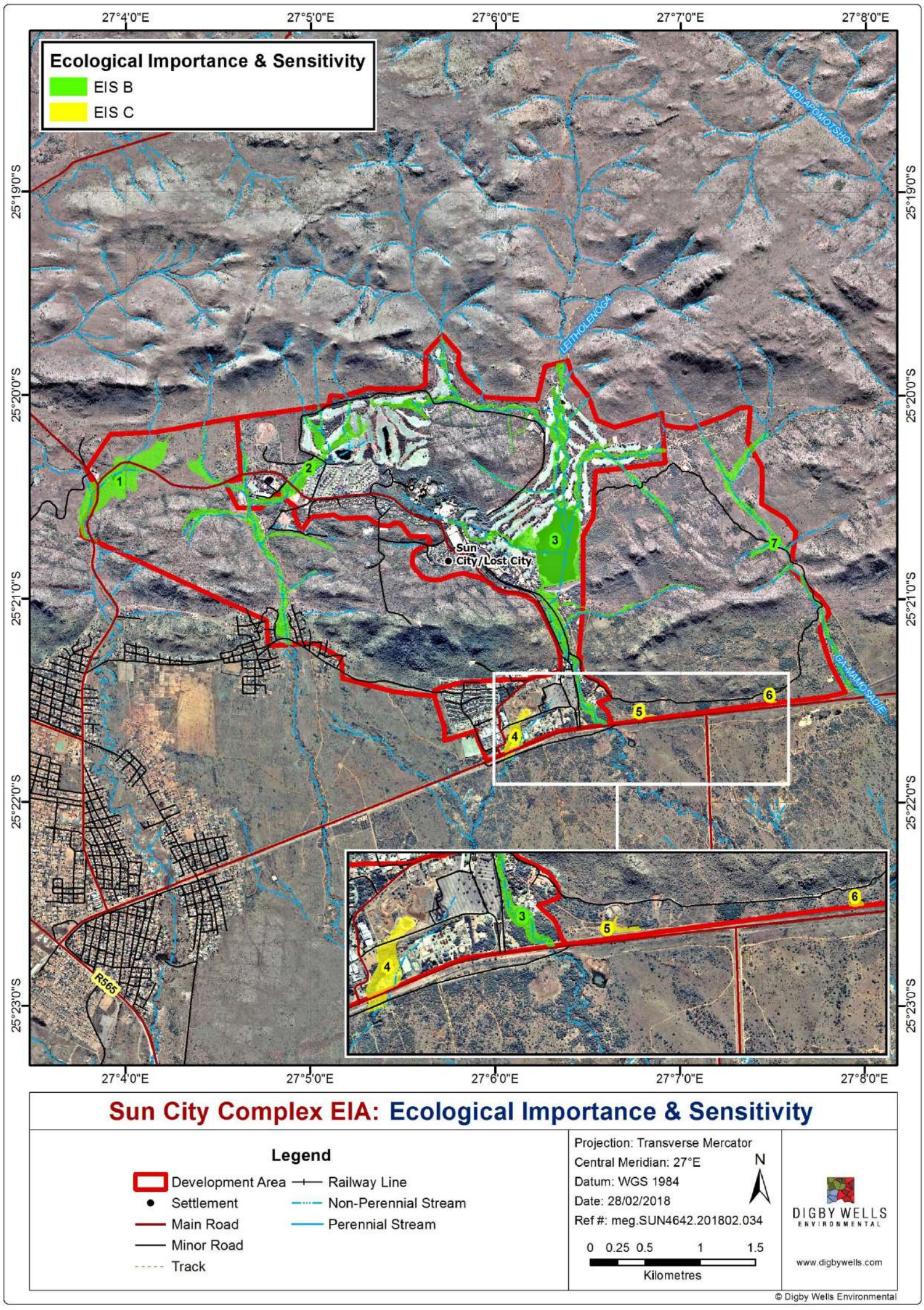


Figure 6-10: Present Ecological State

6.2.2 Ecological Importance and Sensitivity

Table 6-3 indicates the EIS scores for the various HGM Units with the final EIS scores ranging from *Moderate* (1) to *High* (2.5).

Although the wetlands are modified, they do still provide predominantly *Moderate* to *Low* hydrological importance services (ranging between 0.5 and 1.9), such as erosion control and sediment trapping and assimilation of toxicants and nitrates.

The Ecological Importance and Sensitivity category ranges from *Moderate* (1) to *High* (2.4). This is largely due to proximity to the Pilanesberg National Park and the present of various protected species observed at the time of the assessment (*Sclerocarya birrea, Spirostachys Africana)*.

In general, the values are *Low* (0.7) to *High* (2.5) for 'Direct Human Benefits'. The wetlands provide tourism services specifically and some provide water and cultural services further downstream.

Table 6-3: EIS Scores

HGM Unit	Ecological Importance & Sensitivity	Hydrological/Functional Importance	Direct Human Benefits	Final EIS Score	Final EIS Category
1	2.4	1.9	1.7	2.4	B
2	2.3	1.4	2.5	2.5	B
3	2.4	1.1	1.8	2.4	B
4	1.8	1.1	0.8	1.8	C
5*	1	0.8	1.7	1.7	C
6*	1	0.5	0.7	1	C
7	3	1.1	1.3	3	B

*method is not intended for artificial wetlands, however it was applied as an indicator of functionality

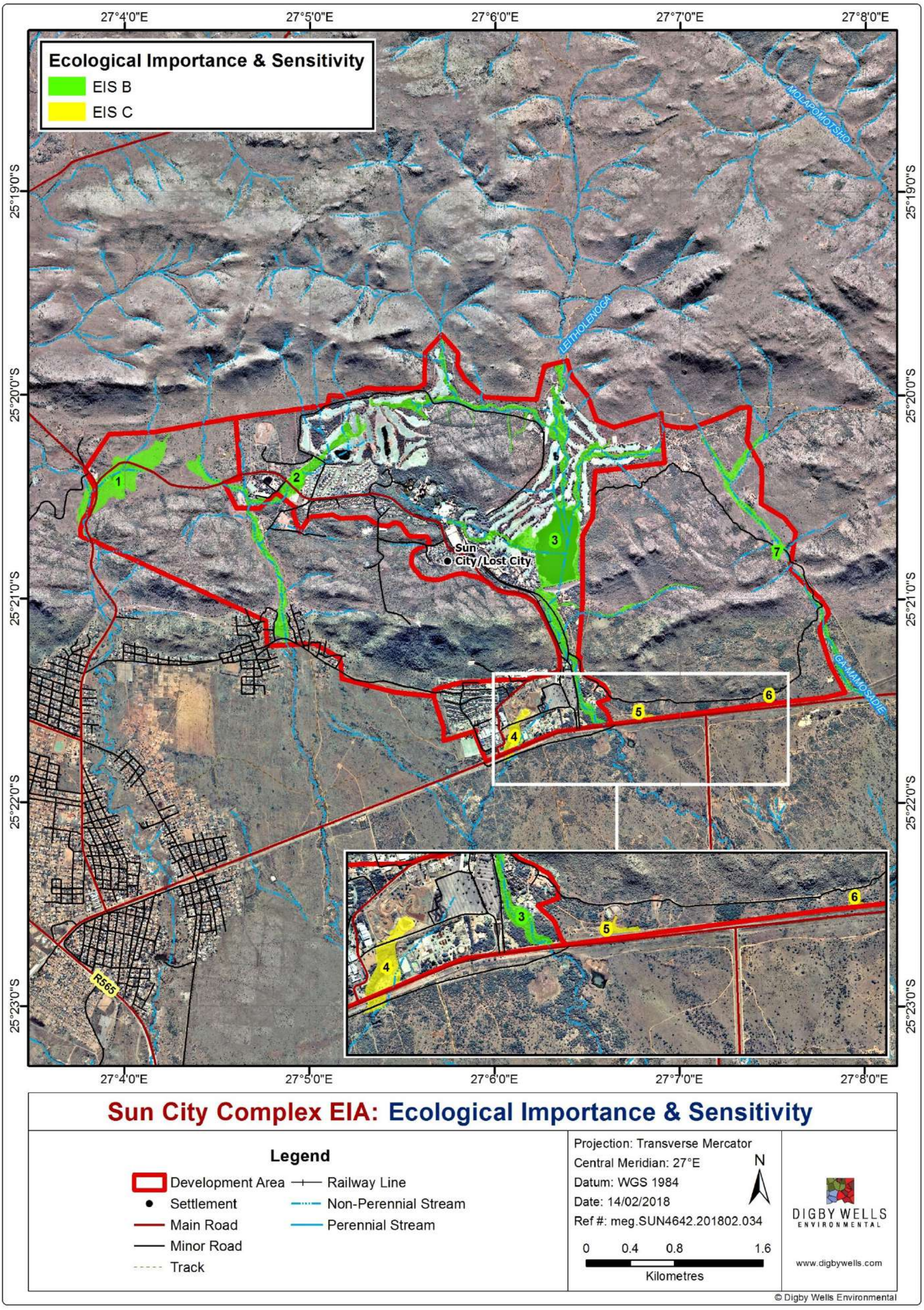


Figure 6-11: Ecological Importance and Sensitivity

7 Assumptions, Limitations and Gaps in knowledge

- Due to the large nature of the site, ground-truthing was focussed predominantly in the proposed infrastructure areas;
- Large portions of this Project area may be regarded as severely modified from natural conditions, with completely altered hydrology and geomorphology in places due to the altered flow of water in the golf course areas and historical construction and placement of infrastructures;
- The composition of the flora and freshwater resources in the Project area prior to major disturbance is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available;

8 Impact Assessment

The impact assessment has been carried out taking both the current ecological status of the wetlands present within the proposed development areas, as well as according to each of the proposed activities relating to the proposed developments. It should be noted that, with specific reference to Development Area B, large impacts to the wetland and freshwater systems present have already occurred due to historical development activities. The natural flow regimes of the wetlands and aquatic systems present have been severely altered due to stream diversions and canals associated with the existing golf course areas. Loss of natural vegetation is extensive throughout the area thus affecting surface water runoff patterns, flood attenuation and streamflow regulation services. Furthermore, a large loss in the natural biodiversity of the area has occurred as a result of vegetation removal and loss of flow connectivity in the systems present. The large dam observed in the central portion of Development Area B has resulted in inundation upstream and severe channel and bed modifications are evident and the ability of any historical wetlands, which may have been present in this area, to retain and store water is no longer viable.

The impact assessment was thus carried out taking into consideration the altered Present Ecological State of the wetlands in the vicinity of the various proposed activities and many of the activities, should the required mitigation and management measures be implemented, will result in Minor and Negligible impacts to the systems present.

The potential impacts to the wetlands and freshwater resources present were assessed considering the two phases of the life of project: the construction and operational phases and are further described in Table 8-1. The proposed layout is presented in Figure 8-1 below and consideration is given to the potential impacts associated with the proposed

project in relation to the wetlands and other freshwater resources present. No planned activities are expected for Development Area C and as such, no impact assessment was carried out for this portion of the Sun City Complex.

Table 8-1: Project Activities

Activity	Phase of Project
Site clearing, soil disturbance, crossing of wetland and river areas, increased vehicular movement, stockpiling of topsoils, storage and dumping of building materials associated with the development and construction of the various proposed activities.	Construction phase
Operational activities, including storm water management, sanitation management, maintenance of buildings, roads, etc.	Operational phase

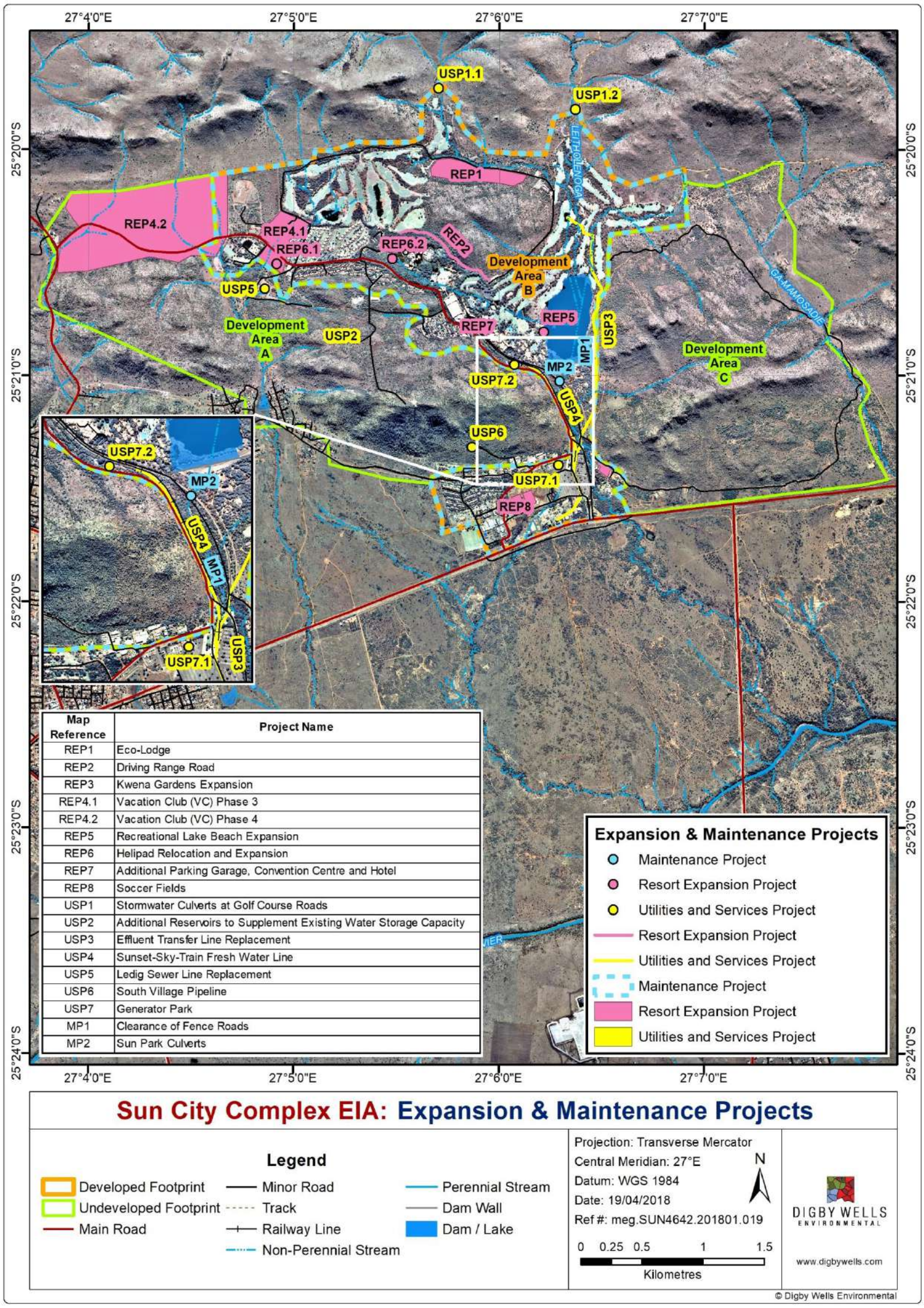


Figure 8-1: Impact Assessment – Proposed development and construction areas

8.1 Construction Phase

8.1.1 Impact Description

The main activities during the construction phase that could result in impacts to the freshwater ecology of the area are associated with the site clearing and construction of the various proposed expansion projects. Activities include site clearing, soil disturbance, topsoil stockpiling, storage and dumping of building materials, compaction of soils and crossing of the wetland and river systems.

Associated impacts include erosion and sedimentation, the potential loss of biodiversity and habitat, fragmentation of the systems present and potential loss of catchment yields and surface water recharge to the systems further downstream. Among the impacts associated with the proposed construction phase are minor potential impacts to soil and water quality as a result of the ingress of hydrocarbons. Larger impacts include compaction of soils, potential loss of vegetation and the increased potential for erosion and sedimentation in the vicinity of any cleared areas and resulting in impacts further downstream. Removal of vegetation and disturbance of soils in the vicinity of the construction footprint is likely to give rise to an increased potential for encroachment by robust pioneer species and AIPs, further altering the natural vegetation profiles of the freshwater resources encountered in the vicinity of the project footprint.

Table 8-2 summarises potential impacts to the freshwater ecology identified during the construction phase.

Table 8-2: Impact assessment parameter ratings for the construction phase

Activity and Interactions 1	**Construction activities within Development Area A**			**Construction activities within Development Area B**		
Removal of vegetation and topsoil, site clearing and excavation activities						
Impact Nature ***Direct loss of wetland and other freshwater habitat for infrastructure and the various proposed activities.*** ***Fragmentation of riverine corridors.*** ***Onset of erosion.*** ***Sedimentation and the potential for the establishment of alien hydrophytic and terrestrial plant species.*** ***Deterioration of wetland PES and provision of ecosystem services.***						
Prior to Mitigation/Management						
Duration	Beyond project life (6)	The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Minor (negative) - 56	Medium term (3)	1-5 years and impact can be reversed with minimal management.	Negligible (negative) - 32
Extent	Greater municipal area (4)	General scouring from sedimentation, erosion, as well as degraded habitat due to water quality deterioration will affect entire watercourse and river reaches.		Local (3)	The degree of modifications of the systems present within this portion of the project area, as well as the modifications to the surrounding land use, will reduce the extent of further impacts to the wetland and aquatic systems present.	

Intensity x type of impact	Serious medium term environmental effects (4)	Due to the sensitivity of wetland systems in this portion of Development Area A, should no management or mitigation measures be employed, activities could result in serious long term impacts.		Minor medium term environmental effects (2)	Due to the sensitivity of wetland systems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.		Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative			Negative		
Post-Mitigation						
Duration	Medium term (3)	1-5 years and impact can be reversed with minimal management.	Negligible (negative) - 32	Short term (2)	Less than 1 year and is reversible.	Negligible (negative) - 24
Extent	Local (3)	Local extending only as far as the development site area.		Limited (2)	Limited to the immediate development site and its immediate surroundings.	
Intensity x type of impact	Minor medium term environmental effects (2)	Should management or mitigation measures be employed, impacts can reduced to minor impacts		Minor medium term environmental effects (2)	Activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B. With mitigation measures, minor medium terms impacts remain anticipated.	

Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.		Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative			Negative		
Activity and Interactions 2	**Construction activities within Development Area A**			**Construction activities within Development Area B**		
Stockpiling and storage of building materials						
Impact Nature ☐ ***Fragmentation of riverine corridors.*** ☐ ***Onset of erosion.*** ☐ ***Sedimentation and the potential for the establishment of alien hydrophytic and terrestrial plant species.*** ☐ ***Deterioration of wetland PES and provision of ecosystem services.***						
Prior to Mitigation/Management						
Duration	Medium term (3)	1-5 years and impact can be reversed with minimal management.	Negligible (negative) -36	Medium term (3)	1-5 years and impact can be reversed with minimal management.	Negligible (negative) -32

Extent	Local (3)	The degree of modifications of the systems present within this portion of the project area, as well as the modifications to the surrounding land use, will reduce the extent of further impacts to the wetland and aquatic systems present.		Local (3)	The degree of modifications of the systems present within this portion of the project area, as well as the modifications to the surrounding land use, will reduce the extent of further impacts to the wetland and aquatic systems present.	
Intensity x type of impact	Moderate medium term environmental effects (3)	Due to the sensitivity of wetland systems in this portion of Development Area A, should no management or mitigation measures be employed, activities could result in moderate medium term impacts.		Minor medium term environmental effects (2)	Due to the sensitivity of wetland systems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.		Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative			Negative		
Post-Mitigation						
Duration	Short term (2)	Less than 1 year and is reversible.	Negligible (negative) - 15	Short term (2)	Less than 1 year and is reversible.	Negligible (negative) - 15
Extent	Very limited (1)	Limited to specific isolated parts of the site.		Very limited (1)	Limited to specific isolated parts of the site.	

Intensity x type of impact	Minor medium term environmental effects (2)	Should management or mitigation measures be employed, impacts can reduced to minor impacts		Minor medium term environmental effects (2)	Activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B. With mitigation measures, minor medium terms impacts remain anticipated.	
Probability	Unlikely (3)	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.		Unlikely (3)	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.	
Nature	Negative			Negative		
Activity and Interactions 3	**Construction activities within Development Area A**			**Construction activities within Development Area B**		
Mixing of cement and chemical spills associated with building activities						
Impact Nature ▪ ***Impaired water quality*** ▪ ***Deterioration of wetland PES and provision of ecosystem services.***						
Prior to Mitigation/Management						
Duration	Beyond project life (6)	The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Minor (negative) -52	Beyond project life (6)	The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Minor (negative) -44

Extent	Greater municipal area (4)	General scouring from sedimentation, erosion, as well as degraded habitat due to water quality deterioration will affect entire watercourse and river reaches.		Local (3)	The degree of modifications of the systems present within this portion of the project area, as well as the modifications to the surrounding land use, will reduce the extent of further impacts to the wetland and aquatic systems present.	
Intensity x type of impact	Moderate medium term environmental effects (3)	Due to the sensitivity of wetland systems in this portion of Development Area A, should no management or mitigation measures be employed, activities could result in moderate medium term impacts.		Minor medium term environmental effects (2)	Due to the sensitivity of wetland systems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.		Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative			Negative		
Post-Mitigation						
Duration	Short term (2)	Less than 1 year and is reversible.	Negligible (negative) - 15	Short term (2)	Less than 1 year and is reversible.	Negligible (negative) - 15
Extent	Very limited (1)	Limited to specific isolated parts of the site.		Very limited (1)	Limited to specific isolated parts of the site.	

Intensity x type of impact	Minor medium term environmental effects (2)	Should management or mitigation measures be employed, impacts can reduced to minor impacts		Minor medium term environmental effects (2)	Activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B. With mitigation measures, minor medium terms impacts remain anticipated.	
Probability	Unlikely (3)	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.		Unlikely (3)	Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.	
Nature	Negative			Negative		

8.1.2 Construction Phase Mitigation and Management Measures

The following mitigation and management measures have been prescribed for the construction phase:

- Ensure soil management programme is implemented and maintained to minimise erosion and sedimentation;
- Active rehabilitation, re-sloping, and re-vegetation of disturbed areas immediately after construction;
- Implement and maintain an alien vegetation management programme. This must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones;
- Limit the footprint area of the construction activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils (all areas but critically so in freshwater areas);
- If it is absolutely unavoidable that any of the freshwater areas present will be affected, disturbance must be minimised and suitably rehabilitated;
- Ensure that no incision and canalisation of the ephemeral drainage lines present takes place;
- All erosion noted within the construction footprint should be remedied immediately and included as part of an ongoing rehabilitation plan;
- Permit only essential personnel within the 32 m zone of regulation for all freshwater features identified;
- All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel;
- No unnecessary crossing of the freshwater features and their associated buffers should take place and the substrate conditions of the ephemeral drainage lines and downstream stream connectivity must be maintained;
- No material may be dumped or stockpiled within any freshwater features;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the construction footprint;
- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly; and
- Appropriate sanitary facilities must be provided for the duration of the construction activities and all waste must be removed to an appropriate waste facility.

8.2 Operational Phase

8.3 Impact Description

The main activities during the operational phase that could result in impacts to the freshwater ecology of the area are associated with the storm water management systems, maintenance and operational activities, gardening services, hardening of surfaces and waste management of soils and crossing of the wetland and river systems.

Associated impacts include loss of catchment yield and surface water recharge, erosion and sedimentation, the potential loss of biodiversity and habitat, further fragmentation of the systems present. Further to this, the potential for ongoing contamination of the wetland systems and other freshwater resources present are deemed likely based on the ingress of hydrocarbons associated with increased vehicular activity, as well as water for domestic use. Any leaks associated with the proposed sewage pipeline may also result in contamination of the freshwater systems present and may result in impacts to the water quality. Removal of indigenous vegetation is likely to give rise to an increased potential for encroachment by robust pioneer species and AIPs, further altering the natural vegetation profiles of the freshwater resources encountered in the vicinity of the project footprint. Hardened surfaces have the potential to result in sheet runoff and there is likely to be a loss in wetland service provision in terms of flood attenuation, sediment trapping and assimilation of toxicants and other pollutants. Storage of water, which is an important service, provided by wetlands in this area, will be compromised. Further alterations to the natural flow regimes will take place and is likely to result in the creation of preferential flow paths over time.

Table 8-3 summarises potential impacts to the freshwater ecology identified during the construction phase.

Table 8-3: Impact assessment parameter ratings for the operational phase

Activity and Interactions 1 and 3	**Operational activities within Development Area A**			**Operational activities within Development Area B**		
Management and maintenance activities, Influx of people to the general area.						
Nature ▪ ***Increased vehicular movement along wetlands and riparian zones, resulting in increased sedimentation and potential for onset of erosion.*** ▪ ***Physical disturbance of soil in wetlands resulting in erosion and sedimentation as a result of recreational activities.***						
Prior to Mitigation/Management						
Duration	Project life (5)	The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Minor (negative) - 44	Project life (5)	The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Minor (negative) - 40
Extent	Local (3)	The degree of modifications of the systems present within this portion of the project area, as well as the modifications to the surrounding land use, will reduce the extent of further impacts to the wetland and aquatic systems present.		Local (3)	The degree of modifications of the systems present within this portion of the project area, as well as the modifications to the surrounding land use, will reduce the extent of further impacts to the wetland and aquatic systems present.	

Intensity x type of impact	Moderate medium term environmental effects (3)	Due to the sensitivity of wetland systems in this portion of Development Area A, should no management or mitigation measures be employed, activities could result in moderate medium term impacts.		Minor medium term environmental effects (2)	Due to the sensitivity of wetland systems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.		Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative			Negative		
Post-Mitigation						
Duration	Permanent (7)	The impact is irreversible, even with management, and will remain after the life of the project.	Minor (negative) - 48	Permanent (7)	The impact is irreversible, even with management, and will remain after the life of the project.	Negligible (negative) - 33
Extent	Local (3)	Local extending only as far as the development site area.		Limited (2)	Limited to the immediate development site and its immediate surroundings.	
Intensity x type of impact	Minor medium term environmental effects (2)	Should management or mitigation measures be employed, impacts can reduced to minor impacts		Minor medium term environmental effects (2)	Activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B. With mitigation measures, minor medium terms impacts remain anticipated.	

Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.		Unlikely (3)	Should precautionary measures be implemented, further impacts to the wetlands present are considered unlikely.	
Nature	Negative			Negative		
Activity and Interaction 2	**Operational activities within Development Area A**			**Operational activities within Development Area B**		
Hardened surfaces, sheet runoff and separation of clean and dirty water						
Nature ▪ ***Fragmentation of wetlands and riverine corridors.*** ▪ ***Onset of erosion.*** ▪ ***Loss of catchment yield and surface water recharge***						
Prior to Mitigation/Management						
Duration	Project life (7)	The impact is irreversible, even with management, and will remain after the life of the project.	Minor (negative) -52	Project life (7)	The impact is irreversible, even with management, and will remain after the life of the project.	Minor (negative) -44

Extent	Local (3)	The degree of modifications of the systems present within this portion of the project area, as well as the modifications to the surrounding land use, will reduce the extent of further impacts to the wetland and aquatic systems present.		Limited (2)	Limited extending only as far as the development site area.	
Intensity x type of impact	Moderate medium term environmental effects (3)	Due to the sensitivity of wetland systems in this portion of Development Area A, should no management or mitigation measures be employed, activities could result in moderate medium term impacts.		Minor medium term environmental effects (2)	Due to the sensitivity of wetland systems in general and the already degraded nature of the systems present, should no management or mitigation measures be employed, activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B.	
Probability	Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.		Probable (4)	Should no precautionary measures be implemented, further impacts to the wetlands present are considered probable.	
Nature	Negative			Negative		
Post-Mitigation						
Duration	Permanent (7)	The impact is irreversible, even with management, and will remain after the life of the project.	Negligible (negative) - 30	Permanent (7)	The impact is irreversible, even with management, and will remain after the life of the project.	Negligible (negative) - 30

Extent	Very limited (1)	Limited to specific isolated parts of the site		Very limited (1)	Limited to specific isolated parts of the site	
Intensity x type of impact	Minor medium term environmental effects (2)	Should management or mitigation measures be employed, impacts can reduced to minor impacts		Minor medium term environmental effects (2)	Activities are likely to impact the systems to a lesser extent than the relatively intact systems observed in Development Area B. With mitigation measures, minor medium terms impacts remain anticipated.	
Probability	Unlikely (3)	Should precautionary measures be implemented, further impacts to the wetlands present are considered unlikely.		Unlikely (3)	Should precautionary measures be implemented, further impacts to the wetlands present are considered unlikely.	
Nature	Negative			Negative		

8.3.1 Operational Phase Mitigation and Management Measures

The following mitigation and management measures have been prescribed for the operational phase:

- Clean and dirty water separation systems to be implemented prior to the commencement of activities and to be maintained throughout the life of the proposed project;
- Ensure that as far as possible all operational infrastructures are placed outside of freshwater areas and their associated 32 m zone of regulation;
- Limit the footprint area of the operational activities to what is absolutely essential in order to minimise impacts as a result of any potential vegetation clearing and compaction of soils (all areas but critically so in freshwater areas);
- If it is absolutely unavoidable that any of the freshwater areas present will be affected, disturbance must be minimised and suitably rehabilitated;
- Ensure that no incision and canalisation of the freshwater features present takes place as a result of the proposed operational activities;
- All erosion noted within the operational footprint as a result of any potential surface activities should be remedied immediately and included as part of the ongoing rehabilitation plan;
- During the operational phase, erosion berms should be installed on roadways and downstream of stockpiles to prevent gully formation and siltation of the freshwater resources. The following points should serve to guide the placement of erosion berms:
    - Where the track has slope of less than 2%, berms every 50m should be installed;
    - Where the track slopes between 2% and 10%, berms every 25m should be installed;
    - Where the track slopes between 10%-15%, berms every 20m should be installed; and
    - Where the track has slope greater than 15%, berms every 10m should be installed.
- A suitable AIP control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones;
- Permit only essential personnel within the 32 m zone of regulation for all freshwater features identified;
- All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel;

- No unnecessary crossing of the wetland features and their associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained;
- No material may be dumped or stockpiled within any of the ephemeral drainage lines in the vicinity of the proposed operational footprint;
- No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads;
- All vehicles must be regularly inspected for leaks;
- Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil;
- All spills should be immediately cleaned up and treated accordingly;
- Appropriate sanitary facilities must be provided for the duration of the operational activities and all waste must be removed to an appropriate waste facility;
- Monitor all systems for erosion and incision.

8.3.2 Cumulative and Latent Impacts

The freshwater resources of this catchment feed largely into the Elands River Catchment, which drains into the Crocodile River further downstream. Cumulative impacts include loss of catchment yields and surface water recharge to this system as a result of the hardening of surfaces as well as the loss of the ingress of water to the groundwater resources present. In addition, the freshwater resources in this area are increasingly subjected to water quality impacts as a result of mining activities and increasing pressure as a result of rural settlements and agriculture (livestock watering) activities within the greater catchment.

Further losses to habitat and biodiversity as a result of the proposed development activities, with special mention of Development Area A, are deemed likely.

9 Wetland Management Plan

The following is a summary of the identified impacts to wetlands that will require mitigation measures for the project to go ahead.

Table 9-1: Potential project impacts

Interaction		Impact
Construction Phase		
1	Removal of vegetation and topsoil.	Direct loss of wetland and other freshwater habitat for infrastructure and the various proposed activities.

Interaction		Impact
2	Stockpiling and storage of building materials	▪ Fragmentation of riverine corridors. ▪ Onset of erosion. ▪ Sedimentation and the potential for the establishment of alien hydrophytic and terrestrial plant species. ▪ Deterioration of wetland PES and provision of ecosystem services.
3	Mixing of cement and chemical spills associated with building activities	▪ Impaired water quality ▪ Deterioration of wetland PES and provision of ecosystem services.
Operational Phase		
4	Management and maintenance activities	Increased vehicular movement along wetlands and riparian zones, resulting in increased sedimentation and potential for onset of erosion.
5	Hardened surfaces, sheet runoff and separation of clean and dirty water	▪ Fragmentation of wetlands and riverine corridors. ▪ Onset of erosion. ▪ Loss of catchment yield and surface water recharge
6	Influx of people to the general area.	Physical disturbance of soil in wetlands resulting in erosion and sedimentation as a result of recreational activities.

9.1.1 Mitigation and Management Measures

Table 9-2 provides a summary of the mitigation and management options for the wetland impacts anticipated during the construction, operational and decommissioning and closure phases.

Table 9-2: Wetland Mitigation and Management Plan

Interaction	Potential impacts	Phase	Mitigation Measures	Complienace with standards	Standard to be achieved/objective	Time period for implementation
Removal of vegetation and topsoil.	Direct loss of wetland and other freshwater habitat for infrastructure and the various proposed activities.	Construction	▪ EMO to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area. ▪ Implement 32m zone of regulation and demarcate with white stakes (or other suitable indicators) for areas that must be avoided. ▪ All activities are to be outside of remaining wetlands and their recommended 32 m zones of regulation. ▪ Active rehabilitation, re-sloping, and re-vegetation of disturbed areas immediately after construction. ▪ All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel; ▪ Offset an area to compensate for direct losses to wetland/riparian vegetation	Water use licence, NEMA	No-nett-loss of wetland area.	EMO to be present during the construction phase Offset strategy to be drafted, approved, and presented to the government authorities prior to construction phase, if required.
Stockpiling of topsoil, removal of overburden and stockpiling of overburden.	▪ Fragmentation of riverine corridors. ▪ Onset of erosion. ▪ Sedimentation and the potential for the establishment of alien hydrophytic and terrestrial plant species. ▪ Deterioration of wetland PES and provision of ecosystem services.		▪ EMO to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area; ▪ Activities are to be outside of remaining wetlands and their recommended 32 m zones of regulation. Demarcate with white stakes (or other suitable indicators) for areas where access is restricted or must be avoided; ▪ Ensure that no incision or canalisation of the wetlands/riparian areas present takes place as a result of construction activities; ▪ All erosion noted within the project area must be remedied immediately and included as part of an ongoing rehabilitation plan; ▪ Ensure that all stockpiles are well managed and have measures in place such as berms and hessian sheets implemented to prevent erosion and sedimentation which may ultimately lead to transformation of wetland and riparian areas; ▪ Ensure soil management programme is implemented and maintained to minimise erosion and sedimentation ▪ Disturbed areas must be revegetated immediately with stoloniferous, fast-spreading species that are native to the area.	Water use licence, NEMA	Maintenance of wetland PES.	EMO to be present during the construction phase Revegetation to take place within two weeks.

Interaction	Potential impacts	Phase	Mitigation Measures	Complienace with standards	Standard to be achieved/objective	Time period for implementation
Mixing of cement and chemical spills associated with building activities	▪ Impaired water quality ▪ Deterioration of wetland PES and provision of ecosystem services.	Construction	▪ All spills should be immediately cleaned up and treated accordingly ▪ All activities are to be outside of remaining wetlands and their recommended 32 m zones of regulation.	Water use licence, NEMA	Maintenance of wetland PES	EMO to be present during the construction phase
Management and maintenance activities	Increased vehicular movement along wetlands and riparian zones, resulting in increased sedimentation and potential for onset of erosion.	Operational	▪ No vehicles or heavy machinery may be allowed to drive indiscriminately within any freshwater areas and their associated zones of regulation. All vehicles must remain on demarcated roads; ▪ All vehicles must be regularly inspected for leaks; ▪ Re-fuelling must take place on a sealed surface area away from freshwater features to prevent ingress of hydrocarbons into topsoil ▪ All vehicular movement are to be outside of remaining wetlands and their recommended 32 m zones of regulation.	Water use licence, NEMA	Maintenance of wetland PES.	The Wet-health tool is to be used to re-evaluate PES on an annual basis by a suitably qualified wetland specialist for 3 years after construction. Thereafter, biannual monitoring is recommended for the life of the proposed development

Interaction	Potential impacts	Phase	Mitigation Measures	Complienace with standards	Standard to be achieved/objective	Time period for implementation
Hardened surfaces, sheet runoff and separation of clean and dirty water	▪ Fragmentation of wetlands and riverine corridors. ▪ Onset of erosion. ▪ Loss of catchment yield and surface water recharge	Operational	▪ Clean and dirty water separation systems to be implemented prior to the commencement of activities and to be maintained throughout the life of the proposed project; ▪ Ensure that no incision and canalisation of the freshwater features present takes place as a result of the proposed operational activities; ▪ All erosion noted within the operational footprint as a result of any potential surface activities should be remedied immediately and included as part of the ongoing rehabilitation plan ▪ Appropriate energy dissipation measures to be implemented in line with the engineering design of the development area ▪ Erosion berms should be installed on roadways and downstream of stockpiles to prevent gully formation and siltation of the freshwater resources. The following points should serve to guide the placement of erosion berms: - Where the track has slope of less than 2%, berms every 50m should be installed; - Where the track slopes between 2% and 10%, berms every 25m should be installed; - Where the track slopes between 10%-15%, berms every 20m should be installed; and - Where the track has slope greater than 15%, berms every 10m should be installed.	Water use licence, NEMA	Maintenance of wetland PES.	The Wet-health tool is to be used to re-evaluate PES on an annual basis by a suitably qualified wetland specialist for 3 years after construction. Thereafter, biannual monitoring is recommended for the life of the proposed development.
Influx of people into the general area.	▪ Physical disturbance of soil in wetlands resulting in erosion and sedimentation as a result of recreational activities.	Operational	▪ Recreational activities are to be outside of remaining wetlands and their recommended 32 m zones of regulation. Demarcate with white stakes (or other suitable indicators) for areas where access is restricted or must be avoided ▪ All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and people	Water use licence, NEMA	Control over the population influx and activities associated with the site.	All freshwater features and their associated 32 m zones of regulation and ecologically sensitive areas to be fenced prior to construction.

10 Monitoring Requirements

The WET-health tool is to be used to re-evaluate PES on an annual basis by a suitably qualified wetland specialist for 3 years after construction. Thereafter, biannual monitoring is recommended for the life of the proposed development.

The EMO must be present on site during construction and must ensure that the wetland areas and their associated zones of regulation are clearly demarcated and that no unnecessary clearing of vegetation takes place.

If an offset is required, an offset area must be identified and selected, a wetland specialist must monitor the improvement /decline of wetland areas over time. The frequency of the monitoring of the offset must be determined after an offset strategy has been devised and will depend on the recommendations of this report.

11 Reasoned opinion of the specialist

With specific reference to Development Area B, large impacts to the wetland and freshwater systems present have already occurred due to historical development activities, including the golf course, accommodation facilities, the valley of the waves, roads, etc. The natural flow regimes of the wetlands and aquatic systems present have been severely altered due to stream diversions and canals associated with the existing golf course areas. The various infrastructures have resulted in losses to catchment yields. Loss of natural vegetation is extensive throughout the area thus affecting surface water runoff patterns, flood attenuation and streamflow regulation services. As a result, a large loss in the natural biodiversity of the area has occurred. It is the opinion of the specialist, that in light of these existing alterations to the natural ecology, should the management and mitigation measures provided in Section 9 be strictly adhered to, the proposed developments in Development Area B, are unlikely to further result in significant losses to the ecological sensitivity and functioning of the area. However, in terms of the proposed developments to Development Area A, the proposed activities are likely to result in further losses to habitat and biodiversity in the area as the natural habitat observed in these areas are deemed largely natural in extent. A slightly larger impact for the proposed activities (i.e. the Vacation Club Phase 4) is thus deemed likely, however, the results of the impact assessment indicate that should the appropriate management and mitigation measures be implemented for both Development Area A and B, impacts can be reduced and are likely to be minor and negligible for both project phases.

12 Public Consultation

The Public Participation (PP) Process will be followed. Should Interested and Affected Parties (I&APs) raise specific queries regarding wetlands/flora, the comments will be addressed in the CRR and updated submission to authorities.

13 References

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Appendix A: CVs of the Project Team

Ms Kieren Jayne Bremner

Biophysical: Wetland and Aquatic Ecology

Digby Wells Environmental

1 Education

Tertiary Education:

M.Sc Aquatic Health (2011) - University of Johannesburg (UJ)

B.Sc. Hons, Natural and Environmental Sciences (2005) - Rand Afrikaans University (RAU)

B.Sc. Zoology and Biochemistry (2004) - Rand Afrikaans University (RAU)

Supplementary training:

Wetland Plants Taxonomy – Short Course (2017) – SANBI

SASS5 Accreditation (2015) – South African River Health Programme

Bread Baking Course (2013) – Il de Pain

First Aid for Children and Family (2011) – Lifestyle Projects

Public Participation (2008) – Golder Associates

First Aid Certificate – Level 1 (2008) – Sharpminds

Environmental Auditing Workshop (2006) – University of Johannesburg (UJ)

Advanced 4x4 driving course (2005) – Driving School

2 Language Skills

English (Fluent)

Afrikaans (Fluent)

French (Basic)

Spanish (Basic)

3 Employment

Institution	Time period	Position held
Digby Wells Environmental	September 2017 - Present	Senior Ecologist: Wetlands and Aquatics
Scientific Aquatic Services	August 2015 – August 2017	Senior Aquatic and Wetland Ecologist
Estuary Care	2014 - 2015	Ecologist
Sustainable Seas Trust	2014	Team Member
The Bakery – Kenton on Sea	November October 2013 – April 2015	Owner and manager
Scientific Aquatic Services	2009 – April 2013	Aquatic Ecologist
TWP Engineering (Johannesburg)	2008	Junior Environmental Scientist
University of Johannesburg	2006 - 2007	Practical demonstrator
University of Johannesburg	2006 - 2007	Laboratory assistant
University of Johannesburg	2005	Research assistant

4 Experience

Desktop evaluations:

- Consulting various national and provincial databases to determine general ecological characteristics of an assessment site.
- Databases include Mining and Biodiversity Guidelines, National Freshwater Ecosystem Priority Areas, various SANBI databases, PESEIS database, etc.
- Sound knowledge and application of relevant legislature including NEMA, MWA, NEMBA, etc.
- Interpretation of datasets through the use of metadata.
- Knowledge and use of various computer programmes including PlanetGIS, GlobalMapper, Basecamp, ArcGIS, Garmin DNR and Microsoft Office.
- Consulting digital satellite images in order to map potential sensitive freshwater features and various points of interest prior to field verification and assessment.
- Desktop wetland delineation prior to field verifications
- Gathering of background information such as vegetation types, soil, climate and geology, conservation status, ecoregions, quaternary catchments, catchment management areas and sub-quaternary reaches.

Ongoing Aquatic Biomonitoring and Toxicological Assessments:

- Aquatic biomonitoring and toxicological assessments include to varying degrees the application of the following:
    - Desktop evaluations of the project area;
    - Site selections and visual assessments of each site;
    - On-site testing of biota specific water quality parameters including pH, electrical conductivity (EC), dissolved oxygen concentration (DO) and temperature, discussed against the relevant guideline water quality values

defined by the Department of Water and Sanitation (DWS), formerly the Department of water Affairs and Forestry (DWAF 1996 vol. 7).
    - Macro-invertebrate sampling according to the SASS5 protocol;
    - Assessment of habitat suitability using IHAS;
    - Fish sampling by means of electro-shocker, seine nets, cast nets;
    - Diatom, sediment and water sampling;
    - Bioaccumulation studies;
    - Application of various Ecostatus methodologies including: FRAI, MIRAI, VEGRAI, IHI and RHAM;
    - In earlier years, application of older RHP indices including: FAII, IHIA and RVI;
    - Whole Effluent Toxicological testing on various trophic levels;
    - Provinces worked in include Gauteng, Mpumalanga, Limpopo Province, North West Province, Eastern Cape and Kwa-Zulu Natal, Free Sate; as well as other African countries including Ghana and the Democratic Republic of Congo.
    - Project range and variety includes aquatic ecological assessments for commercial, mining, residential and linear developments.

Aquatic and Wetland Present Ecological State assessments conducted as part of the Environmental Impact Assessment Process:

- Aquatic ecological assessments include to varying degrees the application of the following:
    - Site selections and visual assessments of each site;
    - On-site testing of biota specific water quality parameters including pH, electrical conductivity (EC), dissolved oxygen concentration (DO) and temperature, discussed against the relevant guideline water quality values defined by the Department of Water and Sanitation (DWS), formerly the Department of water Affairs and Forestry (DWAF 1996 vol. 7).
    - Macro-invertebrate sampling according to the SASS5 protocol;
    - Fish sampling by means of electro-shocker, seine nets, cast nets;
    - Diatom, sediment and water sampling;
    - Application of various Ecostatus methodologies including: FRAI, MIRAI, VEGRAI, IHI and RHAM;
    - In earlier years, application of older RHP indices including: FAII, IHIA and RVI;
    - RDL wetland mammal assessment;
    - Provinces worked in include Gauteng, Mpumalanga, Limpopo Province, North West Province, Eastern Cape and Kwa-Zulu Natal, Free Sate as well as other African countries including Ghana and the Democratic Republic of Congo.
    - Project range and variety includes aquatic ecological assessments for commercial, mining, residential and linear developments.

5 Project Experience

Some of my project experience includes:

Specialist studies and project management

- Numerous wetland delineation and function studies in the Gauteng, Free State and Mpumalanga provinces, South Africa.
- Development of an aquatic intervention plan and regional impact analysis for the Nokeng Flourspar Mine, Gauteng.
- Development and project management of aquatic biomonitoring studies at the Cronimet Mine, Limpopo Province, and the NECSA complex, Pelindaba.
- Implementation of a water quality monitoring programme on the Bushmans and Kariega Estuaries, Eastern Cape.

Aquatic and water quality monitoring and compliance reporting

- Development of the 2010 State of the Rivers Report for the City of Johannesburg.
- Development of an annual report detailing the results of the Everest Platinum Mine water monitoring program.
- Aquatic biomonitoring programs for several Xstrata Alloys Mines and Smelters.
- Aquatic biomonitoring programs for several Anglo Platinum Mines.
- Aquatic biomonitoring programs for several Assmang Chrome Operations.
- Aquatic biomonitoring programs for Petra Diamonds.
- Aquatic biomonitoring programs for several coal mining operations.
- Aquatic biomonitoring programs for several mining operations for various minerals including iron ore, and small platinum and chrome mining operations.
- Aquatic biomonitoring program for industrial clients in the paper production and energy generation industries.
- Aquatic biomonitoring programs for the City of Tshwane Waste Water Treatment Works.
- Aquatic biomonitoring programs for the North West Wastewater Treatment Works.
- Baseline aquatic ecological assessments for numerous mining developments.
- Baseline aquatic ecological assessments for numerous residential commercial and industrial developments.
- Baseline aquatic ecological assessments in Ghana and the Democratic Republic of Congo.
- Water quality monitoring on the Bushmans and Kariega estuaries, Eastern Cape.

Wetland delineation and wetland function assessment

- Wetland studies for developments in the mining industry.
- Wetland studies for developments in the residential commercial and industrial sectors.

Public participation processes • Team member in the Public Participation Process for the Cronimet Mine. • Team member in the Public Participation Process for Wesiswe Platinum Mine.
Training and education • Training of junior staff in the aquatic biomonitoring field. • Educational workshops in mini-SASS in both Mpumalanga and the Eastern Cape. • Educational workshops on water quality monitoring and environmental awareness in the Eastern Cape Province.
Research projects • 2006 – 2010: BREMNER, K.J. The use of the Mozambique Tilapia (Oreochromis mossambicus) as a sentinel species of the possible effects on health and reproduction of DDE in vivo exposure and from a DDT sprayed area. • 2006: BREMNER, K.J. KNEIDINGER, T.M. SERFONTEIN, S. An assessment of the water quality status of the Blesbokspruit Wetlands Ramsar Site. Unpublished. Distinction • 2005: BREMNER, K. A study of the effect of barriers on the integrity of the Houtboschloop River Ecosystem. Unpublished. Distinction

6 Professional Registration

Registered RHP SASS5 practitioner.

Mrs Kathryn Roy

Wetland and Flora Consultant

Closure and Rehabilitation

Digby Wells Environmental

1 Education

- 2008 – 2010: BSc Ecology and Environmental Science (University of Cape Town)
- 2011: BSc Honours in Environmental Management (University of Cape Town)
- 2013 – 2015: MSc Restoration Ecology (University of KwaZulu-Natal)

2 Language Skills

- English (fluent); and
- Afrikaans (fair).

3 Employment

- May 2017 – *present*: Digby Wells Environmental – Wetlands and Flora Consultant
- February 2016 – May 2017: Digby Wells Environmental – Rehabilitation Specialist
- February 2012 – February 2015: Environmental Planning and Climate Protection Department, EThekwini Municipality – Research Assistant and Programme Facilitator

4 Experience

Kathryn received a Bachelor of Science in Ecology and Environmental Science and an Honours degree in Environmental Management from the University of Cape Town. She has also received her MSc in Restoration Ecology through the University of KwaZulu-Natal and has over 5 years of experience in the environmental field.

Kathryn focuses on wetland assessments throughout South Africa as well as wetland and rehabilitation monitoring programmes within the mining and energy production sectors. She has also completed flora surveys and site specific rehabilitation plans. Kathryn previously worked extensively with alien invasive species removal programmes, ecological restoration projects and sustainable development programmes within the Government Sector. This experience includes:

- Compilation of Wetland Assessments throughout South Africa
  - Wetland delineation;
  - Wet-Health tools (PES, EcoServices etc.);

- Monitoring; and
- Rehabilitation.

- Compilation of Rehabilitation Plans and assessment of rehabilitation actions throughout South Africa, including:
  - Conceptual Rehabilitation Plans;
  - Detailed Rehabilitation Plans; and
  - Final Rehabilitation, Decommissioning and Mine Closure Plans.
- Facilitation of the University of KwaZulu-Natal – eThekwini Municipality Reforestation Research Partnership:
  - Acted on behalf of the eThekwini Municipality, in order to actively drive the objectives of the new research partnership;
  - Researched critically important biodiversity and ecosystem assets within the eThekwini Municipality's natural environmental areas;
  - Undertook and promoted research on biodiversity, climate change, and socio economic upliftment within the context of local ecosystem restoration and reforestation;
  - Transcribed scientific and technical work into popular format for dissemination to stakeholders; and
  - Student/staff/researcher liaison.
- Helped to Manage the eThekwini Municipality's Community Reforestation Programme (ecosystem-based adaptation project):
  - Undertook all necessary research, including inputs into experimental design, monitoring, data capture, analyses and verification and contributed to the required proofreading, writing-up, and distribution of research;
  - Showcased the reforestation projects by means of presentations at seminars, field trips, symposiums and conferences locally and internationally;
  - Co-authored a document highlighting the Buffelsdraai Community Reforestation Project;
  - Compiled proposals for funding and awards; and
  - Developed a framework for future monitoring, data capture and evaluation, and ensured relevant databases and reference systems were updated.
- Invasive Alien Plant (IAP) Management:

  Project management for the IAP guideline documents, including authoring, data and photo collection, collation and liaison with designers and between authors.

5 Project Experience at Digby Wells

Some of Kathryn's project experience at Digby Wells is listed below:

Year	Client	Project	Responsibility	Location
2016	Copper Sunset Sands (Pty) Ltd	Bankfontein Rehabilitation and Closure Plan	Compilation of Rehabilitation Plan	Free State, South Africa
2016	Naledzi	Geluk Conceptual Rehabilitation and Closure Plan	Compilation of Rehabilitation Plan	Limpopo, South Africa
2016	Eskom	Kilbarchan Rehabilitation and Closure Plan	Compilation of Rehabilitation Plan	KwaZulu-Natal, South Africa
2016	Namane Resources	Namane Generation IPP and Transmission Line Rehabilitation and Closure Plan	Compilation of Rehabilitation Plan	Limpopo, South Africa
2016	Uranex	Nachu Graphite Mine Conceptual Rehabilitation Plan	Compilation of Rehabilitation Plan	Tanzania
2016 - present	Sasol Mining	Rehabilitation of the East Overburden Stockpile	Project Manager, Rehabilitation Assessment, and Compilation of Rehabilitation Plan	Free State, South Africa
2016	Glencore	Proposed Development of an Underground Coal Mine and Associated Infrastructure near Hendrina, Mpumalanga	Compilation of Rehabilitation Plan	Mpumalanga, South Africa
2017	Sedibelo	Rehabilitation Audit	Rehabilitation Audit	North West, South Africa
2017	Sedibelo	WRD Rehabilitation Plan	Rehabilitation Plan	North West, South Africa
2017	Sasol Mining	Vaalkop	Wetland Assessment	Mpumalanga, South Africa
2017	Sibanye	Lindum and Millsite Reclamation	Wetland Assessment	Gauteng, South Africa
2017	Lanxess	Wetland Assessment	Wetland Assessment	North West, South Africa
2017	HCI	Water Pipeline Specialist	Wetland and Flora Assessment	Mpumalanga, South

		Studies		Africa
2017	Exxaro	Matla Mine Wetland Biomonitoring	Wetland monitoring	Mpumalanga, South Africa
2017	Exxaro	Malta Mine Two Wetland Delineation	Wetland Assessment	Mpumalanga, South Africa
2017	Glencore	River Diversion and Wetlands monitoring	Wetland monitoring	
2018	Savannah	Power Station Environmental Assessment	Wetland Assessment	Limpopo, South Africa
2018	Golden Falls Mining	Elaanslaagte IWULA	Wetland Assessment	Northern Cape, South Africa
2018	Sun City	Sun City Expansion	Wetland Assessment	North West, South Africa
2018	Sasol Mining	Mooikraal Biomonitoring	Wetland Monitoring	Free State, South Africa

6 Publications

- Douwes,E., Rouget, M., Diederichs, N., O'Donoghue, S., Roy, K., Roberts, D. The Buffelsdraai Landfill Site Community Reforestation Project. *Unasylva* 247/248, Vol. 67: 12-28.
- Douwes, E., Roy, K.E., Diederichs-Mander, N., Mavundla, K., Roberts, D. 2015. The Buffelsdraai Landfill Site Community Reforestation Project: Leading the way in community ecosystem-based adaptation to climate change. EThekwini Municipality, Durban, South Africa.
- Water Hyacinth Control Guideline Document: Insight into Best Practice, Removal Methods, Training & Equipment. 2013. Environmental Planning and Climate Protection Department. EThekwini Municipality (co-author), p. 58.
- General Invasive Alien Plant Control Guideline Document: Insight into Best Practice, Removal Methods, Training & Equipment. 2013. Environmental Planning and Climate Protection Department. EThekwini Municipality (co-author), p. 78.
- Beautiful but Dangerous posters. 2013. Environmental Planning and Climate Protection Department. EThekwini Municipality, p 5.

- EThekwini State of Biodiversity: Report 2011/2012. Environmental Planning and Climate Protection Department. EThekwini Municipality (acknowledged contributor), p. 27.

Mr. Brett Coutts

Divisional Manager: Ecology and Atmospheric Sciences

Digby Wells Environmental

1 Education

- 2006 – 2007: BSc Honours in Ecology, Environment and Conservation - University of the Witwatersrand.
- 2003 – 2006: Undergraduate BSc - University of the Witwatersrand.

2 Language Skills

- English; and
- Afrikaans.

3 Employment

- September 2012 – Present: Digby Wells Environmental – Unit Manager: Rehabilitation.
- October 2008 – August 2012: Terra Pacis Environmental (Pty) Ltd – Environmental Consultant.
- November 2007 – September 2008: Hydromulch (Pty) Ltd – Junior Project Manager.

4 Experience

Brett Coutts is an Ecologist with a BSc Honours in Ecology, Environment and Conservation. Brett gained practical hands on experience as a project manager on environmental rehabilitation projects at Hydromulch and his roles and responsibilities include the compilation of Basic Assessment (BA) reports, Scoping & Environmental Impact Reports, compilation of Environmental Management Plans (EMP), GIS mapping and Biodiversity Action Plans linking to rehabilitation. Brett is currently the Divisional Manager for the Ecological and Atmospheric Sciences Division.

Prior to his appointment, he gained experience as a junior project manager on environmental rehabilitation projects at Hydromulch and then was appointed by Terra Pacis as an Environmental Consultant where his roles and responsibilities included the compilation of Basic Assessment (BA) reports, Scoping &Environmental Impact Reports, compilation of Environmental Management Plans (EMP), GIS mapping and Biophysical Studies.

5 Project Experience

- Integrated Environmental Authorisations for Blue Sphere Investments and Trading 103 (Pty) Ltd – Consultant.
- The compilation of the Atmospheric Emissions Licences for Samancor Manganese (Pty) Ltd, Metalloys, BHP Billiton – Consultant.
- Scoping and Environmental Impact Reporting for the Refurbishment of West Plant Sludge Dam No.3 and associated Mixing Facility at Samancor Manganese (Pty) Ltd, Metalloys, BHP Billiton – Consultant.
- Scoping and Environmental Impact Reporting for the Upgrade of the existing Pelletising Plant to an Agglomeration Plant at Samancor Manganese (Pty) Ltd, Metalloys, BHP Billiton – Consultant.
- Waste Assessment for Kopanang Mine (Phase 2) - AngloGold Ashanti –Vaal River Operations - Consultant.
- Waste Assessment for Mponeng Mine (Phase 2) - AngloGold Ashanti - West Wits - Consultant.
- Compilation of Operational Procedures for the New North and West Plant Sludge Dams - Samancor Manganese (Pty) Ltd, Metalloys, BHP Billiton - Consultant.
- Biodiversity Assessment at Samancor Manganese (Pty) Ltd, Metalloys, BHP Billiton– Specialist.
- Basic Assessment for a Proposed Residential Development on Portion 378 and Portion 379 of the Farm Driefontein 85 IR,Boksburg - Business Venture Investments No. 1172 (Pty) Ltd – Consultant.
- Vegetation, Invertebrate and Wetland Assessments for the Proposed a Residential Development on Portions 378 and 379, of the Farm Driefontein 85 IR, Boksburg - Business Venture Investments No. 1172 (Pty) Ltd - Specialist.
- Salvage Yard Layout-Review of Design and Stormwater - Samancor Manganese (Pty) Ltd, Metalloys, BHP Billiton – Consultant.
- Dams Risk Assessment - Goedgevonden Colliery, Xtrata Coal South Africa – Consultant.
- Invasive Alien Plant Control Procedure at Samancor Manganese (Pty) Ltd, Metalloys, BHP Billiton - Consultant.
- Environmental Management Plan Update - North Mara Mine Limited, Barrick Gold Corporation – Consultant.
- Waste Assessment for Kopanang Mine(Phase 1) - AngloGold Ashanti –Vaal River Operations - Consultant.

- Waste Assessment for Mponeng Mine (Phase 1) - AngloGold Ashanti - West Wits - Consultant.
- Admox Bagging Plant, Admox Bagging Plant, Admox Pelletising Plant and OBC Fume Extraction Operation Environmental Management Plan - Samancor Manganese (Pty) Ltd, Metalloys, BHP Billiton - Consultant.
- Compilation of Standard Operational Procedures for the Slag and Dust Stockpiles - Samancor Manganese (Pty) Ltd, Metalloys, BHP Billiton - Consultant.
- Internal Water Use License Audit - Goedgevonden Colliery, Xtrata Coal South Africa - Auditor.
- Biophysical Specialist Study Report for the Bravo 3 Power Line Route Alternatives-2008 – Zitholele Consulting – Specialist.
- Voorspoed Mine Closure Plan - De Beers Consolidated Mines – Consultant.
- Co-ordination and Implementation Project for Thabazimbi Iron Ore Mine associated with Aerial Seeding and Re-vegetation Reporting Plan, Anglo Group – Rehabilitation Consultant.
- Exxaro Portfolio, Rehabilitation Specialist for Grootegeluk Coal Mine, Compilation of Rehabilitation Plan, Exxaro Coal (Pty) Ltd – Rehabilitation Specialist.
- Rehabilitation plan compilation for historical mines located in Mpumalanga with associated biophysical studies and monitoring of progress of rehabilitation, Anker Coal– Rehabilitation Specialist.
- Overall management and coordination of projects associated with the mine and co-ordination with mine personnel, Key Account Management – Environmental Consultant.
- Scoping and Environmental Impact Assessment for the Proposed Schoonoord Underground Mine, Exxaro Arnot Coal Mine, Exxaro (Pty) Ltd – Project Manager.
- Scoping and Environmental Impact Assessment for the Proposed Thabametsi Coal Mine, Exxaro (Pty) Ltd – Project Manager.
- Compilation of Biodiversity Management Plans for Tongon Gold Mine, Rand Gold Resources – Technical Specialist and Project Manager.
- Wetland Offset Strategy for the Waterberg Region , Exxaro (Pty) Ltd– Project Manager.
- Rehabilitation Plan for Consbrey and Hawar Projects Msobo Coal– Rehabilitation Specialist.
- Update of Greenside Colliery Closure Plan, Anglo American (Pty) Ltd – Project Manager.
- Compilation of Putu Iron Ore Rehabilitation Plan, Liberia – Rehabilitation Specialist.

- Compilation of Rehabilitation Plan for Balama, Mozambique, Syrah Resources – Rehabilitation Specialist.
- Compilation of Rehabilitation and Closure Plan for Storm Mountain Diamond Mine – Rehabilitation Specialist.
- Overall management and coordination of projects associated with the mine and co-ordination with mine personnel, Bokoni Platinum Mine – Key Account Manager.
- Environmental and Social Impact Assessment for New Liberty Gold Mine, Liberia, Aureus – Project Manager.
- Preliminary Closure Plan for New Liberty Gold Mine, Liberia, Aureus– Rehabilitation Specialist.
- Waste Assessment for Kopanang Mine(Phase 1) - AngloGold Ashanti –Vaal River Operations - Consultant.
- Compilation of GIS Training Manual – Consultant (Internal).
- Rehabilitation Plan for IPP Station, Vedanta Resources – Rehabilitation Specialist.
- Compilation of Biodiversity Management Plans for Morila Gold Mine, Mali, Rand Gold Resources – Technical Specialist and Project Manager.

6 Short Courses

- 2009: IEMA Approved Carbon Footprint Management Course: An Introductory Programme.
- 2010: Exclusive Panel Discussion on: The Copenhagen Climate Change Conference.
- 2011: International Association for Impact Assessments conference at the Wild Coast.
- 2012: Centre for Environmental Management, North-West University: Environmental Law for Environmental Managers.

7 Professional Affiliations

Geographic Information Society of South Africa (GISSA)

8 Professional Registration

- 2009: IAIAsa - International Association for Impact Assessment (South Africa).