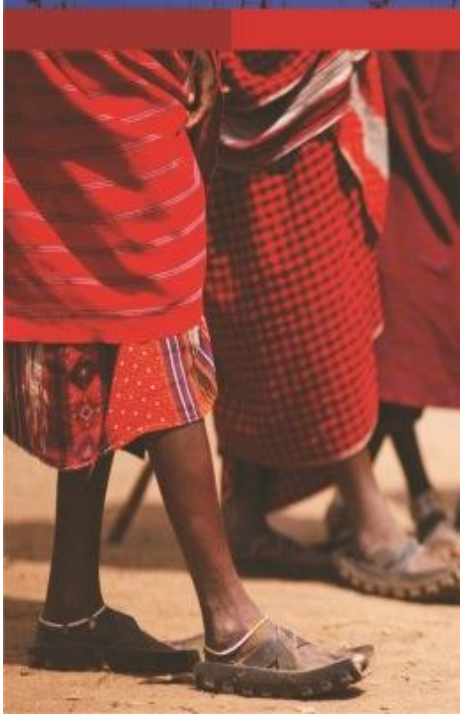

DIGBY WELLS
ENVIRONMENTAL

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

Soils, Land Capability and Land Use Assessment Report

Project Number:

SUN4642

Prepared for:

Sun International (Sun City Resort)

April 2018

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This document has been prepared by Digby Wells Environmental.

Report Type:	**Soils, Land Capability and Land Use Assessment Report**
Project Name:	**Environmental Impact Assessment for proposed Future Developments within the Sun City Complex**
Project Code:	**SUN4642**

Name	Responsibility	Signature	Date
Siphamandla Madikizela Pr.Sci.Nat	Report Writer		April 2018 June 2018
Leon Ellis	OPSCO Review		April 2018
Danie Otto Pr.Sci.Nat	EXCO Review		June 2018

EXECUTIVE SUMMARY

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 future developments within the Sun City Resort Complex located near Rustenburg, North West Province.

In order to identify soils accurately, it is necessary to undertake a soil survey. The aim was to provide an accurate record of the soil resources of an area. Land capability, land use and agricultural potential are then determined from these results. This report presents the findings of a specialist soils, land capability and land use assessment that forms part of the EIA report. The relevant project components include the following:

- The description of the soil types found in the proposed project area (infrastructure);
- Determining the existing land capability;
- Determining the current land use;
- Soil chemical and physical properties; and
- Impact assessment associated with the proposed establishment on soils.

Methodology

As part of the desktop assessment, baseline soil information was obtained from South African land type data published with maps at a scale of 1:250 000 by the Institute for Soil, Climate and Water (ISCW) of the Agricultural Research Council (ARC). A detailed study of the soils within the project expansion area was conducted during field visits in November, 2017.

A free survey method was used where it starts with a detailed physiographic aerial imagery interpretation and the surveyor actually walks most of the landscape, usually in traverses “across the grain”, concentrating on the proposed infrastructure areas. The surveyor chooses sample points in order to systematically confirm a mental model of the soil-landscape relationships, draw boundaries and determine map unit composition. Soils were investigated by augering to a maximum depth of 1.2 metre or to the depth of refusal. Soil survey positions were recorded as waypoints using a handheld Global Positioning System (GPS).

At each observation point, the South African Taxonomic Soil Classification System was used to describe and classify the soils. Land capability was determined by assessing a combination of soil, terrain and climate features. Land capability is defined by the most intensive long term sustainable use of land under rain-fed conditions. Land use was determined by aerial imagery and ground-truthed during the site visit.

The soil and land capability report discusses the approach and findings of a desktop and field survey carried out in November 2017 on the study area. The following legislation was considered during the assessment:

- The National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA);
- Government Notice R983 of December 2014 (related to the above Act);
- The Development Act 28 of 2002; and
- The Conservation of Agricultural Resources Act, 1993 (Act No. 43 of 1993) (CARA).

Findings

The land type gathered suggested that the dominant land types on site were Ae64 and Ib115. Soils under land type Ae64 are freely drained, red and yellow-brown and fine sandy soils (deep and shallow). Soils under land type Ib115 are found on steep and rocky areas, and these soils are very shallow in complex association with surface rockiness.

The project area is dominated by the presence of soils that are not suitable for cultivation. The dominant land capability classes in the project area were Class VI (Light cultivation/intensive grazing) and Class VIII (Wildlife). The land occurring at the project area is considered to have a low agricultural potential.

The land use is dominated by urban development. The land uses of surrounding areas that occur within a 500 m radius of site are: natural area, landfill, wetland, dam, streams, nature conservation area, koppies, golf course, holiday resort, accommodation and protected area.

The fertility status of the soils is generally moderate with some requirement for phosphate fertiliser to achieve full cropping potential. Exchangeable cations (calcium, magnesium and potassium) are present at sufficient levels and sodium levels ranged from low to high. High levels of sodium could lead to decrease in plant production and dispersion is likely to occur and cause dense structure and drainage problems. Texture is variable containing a mixture of sandy loam, clay loam and sandy clay loam.

Impact Assessment

The impacts associated with the infrastructure development are the disturbance of the natural occurring vegetation and soil profile consisting of soil horizons. The clearing of vegetation and topsoil removal during construction will have an impact on soils. The impacts on soils associated with the proposed infrastructure development can be split up into the following:

- Loss of topsoil during clearing of vegetation;

- The removal of vegetation may lead to soil erosion by wind and water movement;
- Soil compaction of soils due to construction vehicles; and
- Chemical soil pollution as a result of oil and fuel spills.

Recommendations

The following actions are recommended to minimise the effects of infrastructure development on soils and land capability:

- Runoff must be controlled and managed by use of proper storm water management facilities;
- Cover, seed or fence soil stockpiles during construction to prevent erosion;
- Ensure an adequate water supply on the site for effective dust matter suppression, using non-potable water where possible and appropriate;
- Fuel and oil spills are common, remediate by actively raising awareness and using commercially available emergency clean up kits; and
- Clearing and removal of soils should be done during dry months (May to September) to reduce erosion and compaction. Dust suppression techniques should be applied.

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1 Introduction

Digby Wells Environmental (hereafter Digby Wells) was appointed by Sun City Resort to undertake an Environmental Impact Assessment (EIA) in relation to proposed future developments within the Sun City Resort Complex located near Rustenburg, North West Province (Figure 1-1). The proposed Projects involve the following:

- Resort Expansion Projects:
  - Development of a Bush Lodge / Eco-Lodge at Bakubung - West gate;
  - 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 - 3 bed units and associated infrastructure to expand capacity at the Vacation Club (VC Phase 3);
  - 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 water to flow under the roads and maintain the road surface for fence inspections by security (prevent floods washing away the road);
  - Construct 2 x 10Ml Reservoirs or alternatively 1 x 20Ml Reservoir to supplement water storage capacity;
  - Currently there is an effluent transfer line (old asbestos line) through Sunset Drive to Hole 2. This line will be decommissioned (shut down) but remain 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). The line will be decommissioned (shut down but remain in place). A new wastewater treatment works (WWTW) will be established to manage sewage from the VC and The Palace;

- Construct an additional pipeline for water supply to South Village;
- 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 in length); 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 EIA Regulations[1] require environmental authorisation prior to commencing. The proposed Projects at Sun City constitute 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 Soils, Land Capability and Land Use Assessment 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.

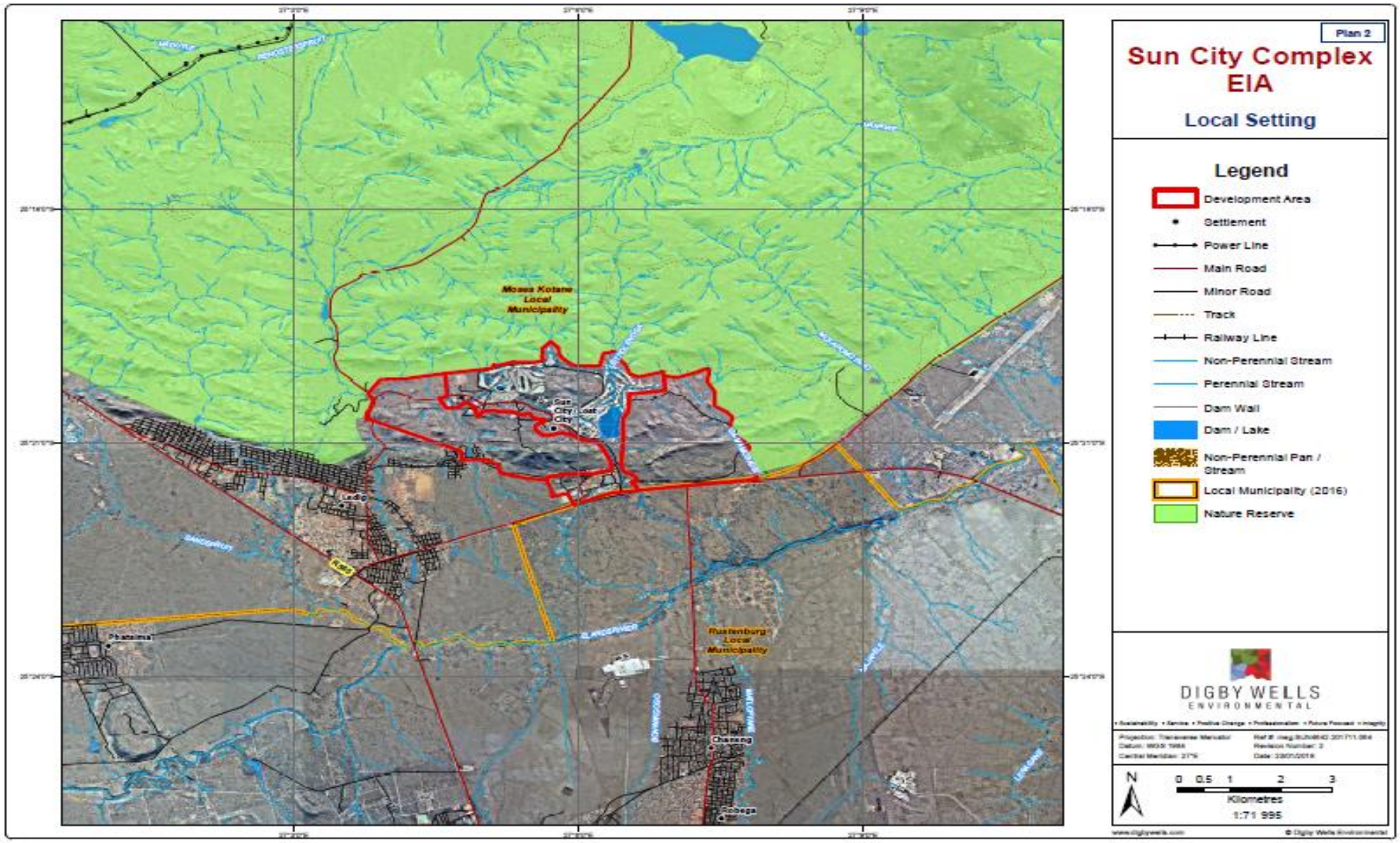

Figure 1-1: Local setting of the Sun City Complex

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
(d) the duration, date and season of the site investigation and the relevance of the season to	Please see Section 5: **Error! Reference source not found.**

Regulatory Requirement for EIA Reports	Relevant Section of this report
the outcome of the assessment;	
(e) a description of the methodology adopted in preparing the report inclusive of equipment and modelling used;	Please see Section 4: 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 7: Soil Chemical and Physical Characteristics A total of seven soil samples were collected from different proposed development areas (Figure 6-1). The objective of this section of the study was to characterise the soil physico-chemical properties assessed which included: ■ Chemical properties (pH, organic carbon (OC), exchangeable bases and phosphorus); and ■ Soil texture (clay, silt and sand).

Regulatory Requirement for EIA Reports	Relevant Section of this report

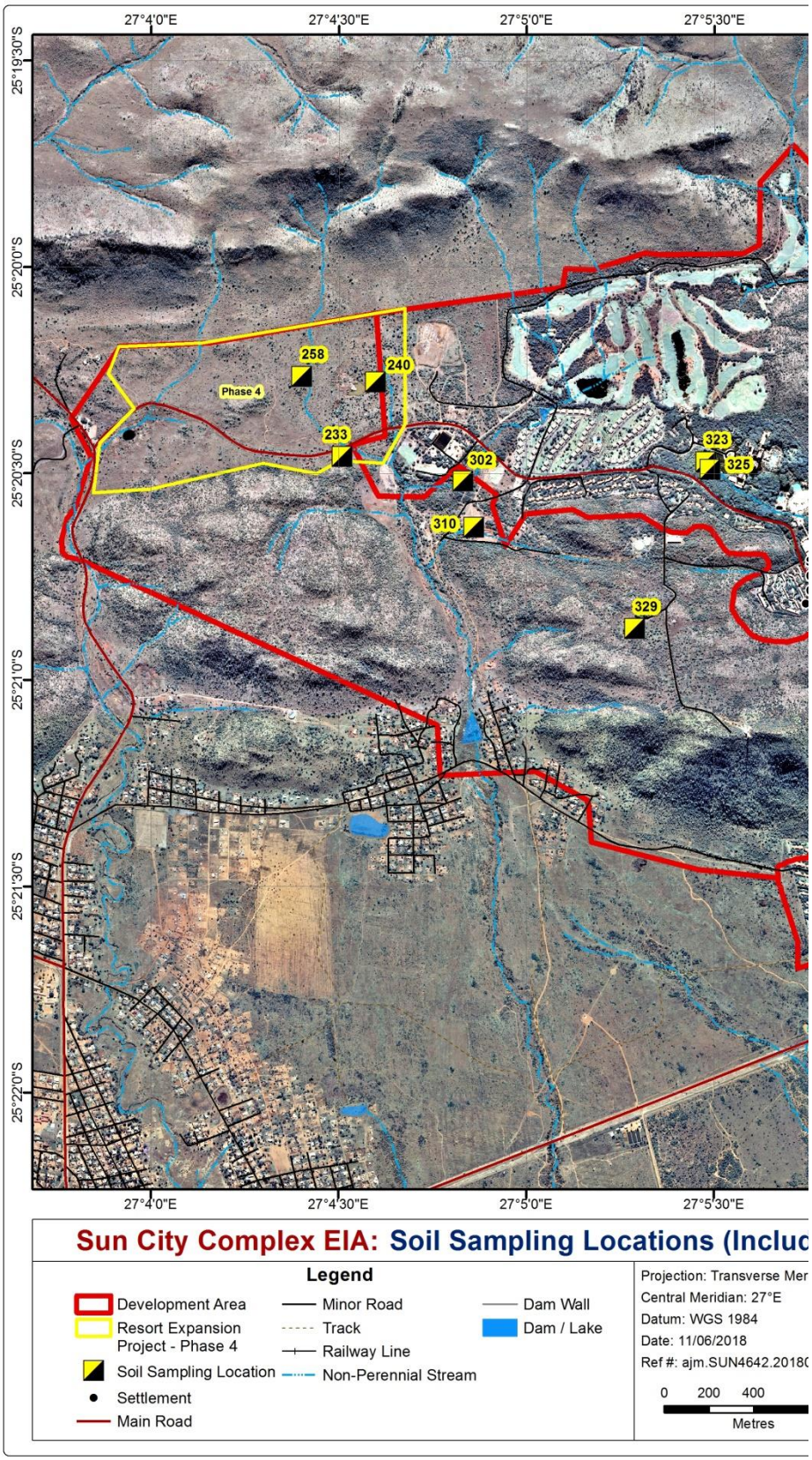

Figure 6-1: Soil sampling locations

The results of soil analysis are presented in Table 6-1 and as a

Regulatory Requirement for EIA Reports	Relevant Section of this report
(g) an identification of any areas to be avoided, including buffers;	Please see Section 6: Soil Chemical and Physical Characteristics A total of seven soil samples were collected from different proposed development areas (Figure 6-1). The objective of this section of the study was to characterise the soil physico-chemical properties assessed which included: ■ Chemical properties (pH, organic carbon (OC), exchangeable bases and phosphorus); and ■ Soil texture (clay, silt and sand).

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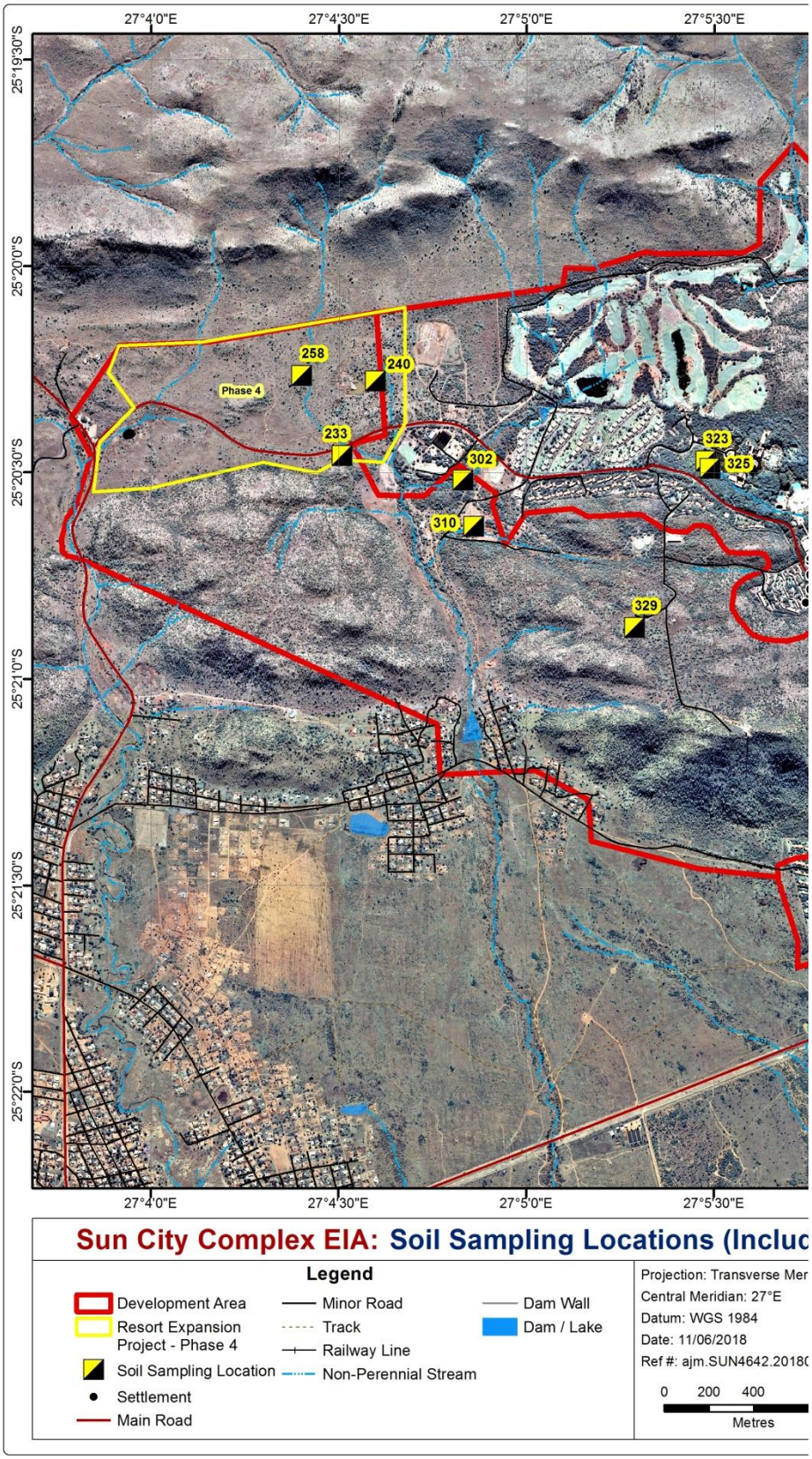

Figure 6-1: Soil sampling locations

The results of soil analysis are presented in Table 6-1 and as a

Regulatory Requirement for EIA Reports	Relevant Section of this report
(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: Soil Chemical and Physical Characteristics A total of seven soil samples were collected from different proposed development areas (Figure 6-1). The objective of this section of the study was to characterise the soil physico-chemical properties assessed which included: ■ Chemical properties (pH, organic carbon (OC), exchangeable bases and phosphorus); and ■ Soil texture (clay, silt and sand).

Regulatory Requirement for EIA Reports	Relevant Section of this report

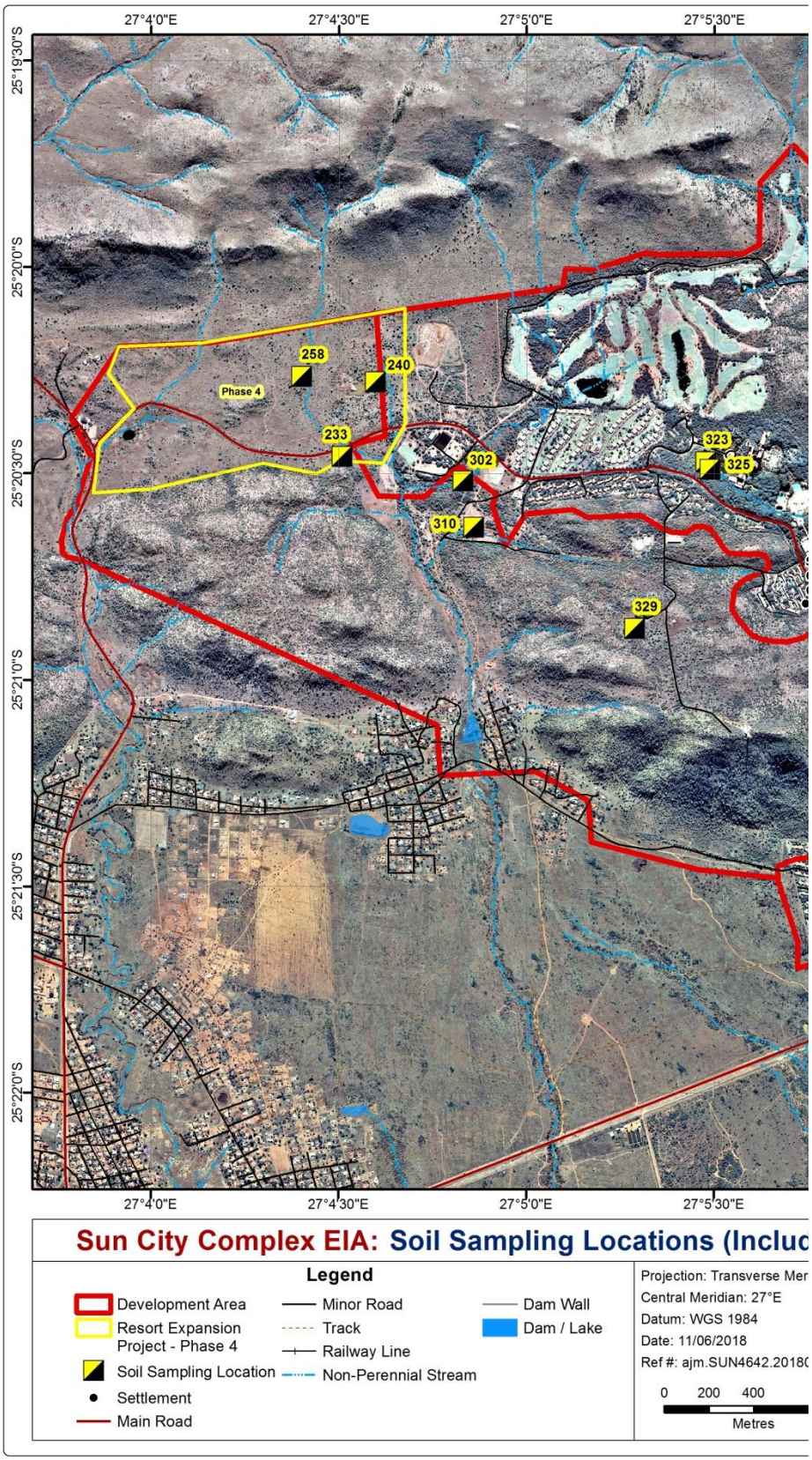

Figure 6-1: Soil sampling locations

The results of soil analysis are presented in Table 6-1 and as a

Regulatory Requirement for EIA Reports	Relevant Section of this report
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Please see Section 8: Assumptions, Limitations and
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Please see Section 9: Potential Impacts The impacts associated with the proposed infrastructure development are the disturbance of the naturally occurring vegetation and soil profile consisting of soil horizons. The impact on the soil is medium because the vegetation will be cleared and topsoil will be disturbed and/or removed during the construction phase. The impacts on soils associated with the proposed infrastructure development can be split up into the following: ■ Potential impacts on soil: ▪ The removal of vegetation may lead to soil erosion by wind and water movement over the soil surface; ▪ Soil compaction in areas where construction will take place; and ▪ Chemical soil pollution may occur as a result of oil and fuel spills. Impact Assessment
(k) any mitigation measures for inclusion in the EMPr;	Please see Section 11: Mitigation and Management Measures
(l) any conditions for inclusion in the environmental authorisation;	
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Please see Section 12: Monitoring Requirements
(n) a reasoned opinion— (i) whether the	Please see Section14: Conclusion and Recommendation The proposed development area is dominated by the land type Ae64

Regulatory Requirement for EIA Reports	Relevant Section of this report
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	and Ib115. The land capability is dominated by the Class VI and VIII, while the land uses within the proposed development area is urban development. The pH of the soils was acidic to slightly alkaline. Exchangeable cations (calcium, potassium and magnesium) are available at adequate levels. Phosphorus levels were low. The soil texture was classified as sandy clay loam, sandy loam and clay loam. The impact on soil is low to moderate, if mismanaged. The impacts associated with the proposed development on soils include: ■ Loss of topsoil during clearing of vegetation; ■ Erosion due to exposed soil surfaces; ■ Compaction of soils due to construction vehicles; and ■ Soil contamination through hydrocarbon spills. The findings of the proposed development will result in: ■ Low risk of loss of soil due to erosion and compaction; and ■ Hydrocarbon spills pose a low risk at the proposed development areas. The major consideration during construction of the infrastructure is to restrict the soil disturbance or removal to the site composed of rock outcrops, shallow Mispah soils. The following recommendations are made to minimise the impact on the soils: ■ Runoff must be controlled and managed by use of proper storm water management facilities; ■ Fuel and oil spills are common, remediate using commercially available emergency clean up kits; and ■ Clearing and removal of soils should be done during dry moths (May to September) to reduce erosion and compaction on soils. Reasoned opinion of the specialist

Regulatory Requirement for EIA Reports	Relevant Section of this report
included in the EMPr, and where applicable, the closure plan;	
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Please see Section 15 & 16: **Error! Reference source not found.**
(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.

The aim of the soil survey was to provide an accurate record of the soil resources of the area. Land capability and land potential is then determined from these results. Soil mapping is therefore essential to determine the types of soils present, their depths and their land capability/ land potential. These results are used to give practical recommendations on preserving and managing the soil resource.

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 compilation
Full Name of Specialist	Siphamandla Madikizela
Highest Qualification	M.Sc.
Years of experience in specialist field	4.5
Responsibility	Report reviewer
Full Name of Specialist	Leon Ellis
Highest Qualification	B.Sc. Hons
Years of experience in specialist field	7
Responsibility	Report reviewer
Full Name of Specialist	Danie Otto
Highest Qualification	M.Sc.
Years of experience in specialist field	> 20

2.1 Declaration of the Specialist

I Siphamandla Madikizela, as the appointed specialists 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:
Siphamandla Madikizela
Full Name and Surname of the specialist:
Digby Wells
Name of company:
June 2017
Date:

3 Scope and Purpose of this Report

The soil, land capability and land use assessment comprised of the following activities:

- Soil survey: the soils occupying the Project site were surveyed during site visits. A hand soil auger was used to survey the soil types present and survey positions were recorded as waypoints;
- Description and categorisation of soils using the South African Soil Classification Taxonomic System (1991);
- Land capability: was assessed from the soil classification for the Project site and climate capability assessment;
- Land use: present land use was mapped in conjunction with the soil survey which included the following information:
  - Current land uses/covers associated with the respective project components.
- Description of soils in terms of soil fertility: ten (10) soil samples were collected in the infrastructure areas; and
- Identification and assessment of potential impacts on soils resulting from the proposed project using the prescribed impact rating methodology. Mitigation measures were recommended to minimise impacts associated with the proposed project.

4 Methodology

This section provides the methodology used in the compilation of the soils report as indicated in Figure 4-1.

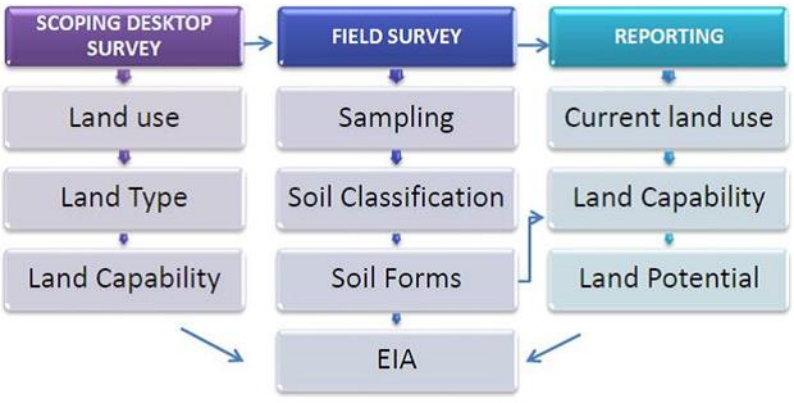

Figure 4-1: Soil, land capability and land use assessment and report process

4.1 Determining the Baseline Environment

To complete the proposed scope of work, there were a number of tasks which needed to be completed and these tasks are explained separately below.

4.1.1 Desktop Assessment

The following data was obtained and studied to prepare for the site survey and the baseline reporting:

- Existing Land Type data was used to obtain generalised soil patterns and terrain types for the Sun City Project site. Land Type data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of relatively uniform terrain, soil pattern and climate (Land Type Survey Staff, 1972 - 2006). These maps and their accompanying reports provide a statistical estimate of the different soils that can be expected in the area.

4.1.2 Soil Classification

A detailed soil assessment of the soils present on the proposed expansion areas was conducted during a field visit in November 2017. The site was traversed by vehicle and on foot. A hand soil auger was used to determine the soil type and depth. Soils were investigated using a bucket auger to a maximum depth of 1.2 metres or to the depth of refusal. Survey positions were recorded as waypoints using a handheld Global Positioning System (GPS). Other features such as existing open trenches were helpful to determine soil types and depth. The soil forms (types of soil) found was identified using the South African Soil Classification System (Soil Classification Working Group, 1991).

4.1.3 Soil Sampling and Analysis

Ten (10) soil samples (0 to 0.6 m) were collected from the proposed areas. The soil samples were stored in plastic bags and sent to Intertek Agricultural Laboratory in Bapsfontein for analysis. Samples were analysed for indicators of acidity, fertility and texture as follows:

- Soil pH (KCl);
- Exchangeable cations (Ca, Mg, K and Na) (Ammonium acetate extraction);
- Phosphorus (Bray No.1 extractant); and
- Soil Texture (Clay, Sand and Silt).

Soil texture is defined as the relative proportion of sand, silt and clay particles found in the soil. The relative proportions of these 3 fractions (clay, sand and silt) as illustrated by the red arrows in Figure 4-2, determines 1 of 12 soil texture classes, for example sandy loam, loam, sand, sandy clay loam etc. The different texture class zones are demarcated by the thick black line in the diagram. The green zone can be used as a guideline for moderate to high agricultural potential, but need to be evaluated together with other soil properties.

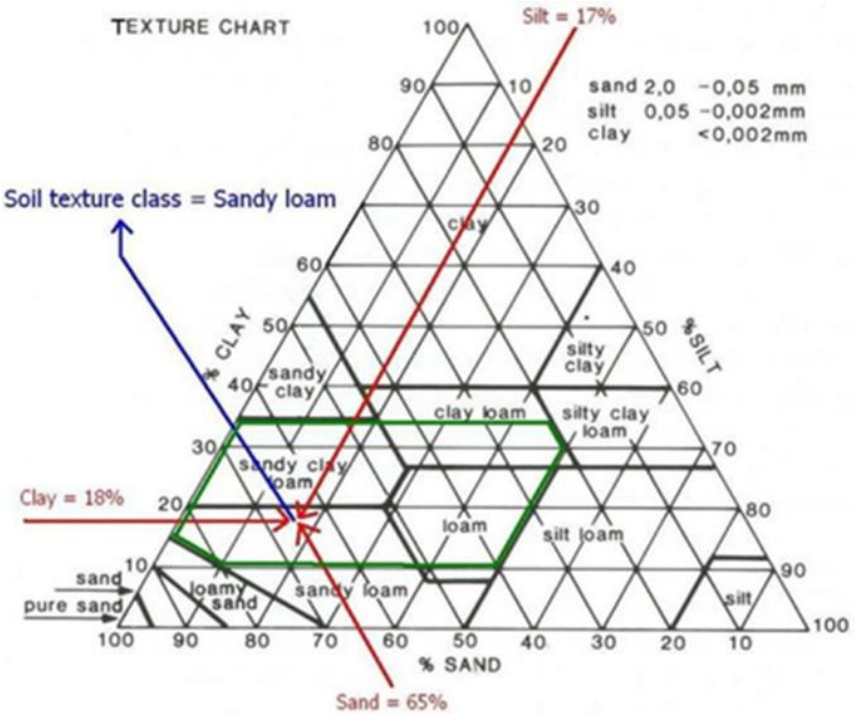

Figure 4-2: Soil textural triangle (SASA, 1999)

4.1.4 Land Capability

Land capability wad determined by assessing a combination of soil, terrain and climate features. Land capability is defined by the most suitable land use under rain-fed conditions. The approach by Schoeman *et al* (2000) was used to assess the land capability. The defined land capability shows the most intensive long-term use of land for rain-fed agriculture and at the same time indicates the permanent limitations associated with different land use classes. The classification system is made up of land capability classes and land capability groups (Table 4-1).

Table 4-1: Land capability classes

Land Capability Class	Increased Intensity of Use									Land Capability Groups
I	W	F	LG	MG	IG	LC	MC	IC	VIC	**Arable Land**
II	W	F	LG	MG	IG	LC	MC	IC		
III	W	F	LG	MG	IG	LC	MC			
IV	W	F	LG	MG	IG	LC				
V	W		LG	MG						**Grazing Land**
VI	W	F	LG	MG						

Land Capability Class	Increased Intensity of Use									Land Capability Groups
VII	W	F	LG							
VIII	W									**Wildlife**

W - Wildlife	**MG - Moderate Grazing**	**MC - Moderate Cultivation**
F- Forestry	**IG - Intensive Grazing**	**IC - Intensive Cultivation**
LG - Light Grazing	**LC - Light Cultivation**	**VIC - Very Intensive Cultivation**

4.1.5 Land Use

The current land use was identified by aerial imagery during the desktop assessment and by on-site inspection during the EIA phase. The land use is classified as follows:

- Plantations;
- Natural;
- Waterbodies;
- Urban built-up; and
- Cultivated.

4.2 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 Environmental Management Plan (EMPr).

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 4-3. 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 4-4).

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 4-2: Impact assessment parameter ratings

Rating	Intensity/ Replicability		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/ Replicability		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/ Replicability		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/ Replicability		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 4-3: 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 4-4: 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) (-)

5 Baseline Environment

5.1 Land Type

Existing Land Type data was used to obtain generalised soil patterns and terrain types for the Sun City area. Land Type data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of similar terrain types, pedosystems (uniform terrain and soil pattern) and climate (Land Type Survey Staff, 1972 – 2006). The land type data gathered suggested that the dominant land type on site was Ae64 and Ib115 (Figure 5-2). Soils under land type Ae64 are freely drained, red and yellow-brown and fine sandy soils, and these soils are deep and shallow (Figure 5-2). Soils under land type Ib115 are found on steep and rocky areas, and these soils are very shallow in complex association with surface rockiness (Figure 5-2). The project site is dominated by the presence of soils not suitable for agricultural potential (Figure 5-1).

Figure 5-1: Rocky outcrops (A and B) and red apedal soils (C) in the proposed development

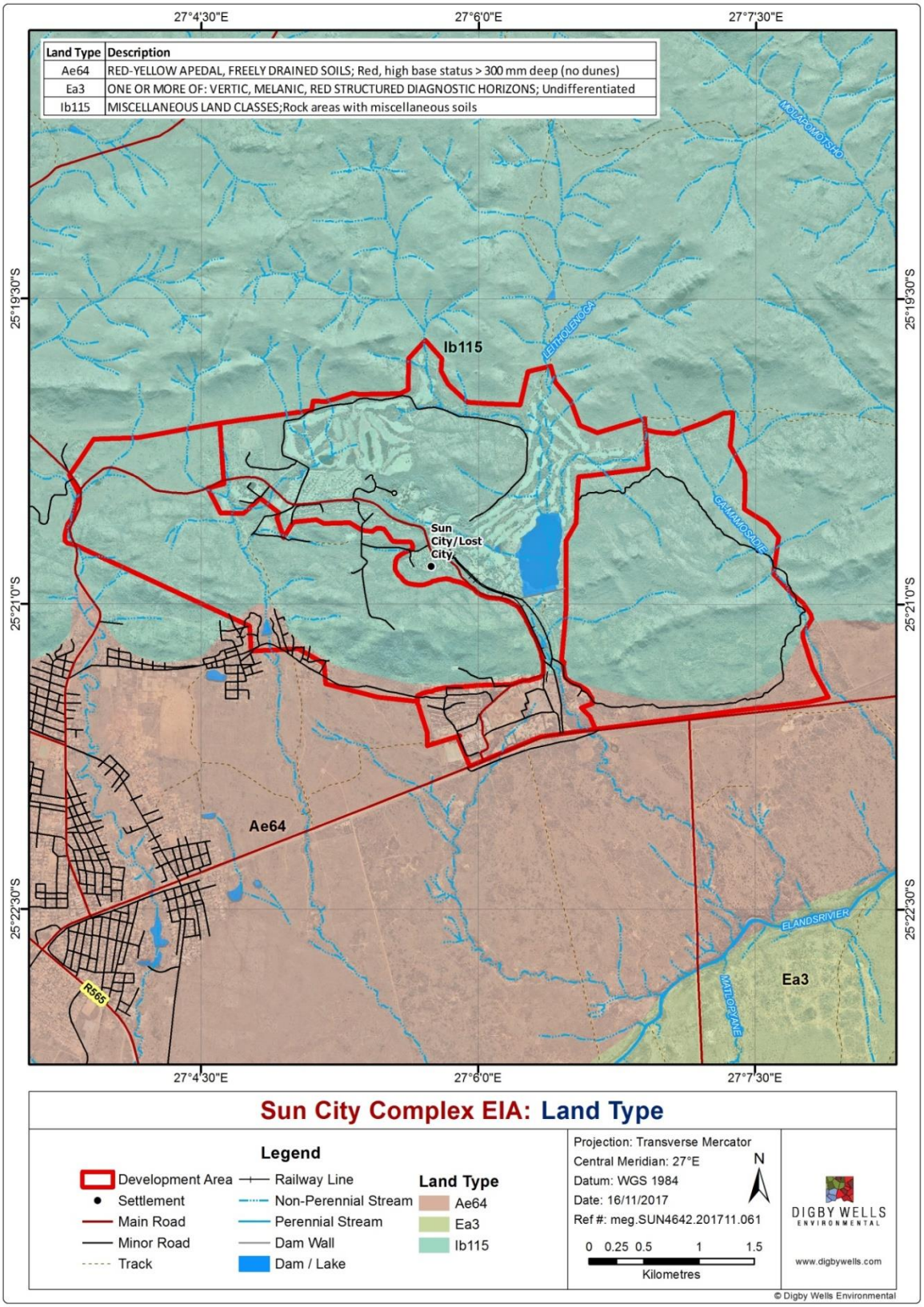

Figure 5-2: Land type map of the Sun City Complex (Land Type Survey Staff, 1976 – 2006)

5.2 Land Capability

The land capability is determined by assessing a combination of soil, terrain and climate features. The dominant land capability classes in the project area were Class VI (Light cultivation/Intensive grazing) and Class VIII (Wildlife) (Table 5-1). A detailed breakdown for each class is given below.

Table 5-1: Land Capability Classification of the Study Area

Land Type	Land Capability Class	Dominant limitation influencing the physical suitability for agricultural use
Ae64	VI	Limiting soil depth, steepness, climate
Ib115	VIII	Rockiness, steepness

5.2.1 Class VI

Land in Class VI has severe limitations that make it generally unsuited for cultivation and limits its use largely to pasture, range, woodland or wildlife food and cover. Land in Class VI has continuing limitations that cannot be corrected, such as:

- Steep slope;
- Severe erosion hazard;
- Stoniness;
- Shallow rooting zone;
- Low water holding capacity; and
- Salinity or sodicity.

5.2.2 Class VIII

Land in Class VIII has limitations that preclude its use for commercial plant production and restrict its use to wildlife, aesthetic purposes or water supply. Land in Class VIII has continuing limitations that cannot be corrected, such as:

- Erosion hazard;
- Wet soil;
- Stoniness;
- Low water holding capacity; and
- Salinity or sodicity.

The land occurring at the proposed project site consists of factors that can be considered as low potential agriculture. It is low potential for the following reasons:

- The proposed site of development is composed of rock outcrops and shallow Mispah resulting in poor effective root depth. Soil is not considered as high potential for agriculture productivity and will not support effective crop production due to potential root zone moisture and stoniness limitation; and
- Available grazing land will not support viable economic crop and livestock production.

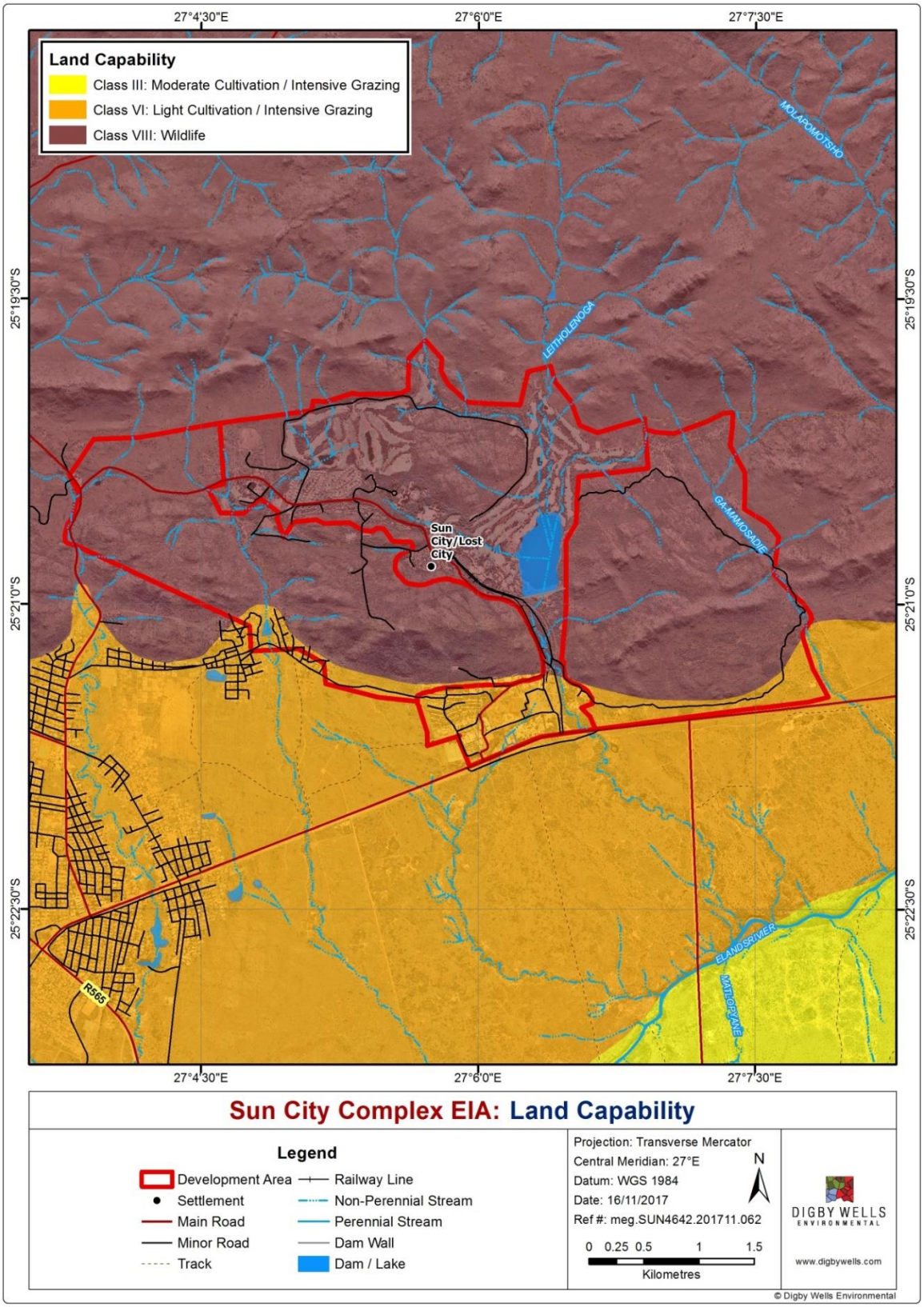

Figure 5-3: Land capability map of the Sun City Complex (Land Type Survey Staff, 1976 – 2006)

5.3 Land Use

The land use for the project area is dominated by urban development (Figure 5-4), shrubland/thicket/woodland and grassland (Figure 5-5).

Figure 5-4: Urban development at Sun City

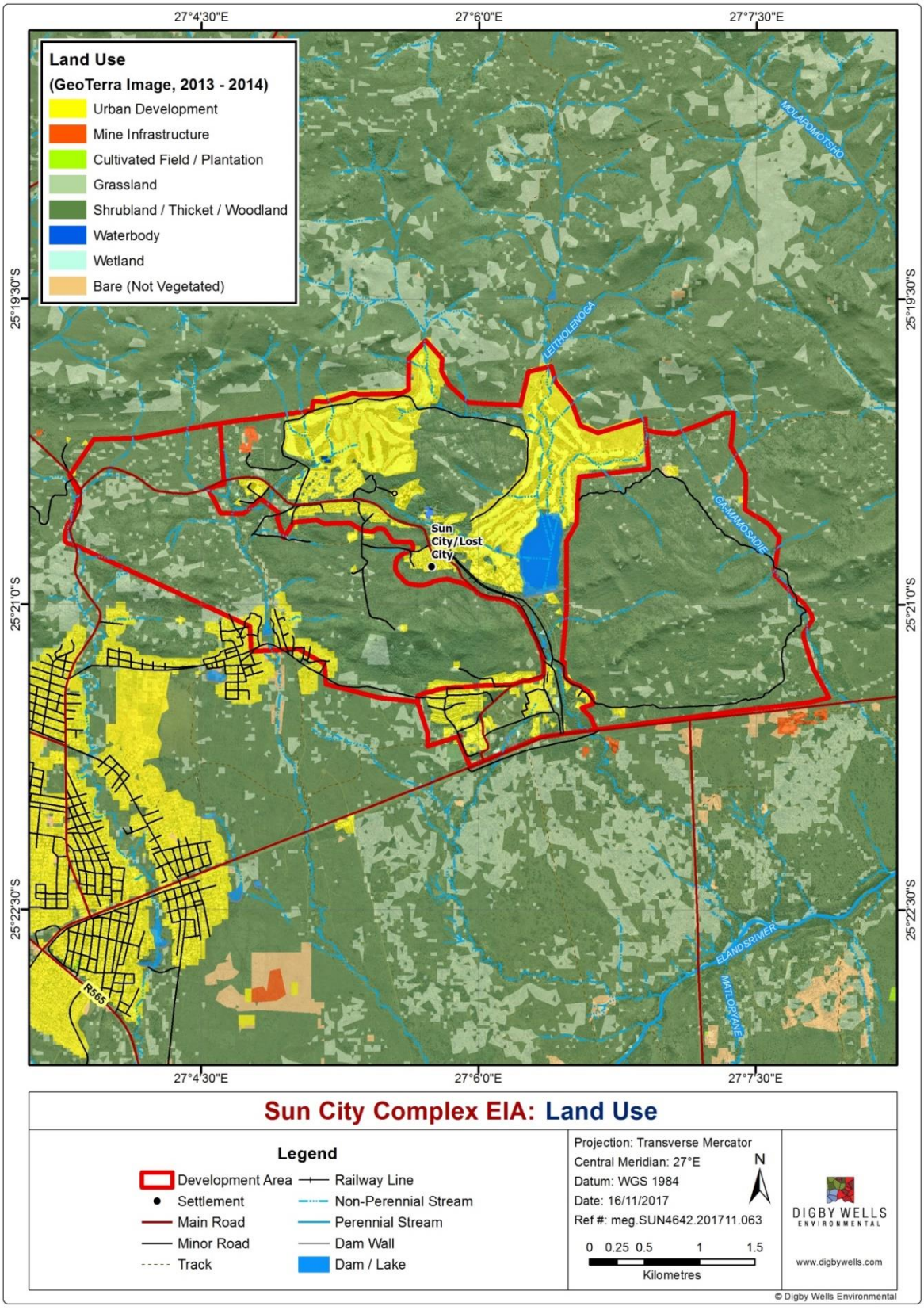

Figure 5-5: Land use map of the Sun City Complex

6 Soil Chemical and Physical Characteristics

A total of seven soil samples were collected from different proposed development areas (Figure 6-1). The objective of this section of the study was to characterise the soil physico-chemical properties assessed which included:

- Chemical properties (pH, organic carbon (OC), exchangeable bases and phosphorus); and
- Soil texture (clay, silt and sand).

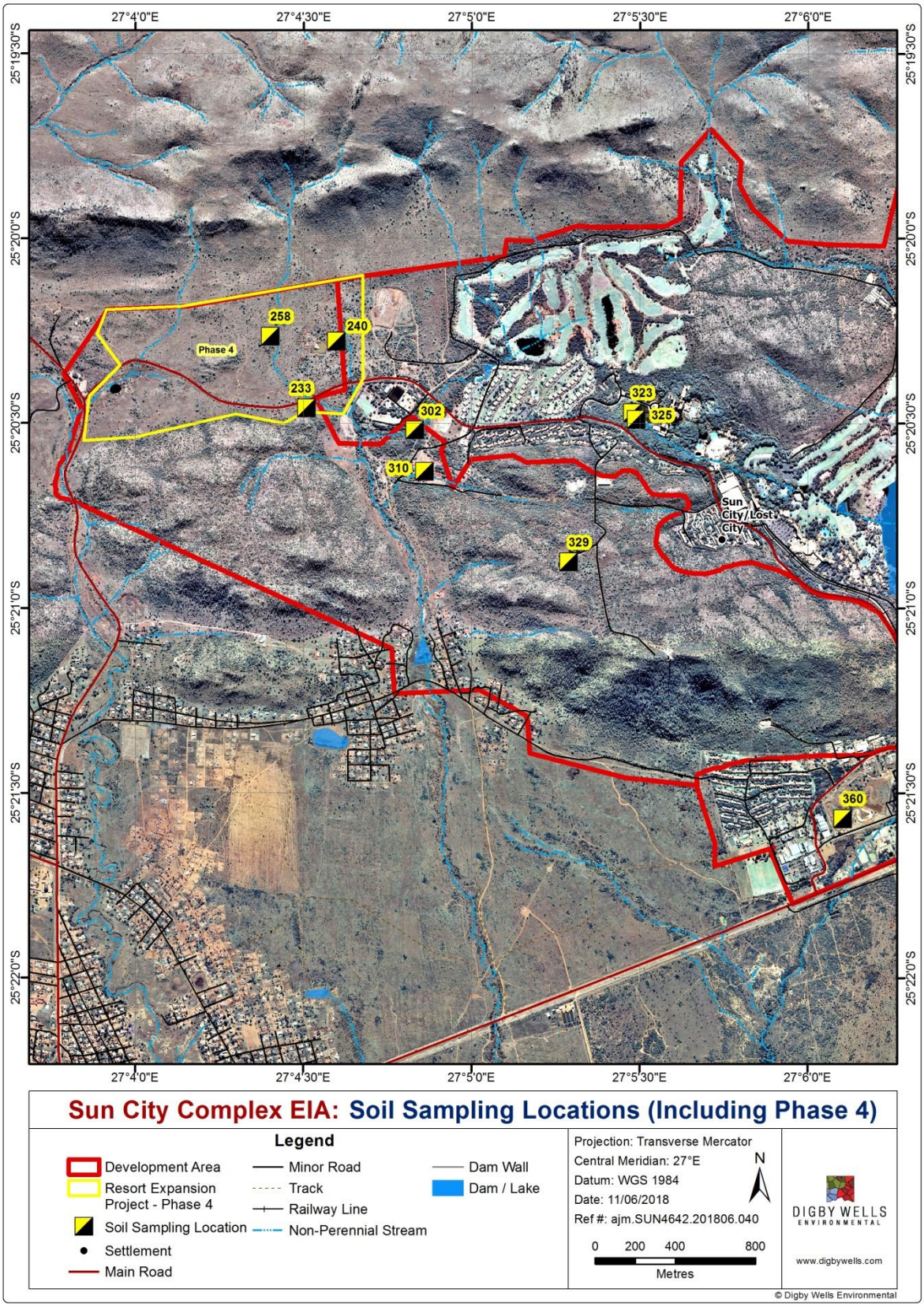

Figure 6-1: Soil sampling locations

The results of soil analysis are presented in Table 6-1 and as a basis for interpreting the data, some local soil fertility guidelines are presented in Table 6-2.

Table 6-1: Soil Physico-Chemical Properties

Land Ref	pH (KCl)	P (Bray1)	K	Na	Ca	Mg	S	Clay	Sand	Silt	Texture
		mg/kg						%			
233	4.86	1	141	20	801	157	9	11	73	16	Sandy Loam
240	4.72	2	312	72	1608	255	11	31	39	30	Clay Loam
258	4.81	1	197	19	625	179	7	31	59	10	Sandy Clay Loam
302-Top	6.0	1	98	47	1246	171	14	15	71	14	Sandy Loam
303-Sub	7.1	1	44	512	3468	171	51	27	48	25	Sandy Clay Loam
310	6.0	1	104	38	1373	145	21	15	72	13	Sandy Loam
323	7.6	7	193	207	2247	912	43	25	58	17	Sandy Clay Loam
325	7.3	2	299	199	3979	1629	50	39	41	20	Clay Loam
329	5.7	19	316	19	2263	265	18	15	71	14	Sandy Loam
360	7.0	11	151	85	4441	737	34	33	45	22	Clay Loam

Table 6-2: Soil Fertility Guidelines

Guidelines (mg per kg)					
Macro Nutrient			**Low**	**High**	
Phosphorus (P)			<5	>35	
Potassium (K)			<40	>250	
Sodium (Na)			<50	>200	
Calcium (Ca)			<200	>3000	
Magnesium (Mg)			<50	>300	
pH (KCl)					
Very Acid	**Acid**	**Slightly Acid**	**Neutral**	**Slightly Alkaline**	**Alkaline**
<4	4.1-5.9	6-6.7	6.8-7.2	7.3-8	>8

6.1 Soil pH

The soil pH is determined in the supernatant liquid of an aqueous suspension of soil after having allowed the sand fraction to settle out of suspension. Soil pH influences plant growth in the following manner:

- Through the direct effect of the hydrogen ion concentration on nutrient uptake;
- The mobilisation of toxic ions such as aluminium which restrict plant growth; and
- Indirect impacts that include the effect on trace nutrient availability.

The soil pH, ranged from 4.7 to 7.6, thus the soils are classified as acidic to slightly alkaline according to the guidelines (Table 6-2). Soil pH below 7 may be due to acidic nature of the parent material from which the soils were derived and also leaching of the nutrients. No addition of agricultural lime or gypsum would be required as the proposed areas are not used for agriculture.

6.2 Exchangeable Cations

The levels of the basic cations Ca, Mg, K and Na are determined in soil samples for agronomic purposes through extraction with an ammonium acetate solution. In general, the amounts of exchangeable cations normally follow the same trend as outlined for soil pH and texture. For most soils, cations follow the typical trend Ca>Mg>K>Na.

Calcium, magnesium and potassium levels in the soils were generally adequate for crop production and these nutrients were not limiting any production or considered as toxic. There is no need to add Ca, K and Mg sources as they might suppress levels of potassium during nutrient uptake by plants.

Sodium levels in soils are low to high and high levels of sodium could lead to decrease in plant growth and development. Soil dispersion is likely to occur and can cause dense structure and drainage problems.

6.3 Phosphorus

The soil phosphorus levels at the proposed site are very low which may be due to phosphorus fixation and the acidic nature of the soil. Phosphorus fertilisation would be required to establish good crop stand and growth, should agricultural activities have taken place over the area. An application of excess phosphorus would lead to long-term improvement in soil fertility.

6.4 Soil Organic Carbon

Soil organic carbon provides an indication of organic matter content in a soil. Levels above 2 to 3% organic carbon are considered moderate to high according to du Preez *et al* (2010). The soil organic carbon content of the soils on the proposed area ranged from 0 to 1.5% and levels below 2% would require an external nutrient input source.

6.5 Soil Texture

The particle size distribution of the soil sampled in the Project area was classed into the percentages of sand, silt and clay present. The textural classes were obtained from plotting the three fractions on a textural triangle (Figure 4-2). The soils can be described as texturally variable containing a mixture of sandy loam, clay loam and sandy clay loam (Figure 6-2).

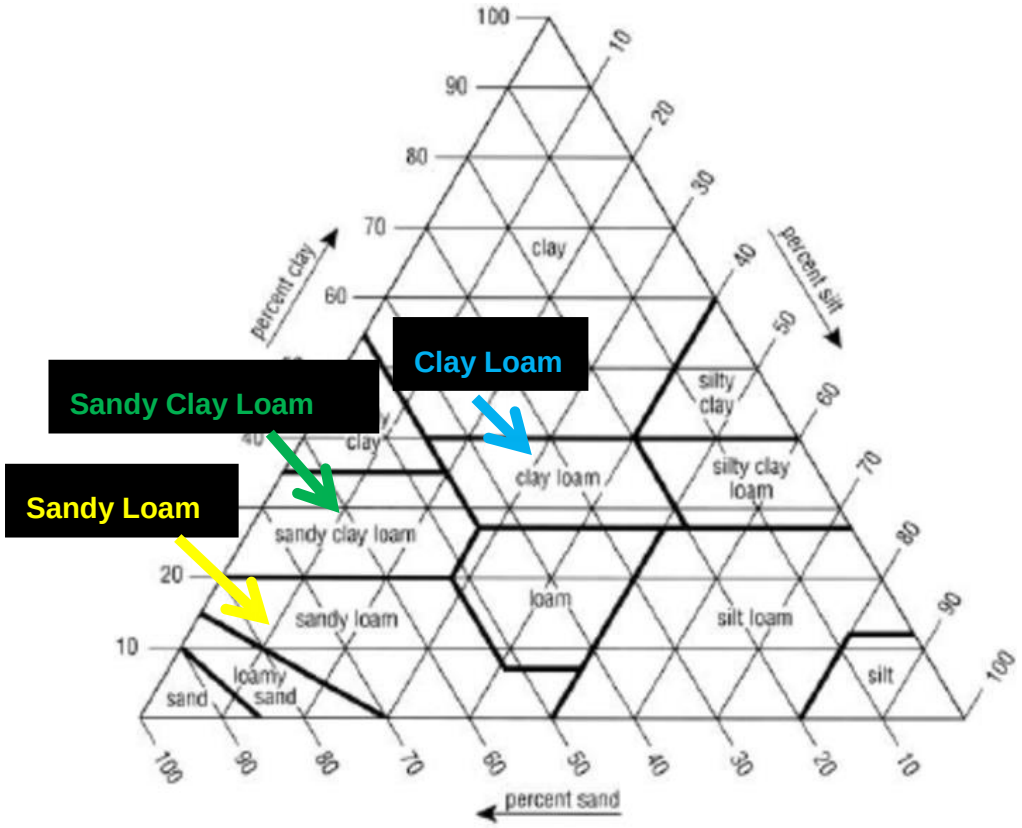

Figure 6-2: Soil Textural Diagram

7 Sensitivity of the Site

Wetland soils, permanent wetland areas and dams should not be disturbed by the infrastructure development activities (Figure 7-1).

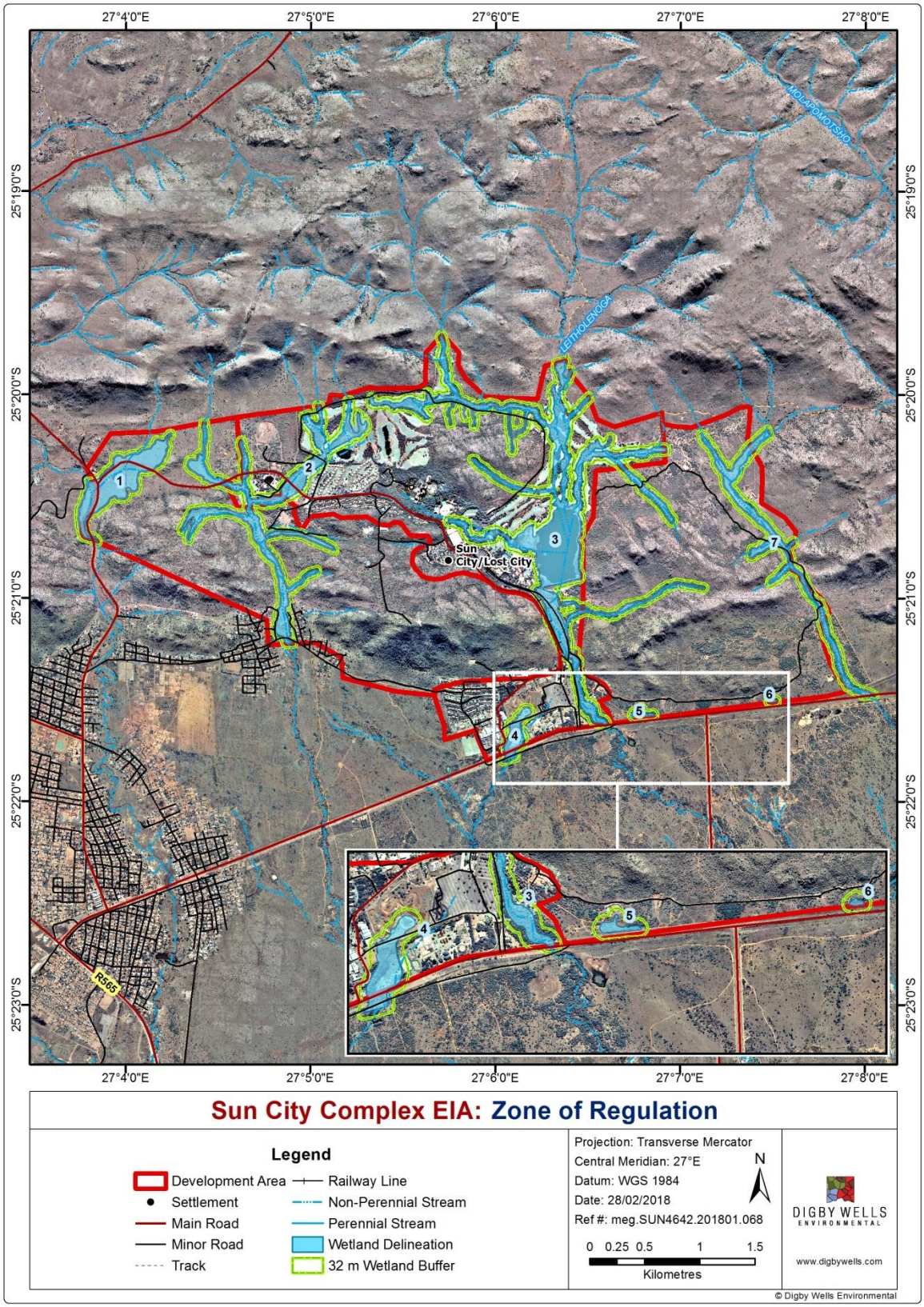

Figure 7-1: Wetland Areas and 32 m Buffer Zone

8 Assumptions, Limitations and Knowledge Gaps

The following assumptions and limitations have been made:

- The information provided in this report is based on information gathered from the site visit undertaken in November 2017;
- A total of ten (10) soil samples were collected on the proposed infrastructure areas;
- The information contained in this report is based on auger points taken and observations on site; and
- The area surveyed was based on the layout presented by the client.

9 Potential Impacts

The impacts associated with the proposed infrastructure development are the disturbance of the naturally occurring vegetation and soil profile consisting of soil horizons. The impact on the soil is medium because the vegetation will be cleared and topsoil will be disturbed and/or removed during the construction phase. The impacts on soils associated with the proposed infrastructure development can be split up into the following:

- Potential impacts on soil:
  - The removal of vegetation may lead to soil erosion by wind and water movement over the soil surface;
  - Soil compaction in areas where construction will take place; and
  - Chemical soil pollution may occur as a result of oil and fuel spills.

10 Impact Assessment

10.1 Soil, Land Capability and Land Use Impact Assessment

The impact on soils and agricultural potential will be limited to the immediate area or site of development.

10.1.1 Construction Phase

The impacts to consider are those relating to the disturbance of the natural soil on site. During the clearing of vegetation, topsoil will be removed. Construction vehicles will drive on the soil surface during the construction phase, thereby causing compaction of the soils. This reduces infiltration rates and ability for plant roots to penetrate the compacted soil.

Vegetation cover will be reduced and runoff potential will be increased. The increased runoff potential will lead to increased erosion hazards. Soils should be handled with care from the construction through to the operational phase. There will be no loss of land capability as the soils have low agricultural potential.

10.1.1.1 Impact Description: Loss of Topsoil as Resource

Topsoil will be removed from a soil profile; the profile loses effective rooting depth, water holding capacity and soil fertility. Soil will be susceptible to erosion because vegetation will be cleared before construction takes place at the proposed project area(s). Soil will be susceptible to compaction from construction equipment and vehicles. Soil compaction reduces ability of plants to absorb water due to soil pores being decreased, reduces water infiltration rate and bulk density increases. If topsoil will be stockpiled, it should not be 2 m high and no vehicles should driver over it.

10.1.1.2 Impact Description: Loss of land capability and land use

When topsoil is removed from the proposed infrastructure areas, the land capability is reduced to nothing and land use will change. There is a potential of topsoil degradation.

10.1.1.3 Management Actions and Targets

Management actions and targets include the following:

- Ensure proper storm water management designs are in place;
- If possible topsoil should be removed when the soil is dry, to reduce compaction;
- If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place; and
- Only the designated access routes are to be used to reduce any unnecessary compaction of soil.

Soils should be handled with care from the construction phase throughout to the project life cycle.

10.1.1.4 Impact Ratings

The construction phase impacts are rated Table 10-1, **Error! Reference source not found.** and Table 10-2.

Table 10-1: Potential Impacts for the Loss of Topsoil as a Resource

Dimension	Rating	Motivation	Significance
Impact Description: Loss of topsoil due to land clearing leading to possible erosion and compaction			
Prior to Mitigation/Management			
Duration	3	Topsoil will be removed in preparation of the foundations for proposed expansions and impact is not more than 10 years	Minor (negative) - 32
Extent	3	Impact is limited to the development site area	

Dimension	Rating	Motivation	Significance
Intensity	2	Moderate loss of topsoil and damage of physical resources during construction	
Probability	4	Loss of topsoil will probably occur during construction	
Nature	Negative		
Mitigation/Management Actions			
▪ If possible, topsoil should be stripped during dry months, to reduce compaction ▪ Only clear vegetation when and where necessary; ▪ Only remove topsoil when and where necessary; ▪ Only the designated access routes are to be used; ▪ Re-vegetation must take place immediately once construction is complete to minimise soil loss due to erosion; ▪ Erosion must be controlled by appropriate erosion control techniques including the use of sand bags, organic material; ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion from taking place; and ▪ Ensure proper storm water management designs are in place.			
Post-Mitigation			
Duration	2	Impact will be less than 5 years if mitigation measures are implemented	Negligible (negative) - 18
Extent	2	Loss of topsoil will occur within and around the project site	
Intensity	2	Loss of topsoil may result in degradation	
Probability	3	If mitigation measures are followed the impact will be lower	
Nature	Negative		

Table 10-2: Potential Impacts for the Loss of Soil as a result of Pipeline Construction

Dimension	Rating	Motivation	Significance
Activity and Interaction: Pipeline route, site clearing and construction			
Impact Description: Loss of topsoil resources as a result of construction of pipeline route through compaction and erosion. Topsoil will be removed during the construction phase.			
Prior to Mitigation/Management			
Duration	5	Pipeline will be in place for the duration of the project.	Minor (negative) - 66

Dimension	Rating	Motivation	Significance
Extent	2	Loss of topsoil (compaction and erosion) will occur within the pipeline route.	
Intensity	4	Loss of usable topsoil as pipelines will be constructed	
Probability	6	By excavating the soil it will certainly impact on the soil	
Nature	Negative		
Mitigation/Management Actions			
▪ Only clear vegetation where the infrastructure will be developed and avoid cultivated areas where feasible; ▪ Only the designated access routes are to be used; and ▪ If erosion occurs, corrective actions must be taken to minimise any further erosion from taking place.			
Post-Mitigation			
Duration	2	Impact on soils will be less than a year if mitigation measures are implemented	Negligible (negative) -18
Extent	2	Loss of soil (compaction and erosion) will only occur within project area	
Intensity	2	Impact will be reduced if mitigation measures are implemented	
Probability	3	Impact will occur and can be reduced if mitigation measures are implemented.	
Nature	Negative		

10.1.2 Operational Phase

During the operational phase, erosion and compaction of all exposed areas are the major impacts to consider. The access road along the pipeline route will also be used to carry out maintenance on the raw water pipeline.

10.1.2.1 Impact Ratings

The operational phase impacts are rated Table 10-3.

Table 10-3: Maintenance of the Pipeline Route

Dimension	Rating	Motivation	Significance
Activity and Interaction: Pipeline routes			

Dimension	Rating	Motivation	Significance
Impact Description: The maintenance and inspections of the pipeline route will cause a loss of topsoil as a resource through erosion and compaction.			
Prior to Mitigation/Management			
Duration	5	When the soil has eroded the impact will be permanent and is potentially irreversible	Minor (negative) - 30
Extent	2	Compaction and erosion will occur on a limited scale	
Intensity	3	Impact will be reduced if mitigation measures are implemented	
Probability	3	Impact is unlikely to occur if mitigation measures are implemented	
Nature	Negative		
Mitigation/Management Actions			
▪ Maintenance and inspections on the pipeline route must be done on to minimise compaction and erosion			
Post-Mitigation			
Duration	2	Impact on soil can be less than a year if mitigation measures are implemented	Negligible (negative) - 14
Extent	2	Compaction and erosion will occur on a very limited scale	
Intensity	3	Intensity of the impact on soils will be reduced if mitigation measures are implemented	
Probability	2	Impact will rarely occur if mitigation measures are followed	
Nature	Negative		

10.2 Unplanned events and low risks

There is a risk of accidental spillages of hazardous substances, for example hydrocarbons or oils from vehicles or other construction machineries and from waste storage facilities during construction.

Contamination is the result of accidental leakage of oils and hydrocarbons from equipment used and it must be ensured that the requirements of South African legislation are met for minimisation of pollution.

10.2.1 Emergency Procedures

Hydrocarbon spills or leaks can occur; therefore emergency procedures are needed to be put in place for remediation.

- Contractors must ensure that all employees are aware of the procedure for dealing with spills and leaks and undergo training on site;
- Ensure that emergency spill equipment is available;
- All machines are to be serviced and refuelled in demarcated bunded areas, workshops or at appropriate off-site locations;
- If a significant (> 5L) spill occurs, it is to be cleaned up immediately, reported to the appropriate authorities and recorded; and
- Contaminated soils must be disposed in a registered and licensed Waste Land Facility.

Table 10-4: Unplanned Events, Low Risks and their Management Measures

Unplanned event	Potential impact	Mitigation/Management/Monitoring
Hydrocarbon leaks from vehicles and machinery or hazardous materials	Soil Contamination	▪ Place drip trays where the leak is occurring if vehicles are leaking; ▪ All vehicles are to be serviced in a correctly concrete area or at an off-site location; and ▪ Machines must be parked within hard park areas and must be checked daily for fluid leaks.
Hazardous substance spillage from pipelines or waste storage	Soil Contamination	▪ Prevent any spills from occurring; ▪ If a spill occurs it is to be cleaned up (Drizit spill kit/Zupazorbtype spill kit, oil or chemical spill kit) immediately and reported to the appropriate authorities; ▪ Pipelines must be checked regularly for leaks; ▪ Pipelines must be maintained; and ▪ Emergency response plans are in place.

11 Mitigation and Management Measures

The following management actions and targets are necessary for the proposed development areas:

- If erosion has occurred, usable soil should be sourced and replaced and shaped to reduce the recurrence of erosion;
- Only the designated access routes are to be used to reduce any unnecessary compaction;
- Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated;
- Usable soil is to be moved when the soil is dry, as to reduce compaction;
- Soil erosion might pose a problem once vegetation cover is removed, thus erosion monitoring should take place especially for soils that have high erosion potential;
- For major spills, if soils are contaminated they must be stripped and disposed of at a licensed waste disposal site; and
- In the event of a hydrocarbon spill, the spill must be cleaned up immediately to prevent further pollution.

11.1 Summary of Mitigation and Management

Error! Reference source not found. provides a description of the mitigation and management options for the environmental impacts anticipated during the construction, operational and post-construction/operational phases.

Table 11-1: Soil, Land Capability and Land Use Mitigation and Management Plan

Activities	Phase	Impact	Size and scale of disturbance	Mitigation Measures	Compliance
Site clearing and topsoil removal	Construction	Loss of topsoil, compaction and erosion	Infrastructure footprint	▪ Ensure proper storm water management designs are in place. ▪ Only the designated access routes are to be used to reduce unnecessary compaction. ▪ If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place. ▪ If possible topsoil removal should occur during dry months as to reduce compaction.	National Environmental Management Act 107 of 1998 Conservation of Agricultural Resources Act 43 of 1983
Site clearing and topsoil removal	Construction	Contamination of soil	Infrastructure footprint	▪ Emergency spillage response plan must be in place. ▪ Spill kits should be in place and accessible to the responsible monitoring team. ▪ Waste management plan must be in place throughout the project life cycle. ▪ Ensure that building rubble and all waste material is removed off and disposed of at an appropriate facility.	National Environmental Management Act 107 of 1998 National Environmental Management Act: Waste Act 59 of 2008
Monitoring	Post-construction/ operational		Infrastructure footprint	▪ Disturbed areas must be rehabilitated and be assessed once every 6 months for compaction and erosion. ▪ Compacted areas must be ripped to loosen the soil structure.	National Environmental Management Act 107 of 1998 Conservation of Agricultural Resources Act 43 of 1983

12 Monitoring Requirements

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented together with ensuring effectiveness of the management measures in place.

12.1 Supervision and Contractor Management

A very important aspect is the supervision and monitoring during construction and operational phase. The following should be observed when clearing and removing topsoil:

- Close supervision will ensure that soils are not being stripped or removed incorrectly;
- Environmental officer is responsible to determine effectiveness of the erosion control structures; and
- Contractor is responsible to undertake the clearing of vegetation and removing of topsoil.

12.2 Monitoring Requirements

The following items should be monitored continuously:

- Soils:
  - Erosion status;
  - Compaction;
  - Runoff; and
  - Contamination.
- Vegetation:
  - Vegetation cover; and
  - Species diversity.

The following maintenance is required:

- Repair any damage caused by erosion;
- Traffic should be limited where possible while the vegetation is establishing;
- The area must be fenced and animals should be kept off the area until the vegetation is self-sustaining;
- Fertilize grassed area with nitrogen containing fertiliser after germination of seeds;
- If soil is polluted, treat the soil by means of *in-situ* bio-remediation; and
- If *in-situ* treatment is not possible then the polluted soil must be classified according to the Minimum Requirements for the Handling, Classification and Disposal of

Hazardous Material and disposed at an appropriate, permitted or licensed disposal facility.

13 Conclusion and Recommendation

The proposed development area is dominated by the land type Ae64 and Ib115. The land capability is dominated by the Class VI and VIII, while the land uses within the proposed development area is urban development.

The pH of the soils was acidic to slightly alkaline. Exchangeable cations (calcium, potassium and magnesium) are available at adequate levels. Phosphorus levels were low. The soil texture was classified as sandy clay loam, sandy loam and clay loam.

The impact on soil is low to moderate, if mismanaged. The impacts associated with the proposed development on soils include:

- Loss of topsoil during clearing of vegetation;
- Erosion due to exposed soil surfaces;
- Compaction of soils due to construction vehicles; and
- Soil contamination through hydrocarbon spills.

The findings of the proposed development will result in:

- Low risk of loss of soil due to erosion and compaction; and
- Hydrocarbon spills pose a low risk at the proposed development areas.

The major consideration during construction of the infrastructure is to restrict the soil disturbance or removal to the site composed of rock outcrops, shallow Mispah soils.

The following recommendations are made to minimise the impact on the soils:

- Runoff must be controlled and managed by use of proper storm water management facilities;
- Fuel and oil spills are common, remediate using commercially available emergency clean up kits; and
- Clearing and removal of soils should be done during dry moths (May to September) to reduce erosion and compaction on soils.

14 Reasoned opinion of the specialist

The proposed expansion projects falls within already disturbed areas of urban development within the Sun City Complex. The land capability is low (light cultivation/grazing/wildlife) due to composition of rock outcrops, shallow Mispah and Glenrosa resulting in poor effective depth. Also available grazing land will not support viable economic crop and livestock production.

Soil management measures should be followed as outlined in this report and land needs to be rehabilitated to prevent possible soil erosion and compaction. It is therefore of my opinion that this project is feasible and could be authorised. It is highly recommended that wetland areas and dams should be not disturbed as they have a valuable natural asset, especially within the Pilanesberg area.

Soil management measures and monitoring requirements as set out in this report should form part of the conditions of environmental authorisation and be included in the EMPr.

15 Consultation Undertaken

The Environmental Managers were contacted prior to the soil survey and on the 1st day of the site visit. This was to obtain the required permission to enter the property and explain the purpose of the study.

16 Comments and Responses

No comments or concerns have been received relating to soil from any registered Interested and Affected Parties. This section will be updated once the comments have been received.

17 References

Land Type Survey Staff. 1972 – 2006. Land Types of South Africa: Digital Map (1:250 000) and soil inventory databases. Agricultural Research Council – Institute for Soil, Climate and Water, Pretoria.

SASA. 1999. Identification & management of the Soils of the South African Sugar Industry. Mount Edgecombe: South African Sugar Association Experiment Station.

Schoeman, J.L., van der Walt, M., Monnik, K.A., Thackrah, A., Malherbe, J., and Le Roux, R.E. 2000. The Development and Application of Land Capability Classification System for South Africa. ARC – Institute for Soil, Climate and Water. Pretoria: ARC-ISCW REPORT No. GW/A/2000/57.

Soil Classification of Working Group. 1991. Soil Classification A Taxonomic System for South Africa. Pretoria: The Department of Agricultural Development.

Appendix A: CV

Mr Siphamandla Madikizela

Soil Scientist

Closure and Rehabilitation Services

Digby Wells Environmental

Education

- 2012 – 2014: MSc in Soil Science – University of KwaZulu-Natal.
- 2011 – 2011: BSc Honours in Soil Science – University of KwaZulu-Natal.
- 2008 – 2010: BSc in Hydrology and Soil Science – University of KwaZulu-Natal.

Employment

- March 2016 – Present: Digby Wells Environmental - Soil Scientist.
- August 2013 – March 2016: EcoPlanet Bamboo (Pty) Ltd - Assistant Plantation Manager.
- 2010 – 2013: University of KwaZulu-Natal - Student demonstrator (2nd and 3rd years majoring in Soil Science).
- 2012: Jeffares & Green Consulting Company - Field Assistant.

Experience

Siphamandla Madikizela is a Soil Scientist and completed his MSc in Soil Science at University of KwaZulu-Natal. Prior to his employment at Digby Wells, Siphamandla worked as an Assistant Plantation Manager for EcoPlanet Bamboo southern Africa. He joined Digby Wells in March 2016 and is part of the Terrestrial and Mine Department. His role involved conducting soil surveys, soil contamination assessment, and identification of soil forms, interpreting results of soil samples, land use and land capability environmental impact assessments and writing detailed scientific reports.

Project Experience

- Scoping and Environmental Impact Reporting for Proposed Palmietkuilen Colliery near Springs – Canyon Resources (Pty) Ltd – Soil Scientist.
- Scoping and Environmental Impact for an Environmental Authorisation Application in support of the Prospecting Right Applications – Anglo American Platinum Ltd – Soil Scientist.
- Scoping and Environmental Impact for Grootvlei TSF Reclamation Project - Ergo Mining (Pty) Ltd – Soil Scientist.

- Risk Assessment and Associated Water Use License Application for the Proposed KPSX Northern Bypass, in Mpumalanga – South32 SA Coal Holdings (Pty) Limited – Soil Scientist.
- Environmental and Social Impact Assessment Update for the Sadiola Sulphides Project (2016), Mali - Société d'Exploitation des Mines d'Or de Sadiola S.A – Soil Scientist.
- Environmental Impact Assessment for the proposed infrastructure expansion at Grootegeluk Coal Mine – Exxaro Reductants (Pty) Ltd – Soil Scientist.
- Gap analysis for the Environmental Authorisation for the Rietspruit Rehabilitation Project – South32 SA Coal Holdings (Pty) Ltd – Soil Scientist.
- Reviewing of the Soils, land capability and land use Environmental Impact Assessment for Hendrina Reserve – Glencore Operations South Africa (Pty) Ltd – Soil Scientist.
- Rehabilitation Guidelines for Sedibelo West – Sedibelo Platinum Mines Limited – Soil Scientist.
- Contamination Assessment for Konskilde Warehouse, Boksburg, Johannesburg, South Africa – EDF Fenice – Soil Scientist.
- Soil and Agricultural Potential Assessment for Training Facility and Firestation Project, Gauteng – Savannah Environmental (Pty) Ltd – Project Manager and Soil Scientist.
- Agricultural Potential Study, Gumu, Kibali, DRC – Randgold Resources – Project Manager and Soil Scientist.
- Basic Assessment for proposed Borrow Pits near Lephalale – Ledjadja Coal (Pty) Ltd – Soil Scientist.
- Klipspruit Environmental Management Programme Consolidation – South 32 SA Coal Holdings (Pty) Ltd – Soil Scientist.
- Extension on Farm Middelbult for the Universal Kangala Coal Mine – Universal Kangala Coal Mine – Soil Scientist.
- Soil, Land Capability and Land Use Assessment for Vaalkop Area, Mpumalanga – Sasol Mining (Pty) Ltd – Soil Scientist.

Research

- The Use of Hydrogel Application at Planting for *Bambusa Balcooa* Species at different rates – EcoPlanet Bamboo southern Africa – Assistant Plantation Manger.
- The Effect of Herbicide Application on *Bambusa Balcooa* – EcoPlanet Bamboo southern Africa – Assistant Plantation Manager.

- The Effect of Plastic Mulch on Growth and Yield on *Bambusa Balcooa* - EcoPlanet Bamboo southern Africa – Assistant Plantation Manager.
- Effect of Nitro-S fertilizer on growth and yield of *Bambusa Balcooa* and *Oxytenanthera Abyssinica.*

Responsibilities

- Plant management including adaptive fertilizer applications, pest management and irrigation schemes.
- Managing daily operations including the oversight of large staff teams of unskilled and semi-skilled workers, scheduling of operations and maintenance of farm equipment.
- Managing a schedule of community development activities
- Managing weekly activities in the nursery, including staff and overseeing the arrival and transplanting of new plants.
- Tracking and recording productivity data of the general workers and prepare the weekly KPI's for the corporate office.
- Adherence to international certification standards, in particular the Forest Stewardship Council (FSC), through plantation planning and administrative work.

Short Courses

- Certificate of Attendance: Wild Fire Suppression – Proto team (1-2 June 2015, Bathurst, Port Alfred).
- Certificate of Attendance: Basic Labour Relations (2 September 2015, Cape Town).
- Certificate of Attendance: Conflict Management Workshop (26 October 2015, Port Elizabeth).
- Certificate of Completion: Technical Report Writing (21 & 22 November 2016)
- Current: Project Management

Professional Affiliations

Soil Science Society of South Africa (SSSA).

Professional Registration

- 2017: Registered as a Professional Natural Scientist with The South African Council for Natural Scientific Professions. Registration number: 400154/17.

Appendix B: Laboratory Results

AGRICULTURAL SERVICES

SOIL ANALYSIS REPORT

CERTIFICATE OF ANALYSIS

Customer : Digby Wells

Certificate Number : AGRI 11_17-0277-0

Report date : 2017/12/08

CN : AGRI 11_17-0277-0				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	Cmol H+/Kg Soil	%	%	%	%	Calculation	Calculation	Calculation	Calculation	Calculation (Ca+ Mg+K+Na)	Calculation	Calculation (Ca+ Mg+K+Na+H)	g/ml	mg/kg	%	%	%	%	Digby Wells	
			S 003	S 007	S 009	S 009	S 009	S 009	*	*	*	*	*	*	*	*	*	*	*	*	S 003	*	*	*	*	*		
Batch Seq Number	Land Reference	Stikker No	pH (KCl)	PBray1	K	Na	Ca	Mg	Exchngeable acid	%Ca	%Mg	%K	%Na	Acid Saturation %	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Value	Na:K	CEC	Digtheid	S	Clay	Sand	Silt	C	Date Received	Date Reported
AGRI 11_17-0277-1		302 Top	5.95	1	98	47	1246	171	0.00	77.1	17.3	3.1	2.5	0.0	4.5	30.5	5.6	8.1	0.8	8.1	1.270	14.31	15	71	14	0.14	2017/11/30	2017/12/08
AGRI 11_17-0277-2		302 Sub	7.14	1	44	512	3468	171	0.00	82.2	6.7	0.5	10.6	0.0	12.3	167.1	12.5	21.1	19.9	21.1	1.209	51.22	27	48	25	0.35	2017/11/30	2017/12/08
AGRI 11_17-0277-3		310	5.95	1	104	38	1373	145	0.00	80.9	14.0	3.1	1.9	0.0	5.8	30.4	4.5	8.5	0.6	8.5	1.295	21.01	15	72	13	0.21	2017/11/30	2017/12/08
AGRI 11_17-0277-4		323	7.59	7	193	207	2247	912	0.00	55.9	37.2	2.5	4.5	0.0	1.5	37.9	15.1	20.1	1.8	20.1	1.016	43.30	25	58	17	0.78	2017/11/30	2017/12/08
AGRI 11_17-0277-5		325	7.31	2	299	199	3979	1629	0.00	57.0	38.3	2.2	2.5	0.0	1.5	43.4	17.4	34.9	1.1	34.9	0.950	50.48	39	41	20	0.35	2017/11/30	2017/12/08
AGRI 11_17-0277-6		329	5.71	19	316	19	2263	265	0.00	78.7	15.1	5.6	0.6	0.0	5.2	16.7	2.7	14.4	0.1	14.4	1.002	17.58	15	71	14	1.41	2017/11/30	2017/12/08
AGRI 11_17-0277-7		360	6.99	11	151	85	4441	737	0.00	76.6	20.8	1.3	1.3	0.0	3.7	73.3	15.7	29.0	1.0	29.0	1.092	34.06	33	45	22	0.11	2017/11/30	2017/12/08

T0627

Nelson Motlhako
Soil Section leader

Results marked as not SANAS accredited (*) in this report are not included in the SANAS Schedule of Accreditation for this laboratory. Measurement of uncertainty values are available upon request.

AGRICULTURAL SERVICES

Farm Elandsfontein
District Bapsfontein
Gauteng, South Africa

SOIL ANALYSIS REPORT

intertek
Total Quality. Assured.

Certificate Number : AGRI 05_18-0134-0
Report date : 2018/05/24

CERTIFICATE OF ANALYSIS

Customer : Digby Wells

CN : AGRI 05_18-0134-0				mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	Cmol H+/Kg Soil	%	%	%	%	Calculation	Calculation	Calculation	Calculation	Calculation (Ca+ Mg+K+Na)	Calculation	Calculation (Ca+ Mg+K+Na+H)	g/ml	mg/kg	%	%	%	Digby Wells	
			S 003	S 007	S 009	S 009	S 009	S 009	*	*	*	*	*	*	*	*	*	*	*	*	S 003	*	*	*	*		
Batch Seq Number	Land Reference	Stikker No	pH (KCl)	PBray1	K	Na	Ca	Mg	Exchngeable acid	%Ca	%Mg	%K	%Na	Acid Saturation %	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Value	Na:K	CEC	Digtheid	S	Clay	Sand	Silt	Date Received	Date Reported
AGRI 05_18-0134-1		233	4.86	1	141	20	801	157	0.00	69.8	22.5	6.3	1.5	0.0	3.1	14.7	3.6	5.7	0.2	5.7	1.316	8.61	11	73	16	2018/05/22	2018/05/24
AGRI 05_18-0134-2		240	4.72	2	312	72	1608	255	0.00	71.5	18.6	7.1	2.8	0.0	3.9	12.7	2.6	11.2	0.4	11.2	1.000	11.39	31	39	30	2018/05/22	2018/05/24
AGRI 05_18-0134-3		258	4.81	1	197	19	625	179	0.00	60.3	28.4	9.7	1.6	0.0	2.1	9.1	2.9	5.2	0.2	5.2	1.132	7.07	31	59	10	2018/05/22	2018/05/24

ilac-MRA
sanas Testing Laboratory
T0627

Nelson Motlhako
Soil Section leader

Results marked as not SANAS accredited (*) in this report are not included in the SANAS Schedule of Accreditation for this laboratory. Measurement of uncertainty values are available upon request.