APPENDIX C -
SPECIALIST IMPACT ASSESSMENTS

APPENDIX C1 -
AQUATIC IMPACT ASSESSMENT

N1 Section 16 Zandkraal (km33.8) to Winburg South (km78.0) upgrade in the Free State Province

AQUATIC IMPACT ASSESSMENT

FOR

SMEC

Bloemfontien

BY

EnviroSci (Pty) Ltd

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DATE

16 November 2020

REVISION 1

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ACRONYMS

CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Area
CSIR	Council for Scientific and Industrial Research
DWS	Department of Water and Sanitation formerly the Department of Water Affairs
EIS	Ecological Importance and Sensitivity
ESA	Ecological Support Area
GIS	Geographic Information System
NFEPA	National Freshwater Ecosystem Priority Atlas (Nel, *et al*. 2011).
PES	Present Ecological State
SANBI	South African National Biodiversity Institute
SQ	Subquaternary catchment
WUL	Water Use License
WULA	Water Use License Application

SPECIALIST REPORT DETAILS

Report prepared by: Dr. Brian Colloty Pr.Sci.Nat. (Ecology) / Member SAEIES.

Expertise / Field of Study: BSc (Hons) Zoology, MSc Botany (Rivers), Ph.D Botany Conservation Importance rating (Estuaries) and interior wetland / riverine assessment consultant from 1996 to present.

I, **Dr. Brian Michael Colloty** declare that this report has been prepared independently of any influence or prejudice as may be specified by the National Department of Environmental Affairs and or Department of Water and Sanitation.

Signed:…  ……………… Date:…16 November 2020…………

Appendix 1 of this report contains a detailed CV

1. Introduction

SMEC appointed EnviroSci (Pty) Ltd to conduct an aquatic impact assessment of the proposed borrow-pits and quarries required to supply materials for the N1 Section 16 Zandkraal (km33.8) to Winburg South (km78.0) upgrade (Figure 1). This included delineating any natural waterbodies, as well as assessing the potential consequences of the proposed activities (including access roads) on the surrounding wetlands and or watercourses. A site-specific visit was conducted in December 2018 and the survey adhered to the assessment criteria contained in the DWAF 2005 / 2008 delineation manuals and the National Wetland Classification System.

Several important national and provincial conservation plans were also reviewed, with the results of those studies being included in this report. Most conservation plans are produced at a high level, so it is therefore important to verify the actual status of the study area.

1.1 Aims and objectives

The aim of this report is to provide the applicant with the requisite delineation of any natural waterbodies, while providing the competent authorities with the relevant information to determine legislative requirements.

Certain aspects of the development will trigger the need for Section 21, Water Use License Applications (WULAs) (or general authorisation [GA] applications) such as watercourse crossings and or activities within 500m of a wetland boundary. These applications will be initiated with the Department of Water and Sanitation (DWS) and information contained in this report will be used as part of the supporting documentation.

Information about the state and function of the observed water bodies, suitable no-go buffers and assessment of the potential impacts are also provided.

1.2 Assumptions and Limitation

To obtain a comprehensive understanding of the dynamics of both the flora and fauna of the aquatic communities within a study site, as well as the status of endemic, rare or threatened species in any area, assessments should always consider investigations at different time scales (across seasons/years) and through replication. No long-term monitoring was undertaken as part of this assessment. However, a concerted effort was made to assess the entire site, as well as make use of any available literature, species distribution data and aerial photography. Furthermore, this area was also surveyed in an assessment undertaken in 2012/2014 by the report author (FiberCo projects) thus the lack on long term data is not seen as a huge limiting factor. The level of investigation undertaken is enough to inform this assessment.

It should be emphasised that information, as presented in this document, only has reference to the study area as indicated on the accompanying maps. Therefore, this information cannot be applied to any other area without detailed investigation.

For the purposes of this report it is assumed that water will be sourced from a licensed resource and not illegally abstracted from any surrounding watercourses.

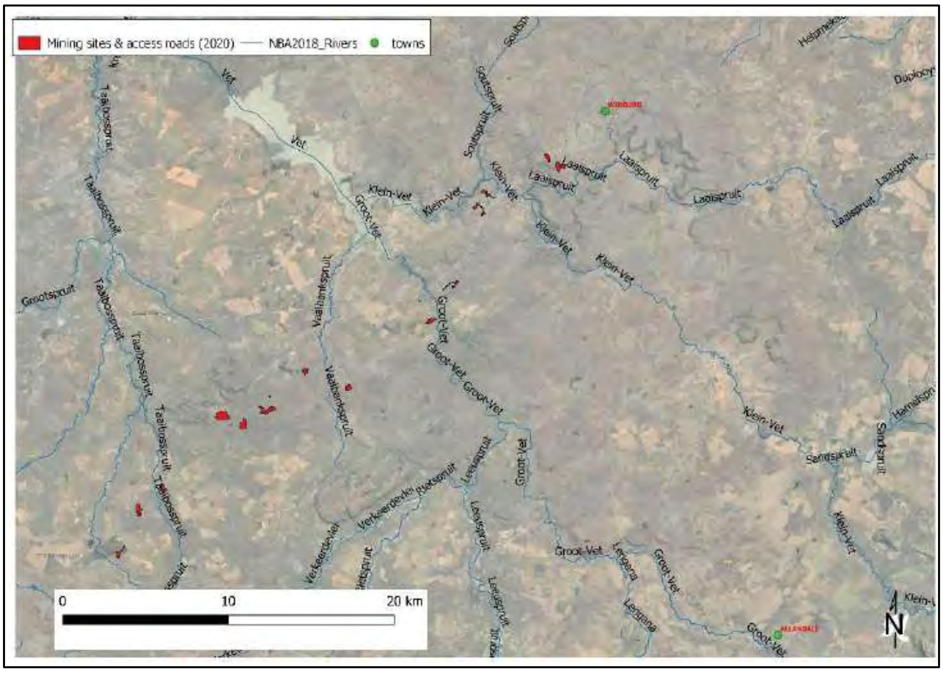

Figure 1: The mainstem rivers in study area with the respective borrow pit and quarries (red polygons) along the N1

2. Terms of Reference

The following scope of work was used as the basis of this study to fulfil the above requirements as provided by SMEC:

- Initiate the assessment with a review of the available information for the region and the proposed project, this will also include review of the proposed project in relation to any conservation plans or assessments known for the area, e.g. Critical Biodiversity Area maps, National Waterbody Inventory etc.
- Conduct a short site visit to inspect the surrounding waterbodies
- Determine the Present Ecological State of any waterbodies incl. wetlands, estimating their biodiversity, conservation importance with regard ecosystem services during the site visit using recognised PES / EIS assessment methods to determine the state, importance and sensitivity of the respective wetland / watercourse systems
- Prepare a map demarcating the respective watercourses or wetland/s, i.e. the waterbody, its respective catchment and other areas within a 500m radius of the study area. This will demonstrate, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the hydrological zone of influence while classifying the hydrogeomorphic type of the respective water courses / wetlands in relation to present land-use and their current state. The maps depicting demarcated waterbodies will be delineated to a scale of 1:10 000, following the methodology described by the DWS, together with an estimation of their functionality, Habitat Integrity (IHI), Wet-Ecoservices (Wet-Health) and Socio-Cultural Importance of the delineated systems, whichever is relevant to the systems
- Recommend buffer zones using the Macfarlane *et al*., 2015 approach to indicate any No-go / Sensitive areas around any delineated aquatic zones supported by any relevant legislation, e.g. any bioregional plans, conservation guidelines or best practice. Assess the potential impacts, based on a supplied methodology, including cumulative impacts and for pre-construction, construction, operations and decommissioning phases.
- Provide mitigations regarding project related impacts, including engineering services that could negatively affect demarcated wetland or water course areas.
- Supply the client with geo-referenced GIS shape files of the wetland / riverine areas with buffers
- Provide a separate Risk Assessment Matrix as per the DWS 2016 requirements to determine the Water Use License Application Requirements, i.e. indication of future permitting requirements.

3. Project Description

AS SUPPLIED BY SMEC

"The project is located on National Road 1 section 16, between Zandkraal (km 33.8) and Winburg (km 78.0), in a southern direction from Winburg town, Free State Province (Figure 1). The objective of this project is to obtain environmental authorisation for the borrow pits and quarries proposed by the proponent, and to register the water uses needed for construction.

The above material sources will be utilised for natural/crushed gravel for earthworks, layer works, asphalt and concrete layers, and thus require environmental authorisation. Dependant on the quantities and quality of each, it may be cost effective to source some, or all, materials from commercial sources. Asphalt and concrete aggregate may be sourced from the quarries, while gravel materials will be sourced from the borrow pits.

Due to the sizes of the material sources envisaged, a Full Scoping and EIA process, as per the National Environmental Management Act (NEMA) (Act No. 107 of 1998, as amended) Amended EIA Regulations (2017), was determined to be necessary and to be submitted to DMR. Use of water from local sources for construction will trigger the need for water use license applications in terms of Section 21a – water abstraction, to be submitted to Department of Water and Sanitation (DWS)."

4. Methodology

This study followed the approaches of several national guidelines with regards to wetland assessment. These have been modified by the author, to provide a relevant mechanism of assessing the present state of the study systems, applicable to the specific environment and in a clear and objective manner, assess the potential impacts associated with the proposed development. This was coupled to a site visit conducted late September 2018, after some rainfall and or snow falls and at the start of the growth season for most plants.

Current water resource classification systems make use of the Hydrogeomorphic (HGM) approach, and for this reason, the National Wetland Classification System approach will be used in this study. It is also important to understand wetland definition, means of assessing wetland conservation and importance as well as understanding the pertinent legislation with regards to protecting wetlands. These aspects will be discussed in greater depth in this section of the report, as they form the basis of the study approach to assessing wetland impacts.

4.1 Waterbody classification systems

Since the late 1960's, wetland classification systems have undergone a series of international and national revisions. These revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith *et al*., 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects. **Coupled to this was the inclusion of other criteria within the classification systems to differentiate between river, riparian and wetland systems, as well as natural versus artificial waterbodies.**

The South African National Biodiversity Institute (SANBI) in collaboration with several specialists and stakeholders developed the newly revised and now accepted National Wetland Classification Systems (Ollis *et al*., 2013). This system comprises a hierarchical classification process of defining a wetland based on the principles of the hydrogeomorphic (HGM) approach at higher levels, with including structural features at the finer or lower levels of classification (Ollis *et al*., 2013).

Wetlands develop in a response to elevated water tables, linked either to rivers, groundwater flows or seepage from aquifers (Parsons, 2004). These water levels or flows then interact with localised geology and soil forms, which then determines the form and function of the respective wetlands. Water is thus the common driving force, in the formation of wetlands (DWAF, 2005). It is significant that the HGM approach has now been included in the wetland classifications as the HGM approach has been adopted throughout the water resources management realm with regards to the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. All these systems are then easily integrated using the HGM approach in line with the Eco-classification process of river and wetland reserve determinations used by the Department of Water and Sanitation (DWS). The Ecological Reserve of a wetland or river is used by DWS to assess the water resource allocations when assessing WULAs

The NWCS process is provided in more detail in the methods section of the report, but some of the terms and definitions used in this document are present below:

Definition Box

Present Ecological State is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State/Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

EcoStatus is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas or wetland that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology and water quality).

Reserve: The quantity and quality of water needed to sustain basic *human needs* and *ecosystems* (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The *Ecological Reserve* pertains specifically to aquatic ecosystems.

Reserve requirements: The quality, quantity and reliability of water needed to satisfy the requirements of basic human needs and the Ecological Reserve (inclusive of instream requirements).

Ecological Reserve determination study: The study undertaken to determine Ecological Reserve requirements.

Licensing applications: Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment.

Ecological Water Requirements: This is the quality and quantity of water flowing through a natural stream course that is needed to sustain instream functions and ecosystem integrity at an acceptable level as determined during an EWR study. These then form part of the conditions for managing achievable water quantity and quality conditions as stipulated in the Reserve Template

Water allocation process (compulsory licensing): This is a process where all existing and new water users are requested to reapply for their licenses, particularly in stressed catchments where there is an over-allocation of water or an inequitable distribution of entitlements.

Ecoregions are geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. • NOTE: For purposes of the classification system, the 'Level I Ecoregions' for South Africa, Lesotho and Swaziland (Kleynhans *et al.* 2005), which have been specifically developed by the Department of Water Affairs & Forestry (DWAF) for rivers but are used for the management of inland aquatic ecosystems more generally, are applied at Level 2A of the classification system. These Ecoregions are based on physiography, climate, geology, soils and potential natural vegetation.

4.2 Wetland definition

Although the National Wetland Classification System (NWCS) (Ollis *et al*., 2013) is used to classify wetland types it is still necessary to understand the definition of a wetland. Terminology currently strives to characterise a wetland not only on its structure (visible form), but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" (Davis 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is recognised as the seaward boundary of the shallow photic zone (Lombard et al., 2005). An additional minor adaptation of the definition is the removal of the term 'fen' as fens are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows (Ollis *et al*., 2013):

WETLAND: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten metres. The only legislated definition of wetlands in South Africa, however, is contained within the National Water Act (Act No. 36 of 1998) (NWA), where wetlands are defined 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 adapted to life in saturated soil." This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the latter as a watercourse (Ollis *et al*., 2013). Table 1 below provides a comparison of the various wetlands included within the main sources of wetland definitions used in South Africa.

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. "wetlands", as defined by the NWA, together with open waterbodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands in order to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (Ollis *et al.*, 2013).

Wetlands must therefore have one or more of the following attributes to meet the above definition (DWAF, 2005):

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

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines and rivers.

Table 1: Comparison of ecosystems considered to be ‘wetlands’ as defined by the proposed NWCS, the NWA and ecosystems included in DWAF’s (2005) delineation manual.

Ecosystem	NWCS “wetland”	National Water Act wetland	DWAF (2005) delineation manual
Marine	YES	NO	NO
Estuarine	YES	NO	NO
Waterbodies deeper than 2 m (i.e. limnetic habitats often described as lakes or dams)	YES	NO	NO
Rivers, channels and canals	YES	NO[1]	NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	YES	YES	YES
Riparian[2] areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	YES	YES	YES[3]
Riparian [3] areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	NO	NO	YES[3]

Although river channels and canals would generally not be regarded as wetlands in terms of the National Water Act, they are included as a ‘watercourse’ in terms of the Act

[2] According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods and would be considered riparian wetlands, as opposed to non –wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.

[3] The delineation of ‘riparian areas’ (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF’s (2005) delineation manual.

4.3 National Wetland Classification System method

During this study, due to the nature of the wetlands and watercourses observed, it was determined that the newly accepted NWCS be adopted. This classification approach has integrated aspects of the HGM approach used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers.

The NWCS (Ollis *et al*., 2013) as stated previously, uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils & vegetation) stemming from the Cowardin approach (Ollis *et al.,* 2013).

The classification system used in this study is thus based on Ollis *et al*. (2013) and is summarised below:

The NWCS has a six-tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 2). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular system has with the open ocean (greater than 10 m in depth). Level 2 then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale.

This is opposed to specific attributes such as soils and vegetation. **Level 2** has adopted the following systems:

- Inshore bioregions (marine)
- Biogeographic zones (estuaries)
- Ecoregions (Inland)

Level 3 of the NWCS assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the hydrogeomorphic (HGM) units discussed earlier. The HGM units are defined as follows:

- Landform – shape and localised setting of wetland
- Hydrological characteristics – nature of water movement into, through and out of the wetland
- Hydrodynamics – the direction and strength of flow through the wetland

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for inland wetlands. Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the NWCS.

Level 6 uses six descriptors to characterise the wetland types based on biophysical features. As with Level 5, these are non-hierarchal in relation to each other and are applied in any order, dependent on the availability of information. The descriptors include:

- Geology;
- Natural vs. Artificial;
- Vegetation cover type;
- Substratum;
- Salinity; and
- Acidity or Alkalinity.

It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, and these are thus nested in relation to each other.

The HGM unit (Level 4) is the **focal point of the NWCS**, with the upper levels (Figure 3 – Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

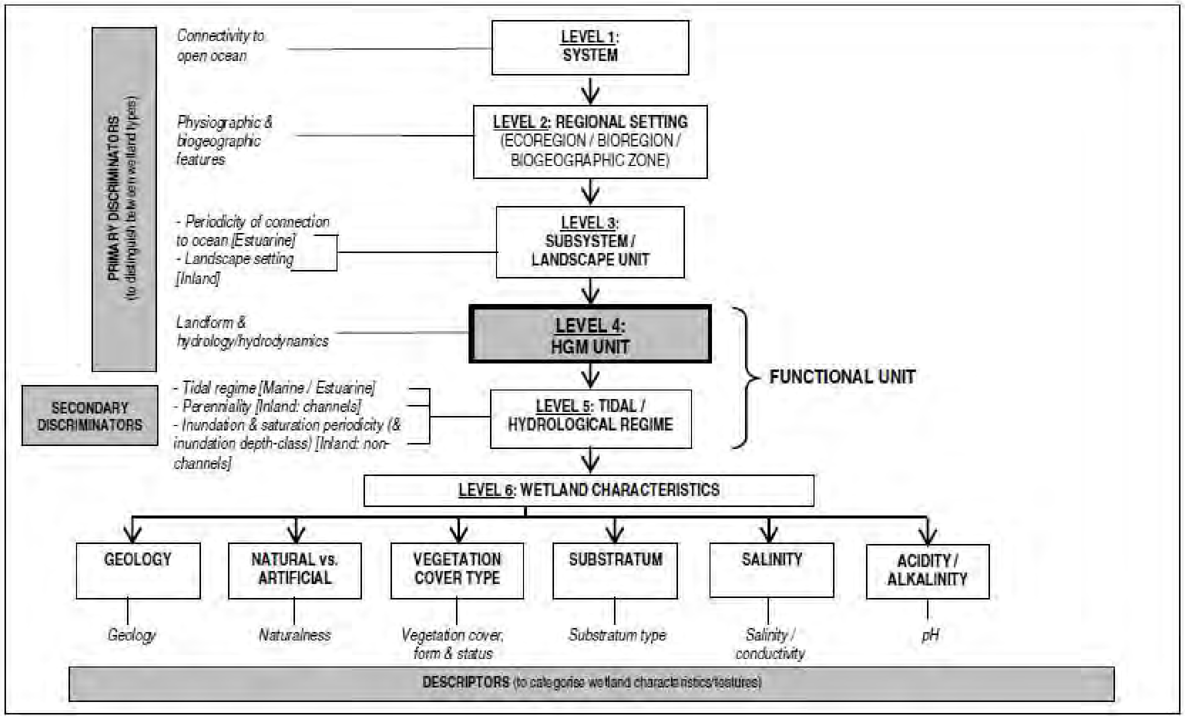

Figure 2: Basic structure of the NWCS, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From Ollis *et al*., 2013).

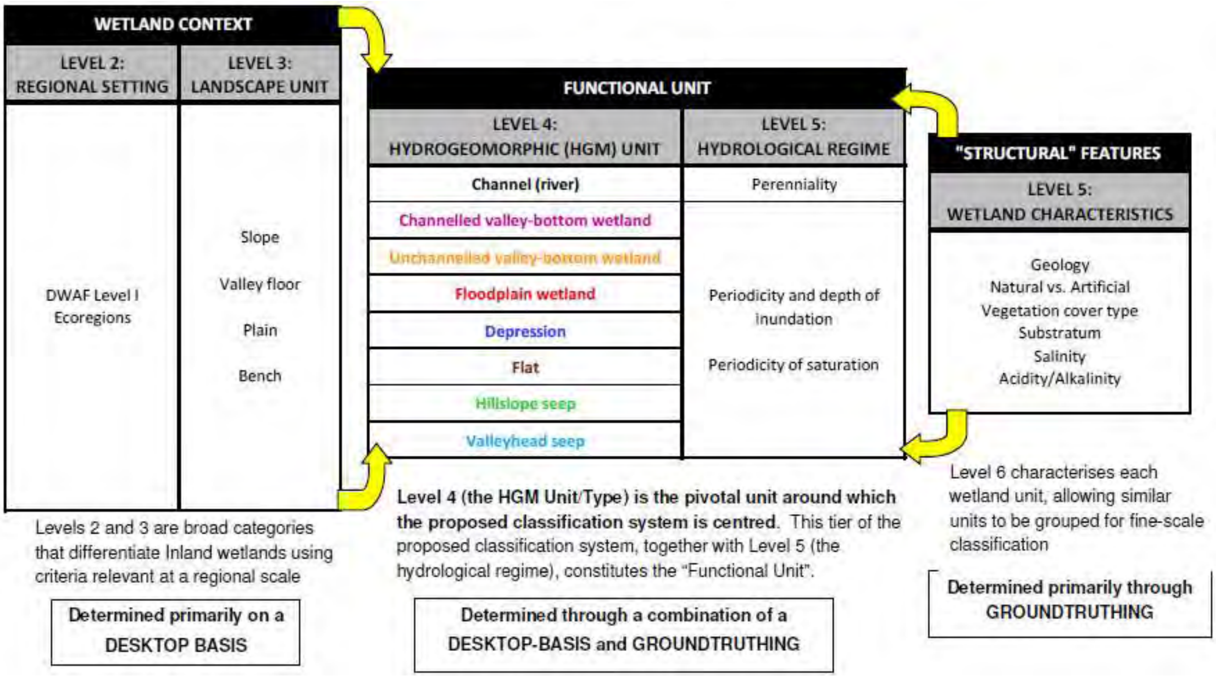

Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al*., 2013).

4.4 Waterbody condition

To assess the PES) or condition of the observed wetlands, a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A-F ecological categories (Table 2) and provide a score of the PES of the habitat integrity of the wetland system being examined. The author has included additional criteria into the model-based system to include additional wetland types. This system is preferred when compared to systems such as WET-Health – wetland management series (WRC 2009), as WET-Health (Level 1) was developed with wetland rehabilitation in mind and is not always suitable for impact assessments. This coupled with the degraded state of the wetlands in the study area, indicated that a complex study approach was not warranted, i.e. conduct a Wet-Health Level 2 and WET-Ecosystems Services study required for an impact assessment.

Table 2: Description of A – F ecological categories based on Kleynhans *et al*., (2005)

ECOLOGICAL CATEGORY	ECOLOGICAL DESCRIPTION	MANAGEMENT PERSPECTIVE
A	Unmodified, natural.	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	Some human-related disturbance, but mostly of low impact potential
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	**Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation**
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	**Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality**
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	

The WETLAND-IHI model is composed of four modules. The “Hydrology”, “Geomorphology” and “Water Quality” modules all assess the contemporary driving processes behind wetland formation and maintenance. The last module, “Vegetation Alteration”, provides an indication of the intensity of human landuse activities on the wetland surface itself and how these may have modified the condition of the wetland. The integration of the scores from these 4 modules provides an overall PES score for the wetland system being examined. The WETLAND-IHI model is an MS Excel-based model, and the data required for the assessment are generated during a site visit.

Additional data may be obtained from remotely sensed imagery (aerial photos; maps and/or satellite imagery) to assist with the assessment. The interface of the WETLAND-IHI has been developed in a format which is similar to DWA’s River EcoStatus models which are currently used for the assessment of PES in riverine environments.

4.5 Aquatic ecosystem importance and function

South Africa is a Contracting Party to the Ramsar Convention on Wetlands, signed in Ramsar, Iran, in 1971, and has thus committed itself to this intergovernmental treaty, which provides the framework for the national protection of wetlands and the resources they could provide. Wetland conservation is now driven by the South African National Biodiversity Institute, a requirement under the National Environmental Management: Biodiversity Act (No 10 of 2004).

Wetlands are among the most valuable and productive ecosystems on earth, providing important opportunities for sustainable development (Davies and Day, 1998). However, wetlands in South Africa are still rapidly being lost or degraded through direct human induced pressures (Nel *et al.,* 2004).

The most common attributes or goods and services provided by wetlands include:

- Improve water quality;
- Impede flow and reduce the occurrence of floods;
- Reeds and sedges used in construction and traditional crafts;
- Bulbs and tubers, a source of food and natural medicine;
- Store water and maintain base flow of rivers;
- Trap sediments; and
- Reduce the number of water-borne diseases.

In terms of this study, the wetlands provide ecological (environmental) value to the area acting as refugia for various wetland associated plants, butterflies and birds.

In the past wetland conservation has focused on biodiversity as a means of substantiating the protection of wetland habitat. However not all wetlands provide such motivation for their protection, thus wetland managers and conservationists began assessing the importance of wetland function within an ecosystem.

Table 3 below summarises the importance of wetland function when related to ecosystem services or ecoservices (Kotze *et al*., 2008). One such example is emergent reed bed wetlands that function as transformers converting inorganic nutrients into organic compounds (Mitsch and Gosselink, 2000).

Table 3: Summary of direct and indirect ecoservices provided by wetlands from Kotze *et al*., 2008

Ecosystem services supplied by wetlands	Indirect benefits	Hydro-geochemical benefits		Flood attenuation
				Stream flow regulation
			Water quality enhancement benefits	Sediment trapping
				Phosphate assimilation
				Nitrate assimilation
				Toxicant assimilation
				Erosion control
				Carbon storage
				Biodiversity maintenance
	Direct benefits			*Provision of water for human use*
				Provision of harvestable resources[2]
				Provision of cultivated foods
				Cultural significance
				Tourism and recreation
				Education and research

Conservation importance of the individual wetlands was based on the following criteria:

- Habitat uniqueness;
- Species of conservation concern;
- Habitat fragmentation or rather, continuity or intactness with regards to ecological corridors; and
- Ecosystem service (social and ecological).

The presence of any or a combination of the above criteria would result in a HIGH conservation rating if the wetland was found in a near natural state (high PES). Should any of the habitats be found modified the conservation importance would rate as MEDIUM, unless a Species of Conservation Concern (SCC) was observed, in which case it would receive a HIGH rating. Any system that was highly modified (low PES) or had none of the above criteria, received a LOW conservation importance rating. Wetlands with HIGH and MEDIUM ratings should thus be excluded from development with incorporation into a suitable open space system, with the maximum possible buffer being applied. Natural wetlands or Wetlands that resemble some form of the past landscape but receive a LOW conservation importance rating could be included into stormwater management features, and should not be developed to retain the function of any ecological corridors.

4.6 Relevant wetland / riverine related legislation and policy

Locally the South African Constitution, seven (7) Acts and two (2) international treaties allow for the protection of wetlands and rivers. These systems are protected from destruction or pollution by the following:

- Section 24 of The Constitution of the Republic of South Africa;
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- The Ramsar Convention, 1971 including the Wetland Conservation Programme (DEAT) and the National Wetland Rehabilitation Initiative (DEAT, 2000);
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments, as well as the NEM: Biodiversity Act;
- National Water Act, 1998 (Act No. 36 of 1998);
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983); and
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).
- Nature and Environmental Conservation Ordinance (No. 19 of 1974)
- National Forest Act (No. 84 of 1998)
- National Heritage Resources Act (No. 25 of 1999)

NEMA and the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983) would also apply to this project. These Acts have categorised many invasive plants together with associated obligations on the land owner. A number of Category 1 & 2 plants were observed in several areas of the site under investigation and are listed in the ecological assessment.

4.7 Provincial legislation and policy

Currently there are no formalised riverine or wetland buffers distances provided by the provincial authorities and as such the buffer model as described Macfarlane *et al.*, 2017 wetlands, rivers and estuaries was used.

These buffer models are based on the condition of the waterbody, the state of the remainder of the site, coupled to the type of development, as wells as the proposed alteration of hydrological flows. Based then on the information known for the site the buffer model provided the following:

Rivers (with riverine wetlands and or oxbow / relic channels)

1. Construction period: 58 m
2. Operation period: 47 m
3. Final: 58 m

NONE WERE OBSERVED WITHIN 500 M OF THE PROPOSED SITES

Other water courses (no wetland vegetation)

1. Construction period: 46 m
2. Operation period: 42 m
3. Final: 45 m

BORROWPIT 64.2 IS LOCATED WITHIN THE FINAL PROPOSED BUFFER, NOTING BP50.6 AND BP57.9 HAS ALREADY DISTRUBED THE RESPECTIVE WATER COURSES AND BUFFER AREA

Wetlands (Endorheic Pans)

1. Construction period: 65 m
2. Operation period: 60 m
3. Final: 65 m

NONE WERE OBSERVED WITHIN 200 M OF THE PROPOSED SITES

Other policies that are relevant include:

- National Freshwater Ecosystems Priority Areas (NFEPA) – (Nel *et al.,* 2011). This mapping product highlights potential rivers and wetlands that should be earmarked for conservation on a national basis.
- The site is not located within any Strategic Water Resource Areas or Water Stressed Areas

5. Description of the affected environment

As previously mentioned, the study area was assessed during a site specific visit, to confirm the current state of the aquatic environment. Due to the nature of the aquatic systems, this was sufficient to gain an understanding of these, coupled to information collected within the region in the past by the report author in other portions of the same river / catchment system within the region.

The proposed material sources are located within the following catchments (Figure 4 a – c) all within the Highveld Ecoregion, associated with the Groot and Klein Vet River systems. In terms of the Hydrogeomorphic approach these were all classified as inland freshwater systems, and were observed within the site as follows:

1. Small drainage lines and water courses with no obligate wetland or riparian elements (Plate 1)
2. Mainstem streams and rivers with riverine wetland (*Typha capensis* / *Phragmites australis* reedbeds) (Plate 2). Some of the larger systems also contained relic channels similar to oxbow areas that also contained wetland elements (*Phragmites* australis*, Isolepis spp*, *Juncus spp*) (Plate 3)
3. Mainstem stream and rivers with no wetland elements thus containing riparian elements only. The riparian systems were dominated by various *Searsia* or Karee species, which included *Searsia erosa, S. lancea, S. pyroides*, Salix babylonica (Plate 4)
4. Small endorheic pans / depression wetlands (Plate 5) associated with the eastern edge of the Free State Panfield Complex (Holmes, 2015).

Overall the vegetation attributes resembled those described by Retief & Meyer (2017), i.e. Free State Dry Grassland, with the region dominated by typical grassland species, *Searsia serosa* and *Vachellia karroo*.

The study area systems have also seen several forms of modification over time and include the following impacts:

- Roads and road crossings, together with the associated stormwater management features some of which have created impoundments
- Landscape transformation through agricultural (grazing and crop production)
- Existing quarries / borrow pits
- Alien plant growth which includes dense stands *Salix babylonica* (weeping willow), Eucalypts, *Opuntia ficus indica* (Prickly pear) and *Populus x canescens* (Poplars) and
- Stream flow reduction (numerous farm dams, Erfenis and Laaispruit Dams) and water quality impacts related to the housing developments on the outskirts of Winburg with untreated runoff flowing into the Laaispruit Dam.

Several natural and artificial wetland types were shown in the National Wetland Inventory v5.2 spatial data, and those confirmed during the site visit are mentioned above and shown in Figures 5a -d. Figures 5a-d also indicate significant watercourses delineated within the site together with the appropriate buffers as calculated in the Macfarlane *et al* (2017) model. Any activities (access roads) within these areas or within 500m of a wetland boundary will require a WUL (possible GA) under Section 21 c & i of the NWA, 1998. <u>A small portion of BP 64.2 is located within the 45m riverine buffer and if at all possible, this boundary should be shifted to avoid any direct impacts on the river and or by the river (floods) on the borrow pit. The existing Quarry located within the prosed Quarry 50.6 is also located within the 45m, but as this is existing it is recommended that this area is carefully rehabilitated once mining has been completed within the new quarry area (outside of buffer. Similarly Borrowpit 57.9 is also located within an existing developed area, within a watercourse and should also be reinstated as best possible when mining is completed.</u>

The National Freshwater Ecosystems Priority Atlas or NFEPA (Nel *et al*., 2011), also earmarked sub-quaternaries, based either on the presence of important biota (e.g. rare or endemic fish species) or conversely the degree of riverine degradation, i.e. the greater the catchment degradation the lower the priority to conserve the catchment. The important catchments areas are then classified as Freshwater Ecosystems Priority Areas or FEPAs. The survey area falls within Upstream FEPA and FEPAs as shown in (Figure 6a & b), but this due to the subquaternary catchments being associated important mains stem systems, that also contain refugia or regular flow. The subquaternary catchment associated with the Erfenis and Laaispruit dams are not considered as NEFPA (Figure 6 a & b) as the upstream areas of the Erfenis Dam in particular are artificial.

Currently only two Borrow pits (42.7 and 42.2) are located within 500m of a wetland boundary.

None of the propose access roads are located within any aquatic zones or will make use of existing access routes off the N1.

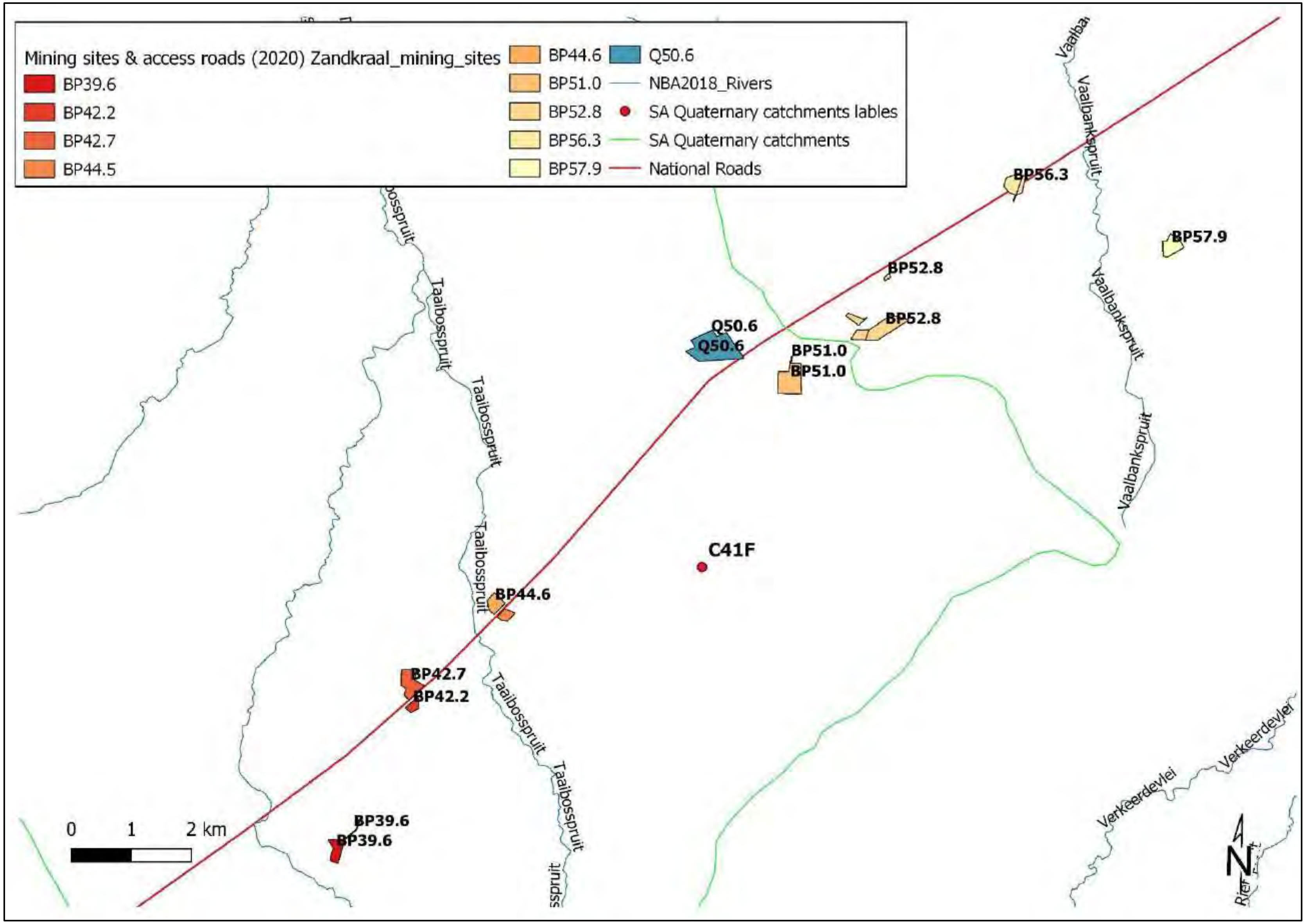

Figure 4a: Project locality map indicating the various quaternary catchment boundaries (green line) in relation to the study area (Source DWS and NGI)

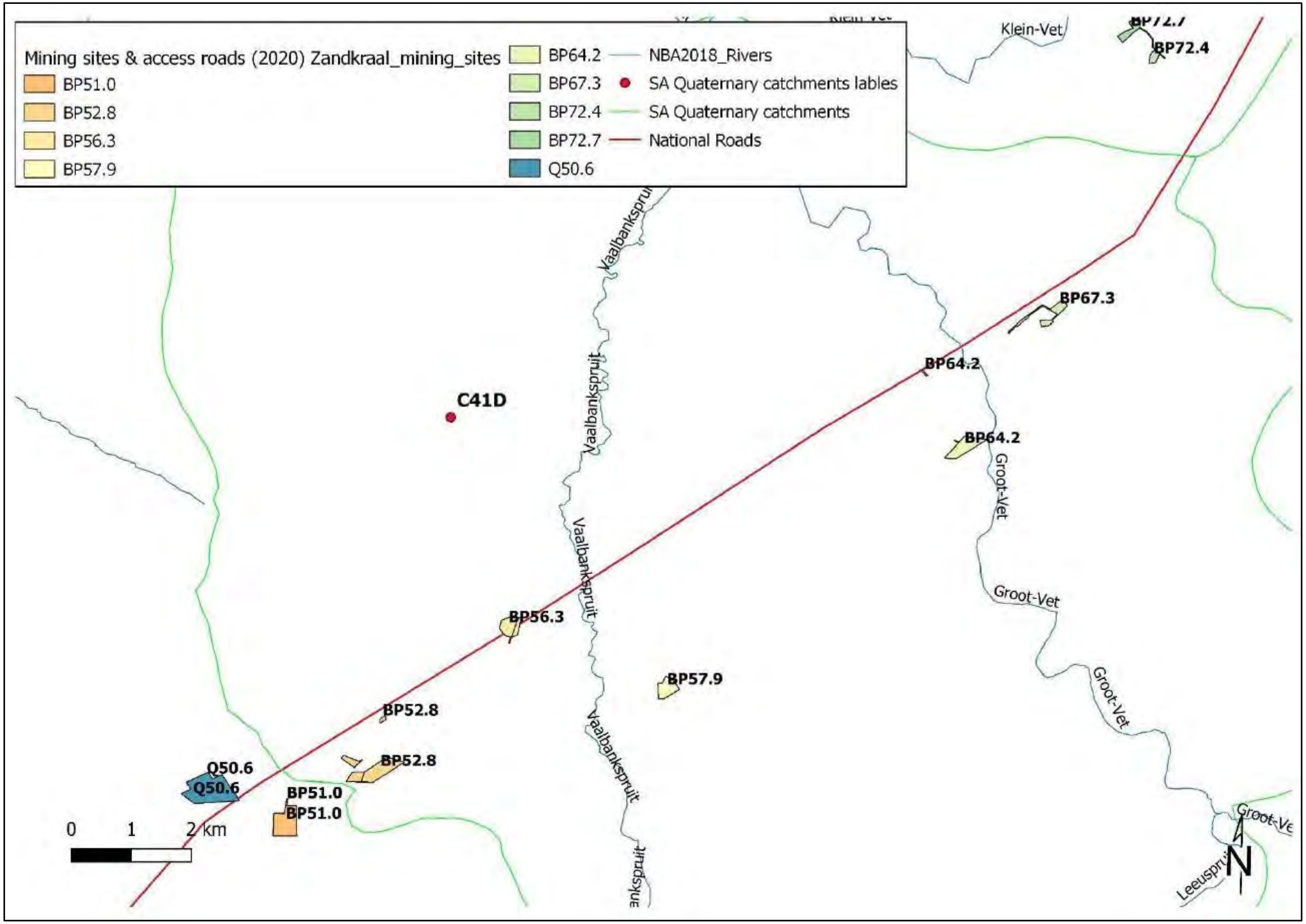

Figure 4b: Project locality map indicating the various quaternary catchment boundaries (green line) in relation to the study area (Source DWS and NGI)

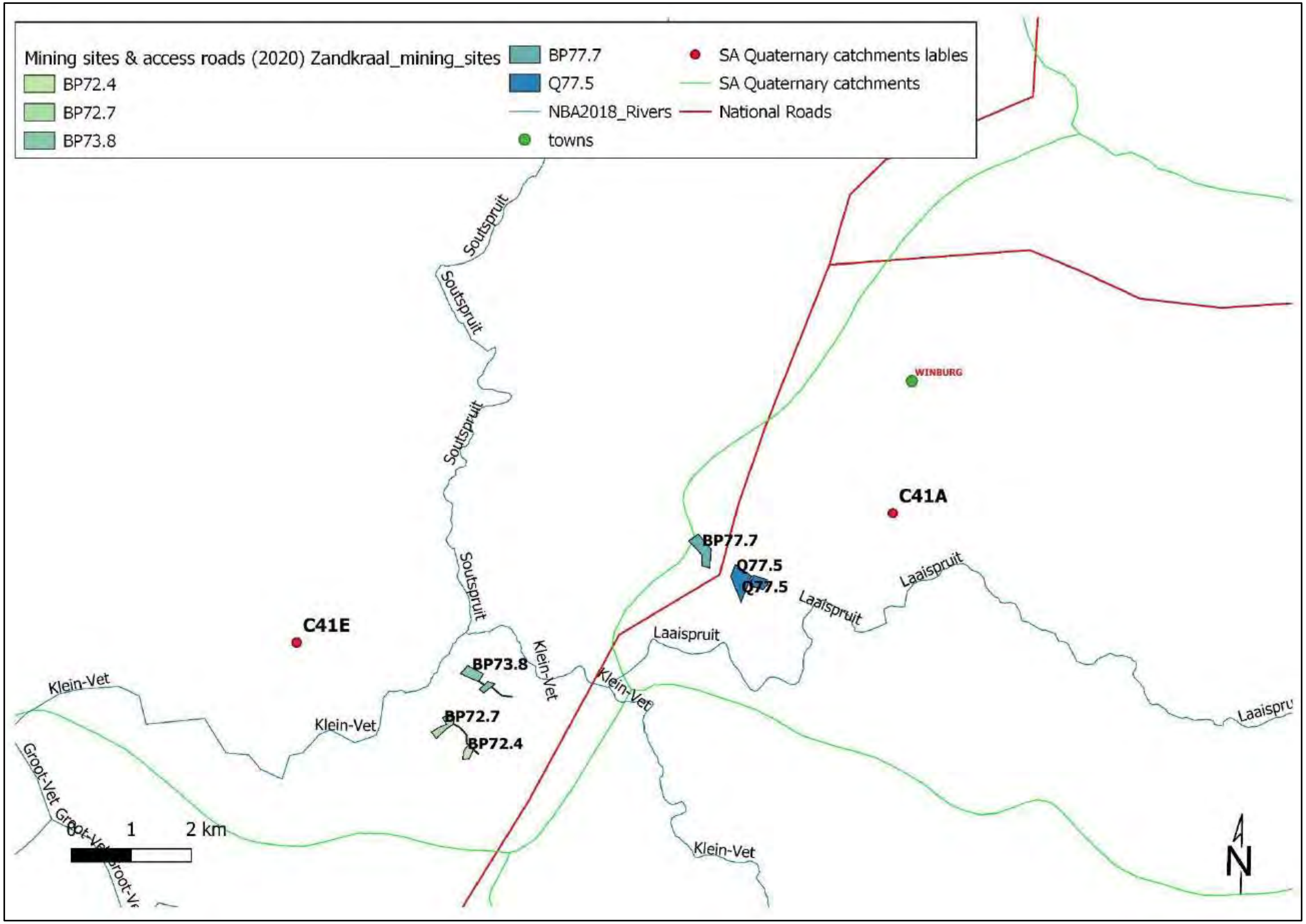

Figure 4c: Project locality map indicating the various quaternary catchment boundaries (green line) in relation to the study area (Source DWS and NGI)

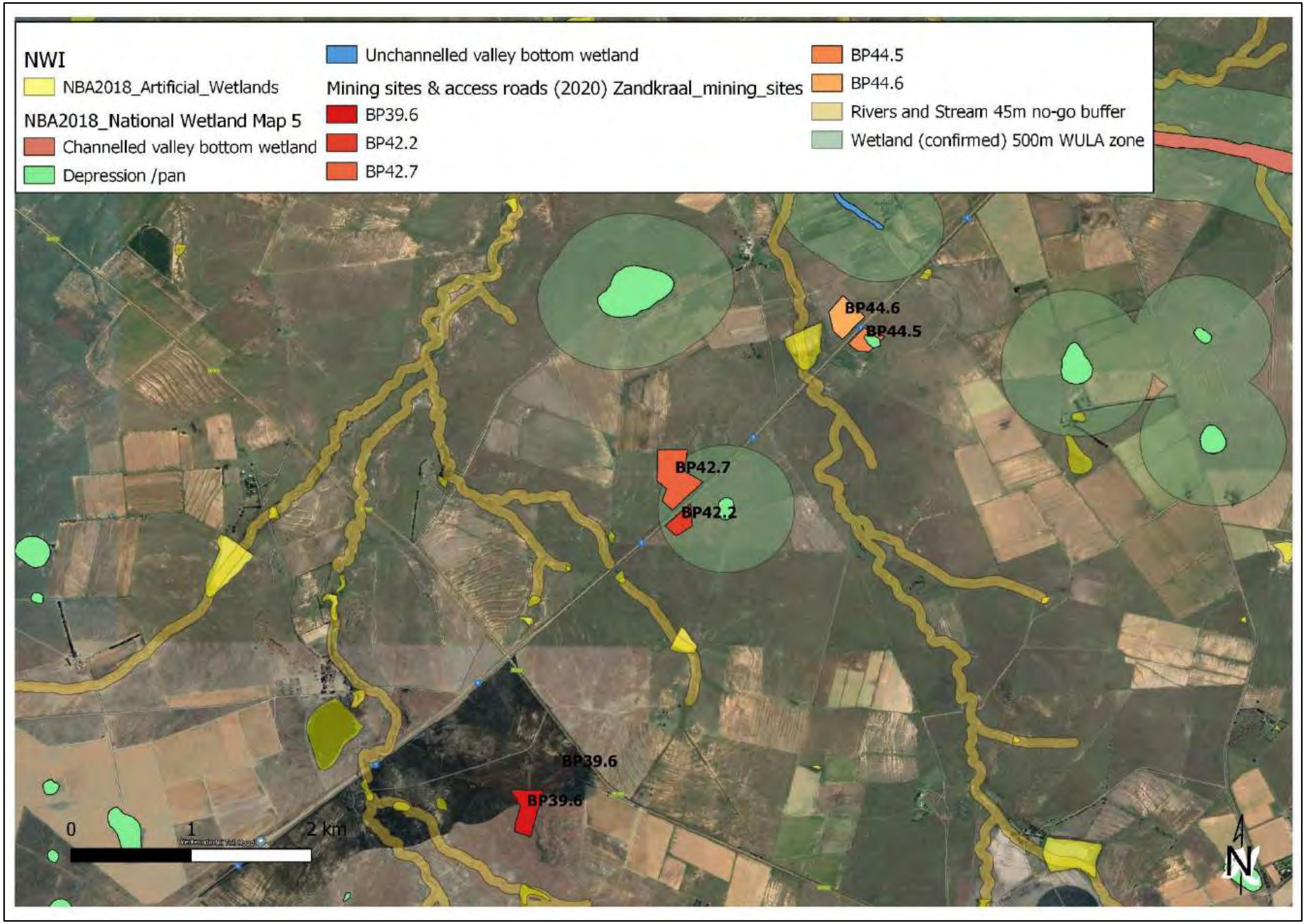

Figure 5a: The waterbodies identified in the National Wetland Inventory V5.2 (2018), wetlands and watercourse that were confirmed inclusive of the respective buffers and DWS regulated WUA zones

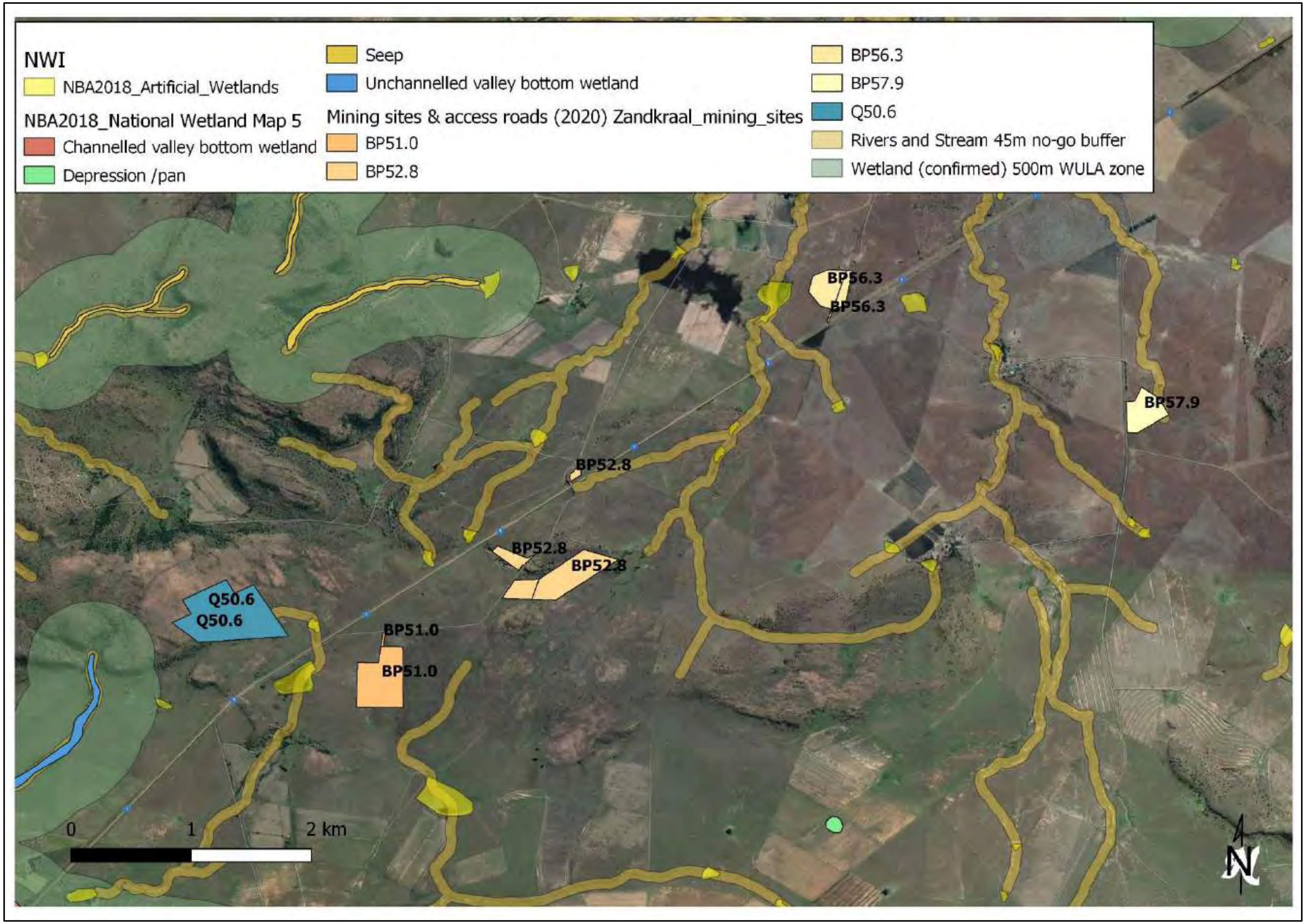

Figure 5b: The waterbodies identified in the National Wetland Inventory V5.2 (2018), wetlands and watercourse that were confirmed inclusive of the respective buffers and DWS regulated WUA zones

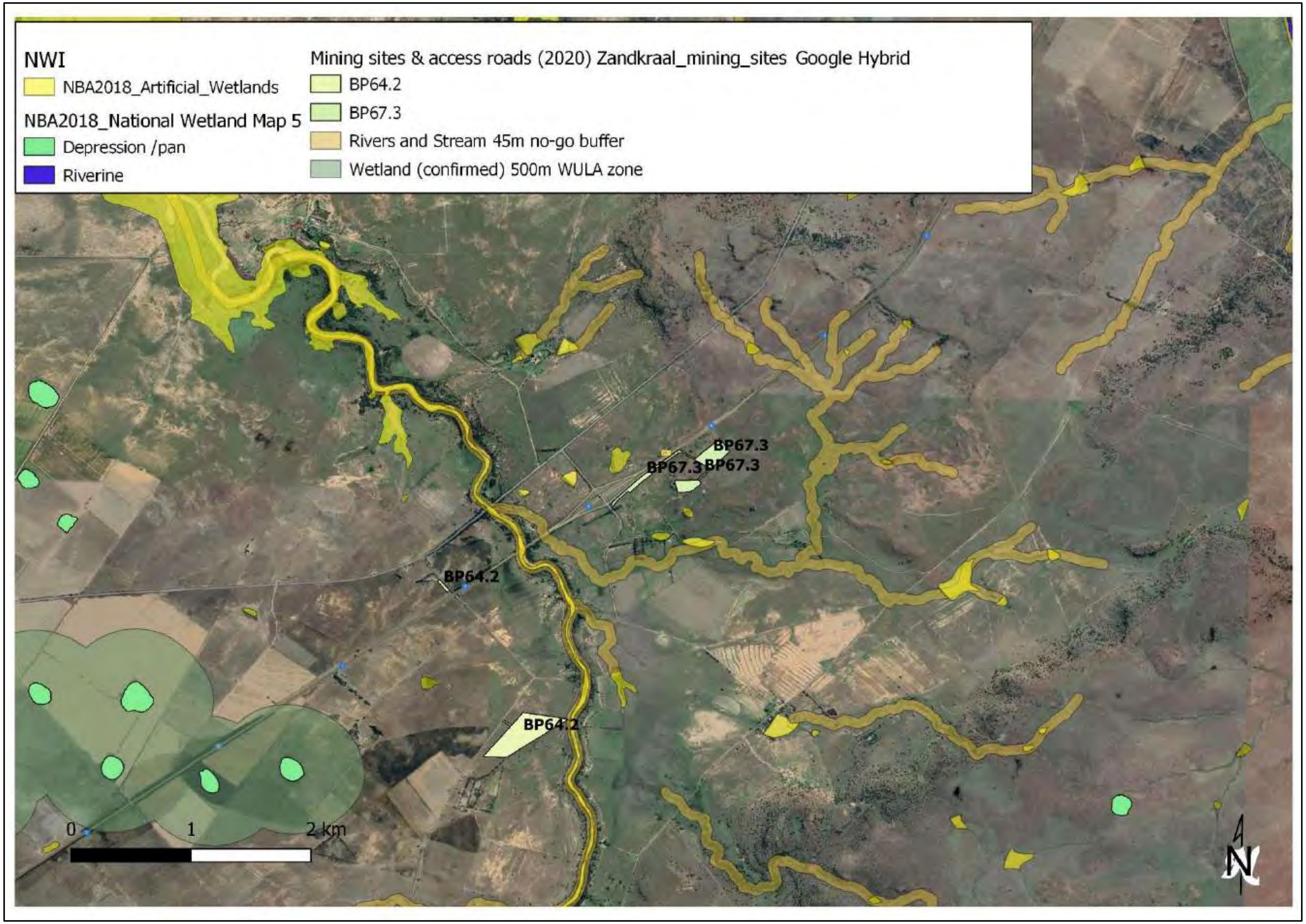

Figure 5c: The waterbodies identified in the National Wetland Inventory V5.2 (2018), wetlands and watercourse that were confirmed inclusive of the respective buffers and DWS regulated WUA zones

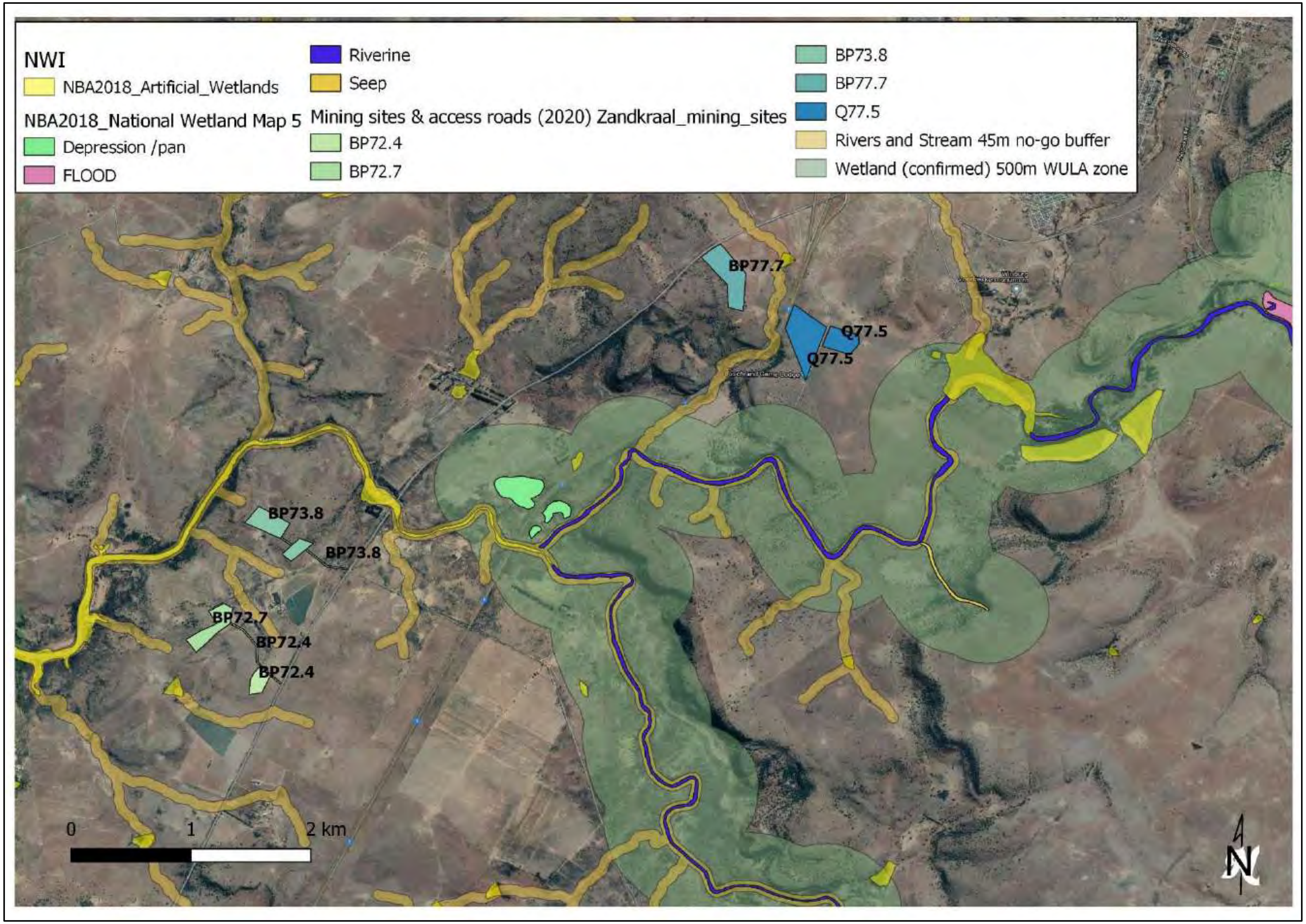

Figure 5d: The waterbodies identified in the National Wetland Inventory V5.2 (2018), wetlands and watercourse that were confirmed inclusive of the respective buffers and DWS regulated WUA zones

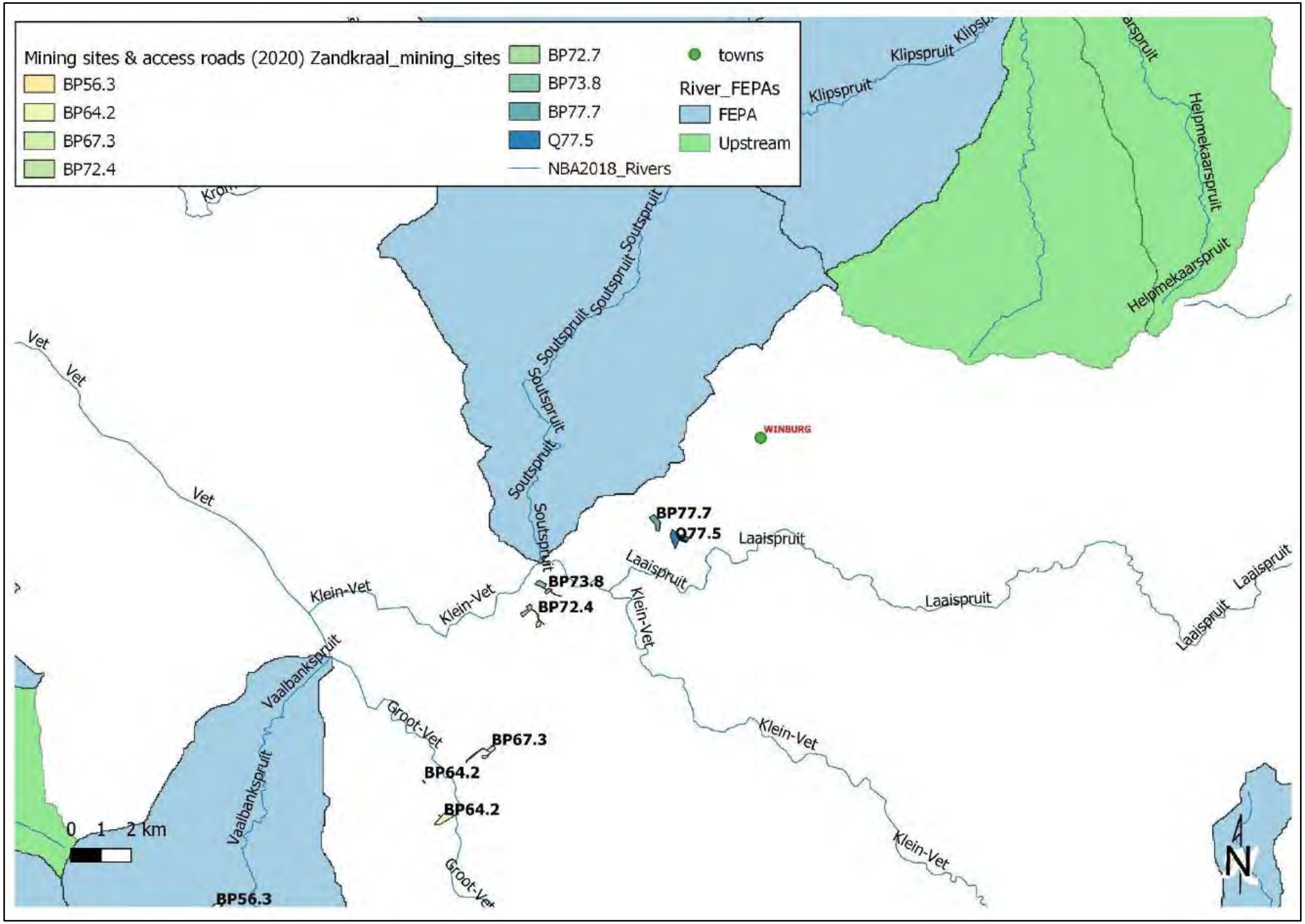

Figure 6a: The respective subquaternary catchments rated in terms of Freshwater Ecosystem Priority Areas (FEPAs) in relation to the study arear

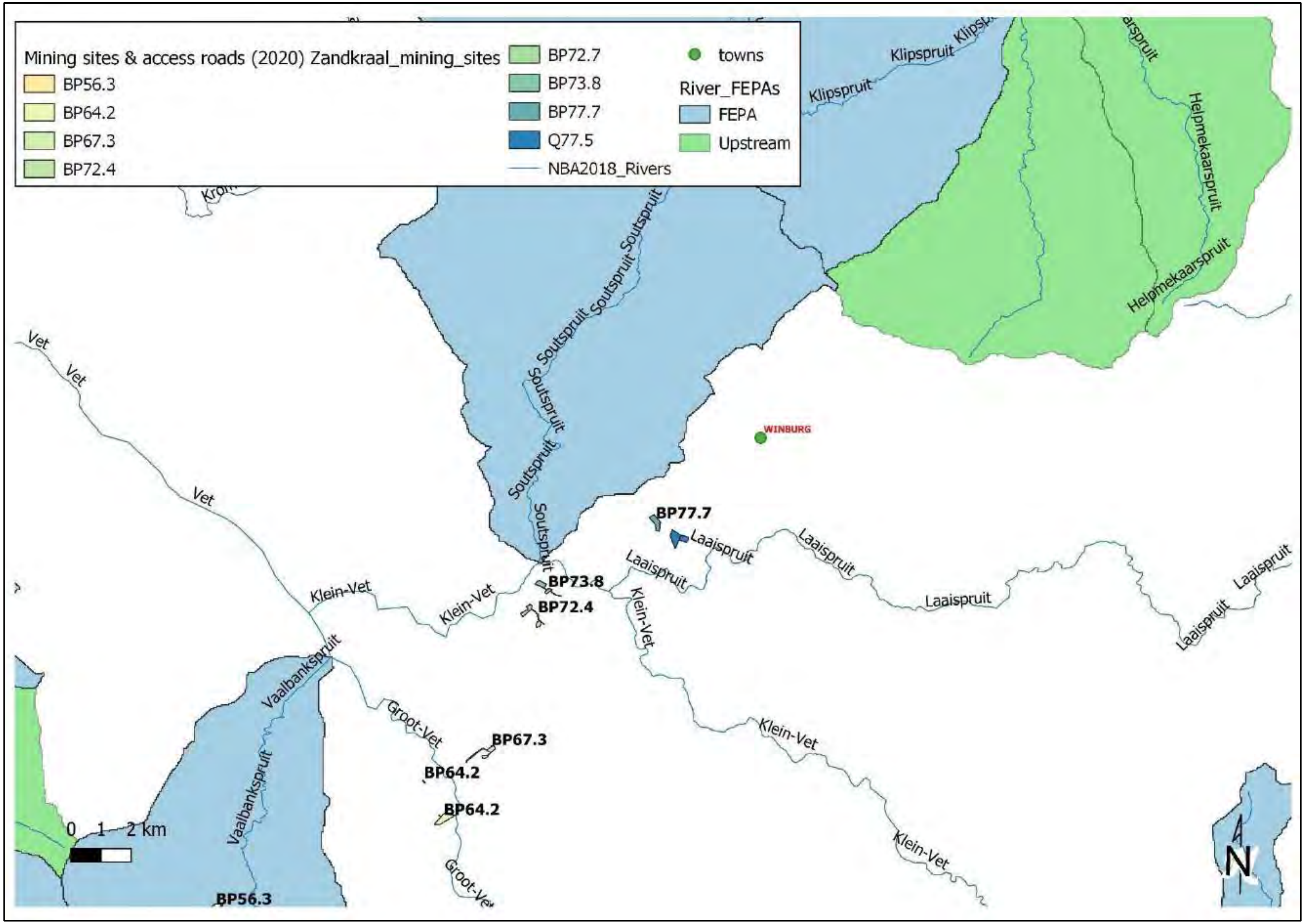

Figure 6b: The respective subquaternary catchments rated in terms of Freshwater Ecosystem Priority Areas (FEPAs) in relation to the study arear

Plate 1: A view of a drainage line near BP77.7 showing no real aquatic features but will contain flow during high rainfall periods

Plate 2: A watercourse with Reedbed (*Phragmites australis*) wetland, however none of these are located within 500m of any of the proposed sites

Plate 3: The oxbow channel (arrow) associated with the Groot Vet River

Plate 4: The Groot Vet River, - riparian system dominated by invasive Willows, with no wetland elements

Plate 5: One of the larger pans in the region that has been transformed into a dam 800m from BP44.6

6. Present Ecological State and conservation importance

The PES of a river represents the extent to which it has changed from the reference or near pristine condition (Category A) towards a highly impacted system where there has been an extensive loss of natural habit and biota, as well as ecosystem functioning (Category E).

The PES scores have been revised for the country and based on the new models, aspects of functional importance as well as direct and indirect impacts have been included (DWS, 2014) and again with the National Biodiversity Assessment 2018 data (CSIR, 2018). The new PES system also incorporates Ecological Importance (EI) and Ecological Sensitivity (ES) separately as opposed to Ecological Importance and Sensitivity (EIS) in the old model, although the new model is still heavily centred on rating rivers using broad fish, invertebrate, riparian vegetation and water quality indicators. The Recommended Ecological Category (REC) is still contained within the new models, with the default REC being B, when little or no information is available to assess the system or when only one of the above-mentioned parameters are assessed or the overall PES is rated between a C or D.

The PES for the main watercourses in the study area were rated as follows (DWS, 2014 – where D = Largely Modified):

Subquaternary Catchment Number	Present Ecological State (2014)	Present Ecological State (2017)	Ecological Importance	Ecological Sensitivity	Sites	SITE BASED ASSESSMENT (THIS REPORT) – PES / EIS
3282	C	C	Moderate	Moderate	BP 42.2 & 42.7	C – Moderate
3283	C	C	Moderate	Moderate	Quarry 50.6 BP 44.5 44.6 & 51	C – Moderate
3184	B	B	High	Moderate	BP 52.8 56.3 57.9	C – Moderate
3169	B	B	High	High	BP 64.2 67.3 A & B	C – Moderate
Remaining sites fall within the Erfenis Dam inundation area thus were rate rated in past assessment, however the 2017 data indicates that the affected catchments are rated a F – Critically Modified – None functional					BP 72.4 72.7 73.8 77.7 Quarry New	F LOW
All Endorheic pans were not rated in these assessments					BP 42.2 42.7	C/D Moderate

7. Permit requirements

Based on an assessment of the proposed activities and past engagement with DWS, the following WULs/ GA's could be required based on the following thresholds as listed in the following Government Notices, however ultimately the Department of Water and Sanitation (DWS) will determine if a GA or full WULA will be required during the pre-application process (Phase 1):

- **DWS Notice 538 of 2016, 2 September in GG 40243**– Section 21 a & b, Abstraction and Storage of water.
- **Government Notice 509 in GG 40229 of 26 August 2016 –** Section 21 c & i, Impeding or diverting the flow of water in a watercourse and or altering the bed, banks, course or characteristics of a watercourse.
- **Government Notice 665, 6 September 2013 in GG 36820** (expired as GA is only valid for 5 years) – Section 21g Disposing of waste in a manner that may detrimentally impact on a water source which includes temporary storage of domestic waste water i.e. conservancy tanks under Section 37 of the notice.

	Water Use Activity	**Applicable to this development proposal**
S21(a)	Taking water from a water resource	Yes, if water is abstracted or supplied from any other sources than municipal supply
S21(b)	Storing water	If the total volume stored is greater than 40 000 m^3 then a full Water Use License will be required.
S21(c)	Impeding or diverting the flow of water in a watercourse	Yes, with the potential of the GA process being followed if all impacts can be reduced to LOW
S21(d)	Engaging in a stream flow reduction activity	Not applicable
S21(e)	Engaging in a controlled activity	Not applicable
S21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit	Not applicable
S21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource	Typically, the conservancy tanks at construction camps require a license (GA if volumes are below 5000 m^3 noting that GA expired 30.8.2018). If above this threshold then a full WUL is required.
S21(h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process	Not applicable
S21(i)	Altering the bed, banks, course or characteristics of a watercourse	Yes, with the potential of the GA process being followed if all impacts can be reduced to LOW
S21(j)	Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons	Not applicable – unless seepage from any of the quarries / borrow pits occurs and this must be discharge to continue mining.
S21(k)	Using water for recreational purposes	Not applicable

8. Impact assessment

The following direct impacts were assessed with regard the riparian areas and watercourses:

- Impact 1: Loss of riparian / wetland systems, habitat fragmentation and disturbance of the watercourses and or wetlands in the construction, operational and decommissioning phases
- Impact 2: Impact on riparian systems through the possible increase in surface water runoff on riparian form and function during the operational and decommissioning phases
- Impact 3: Increase in sedimentation and erosion in the construction, operational and decommissioning phases
- Impact 4: Potential impact on localised surface water quality during the construction and decommissioning phases

Noting that construction/operational are interchangeable in this context of mining operations, however construction refers to establishment of any access roads need for the operational / mining process.

The impacts were assessed as follows, noting that the impact statements are based on post mitigation activities:

Environmental Parameter	Impact 1 - Loss of riparian and wetland systems, habitat fragmentation and disturbance to watercourses and or wetlands during construction, operations and decommissioning phases
Issue/Impact/Environmental Effect/Nature	The physical removal of the riparian zones and disturbance of any watercourses or wetlands is unlikely. Should any loss occur this could also result in additional habitat fragmentation resulting in a loss of connectivity between aquatic systems. As highlighted by NFEPA. These disturbances will be the greatest during the construction / operational phase.
Extent	Local
Probability	Unlikely as all aquatic systems are avoided with the exception of one new BP
Reversibility	Partially reversible
Irreplaceable loss of resources	No loss in resources through avoidance of systems inclusive of the buffers
Duration	With mitigation and completion of the operational phase the impacts would be minimal, however the duration would be long term
Cumulative effect	Downstream alteration of hydrological regimes due to the decreased run-off from the area i.e. creation of impoundments. However due to avoidance of the aquatic environment this is anticipated to be low.
Intensity/magnitude	The overall intensity of the impact would be Low when compared to scale of the impact and the remaining habitat within the greater catchment, coupled to fragmentation that has already occurred together with overall avoidance of the aquatic environment.
Significance Rating	Impact would be considered LOW with mitigations in place based on the intensity of the impact described above

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	4	3
Reversibility	1	1
Irreplaceable loss	2	2
Duration	3	1
Cumulative effect	2	1
Intensity/magnitude	1	1
Significance rating	-14 (Low negative)	-9 (LOW negative)
Mitigation measures	• The engineering team must provide an effective means to minimise the potential upstream and downstream effects of sedimentation and erosion (erosion protection) generated by ay runoff in particular any access roads. • The final access road layout and any processing areas / stockpiles must make provision for stormwater management with the provision of suitable erosion protection features and or culverts. During the construction and operational /decommissioning phase, monitor culverts to see if erosion issues arise and if any erosion control is required. • Where possible culvert bases for any road crossings if needed, must be placed as close as possible with natural levels in mind so that these don't from additional steps / barriers. • Vegetation clearing should occur in in a phased manner in accordance with the construction programme to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment. • It is also advised that an Environmental Control Officer (ECO), with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas within aquatic environment, using selected species detailed in this report. • All alien plant re-growth must be monitored, and should it occur these plants should be eradicated. The scale of the operation does however not warrant the need of a Landscape Architect and / or Landscape Contractor.	

Environmental Parameter	Impact 2 - Impact on riparian / wetland systems through the possible increase in surface water runoff on downstream riparian form and function, due to impacts to the hydrological regime such as alteration of surface run-off patterns
Issue/Impact/Environmental Effect/Nature	This could occur within the operational and decommissioning phases. when any of the hard or compacted surfaces (roads or platforms) and open pit areas would either increase or decrease the volume and velocity of the surface runoff dependent on what structure is being considered, i.e. pits will trap flows, roads and stockpile platforms will increase flows. This would impact the hydrological regime which then affects the structure (i.e. larger taller grasses / shrubs / trees) and function (greater attenuation of flows, restricting any runoff from reaching downstream areas). The opposite can also happen. If flows are too concentrated with

	high velocities, scour and erosion results, with a complete reduction or disturbance of riparian / wetland habitat.	
Extent	Local	
Probability	Unlikely	
Reversibility	Partially reversible as pit will remaining	
Irreplaceable loss of resources	A marginal loss in resources	
Duration	With mitigation the impacts would be minimal however the duration would be long term	
Cumulative effect	Downstream alteration of hydrological regimes due to the decreased run-off from the area i.e. creation of impoundments. However due to avoidance of the aquatic environment this is anticipated to be low.	
Intensity/magnitude	The overall intensity of the impact would be Low when compared to scale of the impact and the remaining habitat within he catchment, especially if the watercourse areas could be avoided	
Significance Rating	Impact would be considered LOW with mitigations in place based on the intensity of the impact described above	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	3
Reversibility	1	1
Irreplaceable loss	2	2
Duration	4	1
Cumulative effect	1	1
Intensity/magnitude	1	1
Significance rating	-13 (Low negative)	-9 (LOW negative)
Mitigation measures	• Vegetation clearing should occur in in a phased manner in accordance with the construction programme to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment. • Any storm-water within the site must be handled in a suitable manner, i.e. trap sediments, and reduce flow velocities • No stormwater runoff must be allowed to discharge directly into any water course along roads / platforms, and flows should thus be allowed to dissipate over a broad area covered by natural vegetation. • Stormwater from hard surfaces must be managed using appropriate channels and swales when located within steep areas or have steep embankments	

Environmental Parameter	Impact 3 - Increase in sedimentation and erosion within the development footprints	
Issue/Impact/Environmental Effect/Nature	Impacts include changes to the hydrological regime such as alteration of surface run-off patterns which could occur during the construction, operational and decommissioning phases.	
Extent	Local	
Probability	Probable	
Reversibility	Completely reversible – as the scale and nature of soils the erosion can be halted and over time any erosion can be remediated	
Irreplaceable loss of resources	A marginal loss in resources	
Duration	With mitigation and completion of the construction /operational phase the impacts would be minimal however the duration would be long term	
Cumulative effect	Erosion and sedimentation of the downstream systems and farming operations could result in cumulative impacts. However due to the proposed layout aquatic systems have been avoided	
Intensity/magnitude	The overall intensity of the impact would be Low when compared to scale of the impact and the remaining habitat within he catchment, coupled to the overall avoidance the aquatic systems	
Significance Rating	Impact would be considered LOW with mitigations in place based on the intensity of the impact described above	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	4	3
Reversibility	3	1
Irreplaceable loss	3	2
Duration	4	1
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-34 (MEDIUM negative)	-9 (LOW negative)
Mitigation measures	• Any storm-water within the site must be handled in a suitable manner, i.e. trap sediments and reduce flow velocities. Any management actions must be dealt with in the Stormwater Management Plan (SWMP) typically submitted post EA, forming part of any WULA	

Environmental Parameter	Impact 4 – Impact on localized surface water quality	
Issue/Impact/Environmental Effect/Nature	During construction and operational activities, chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement powder, wet cement, shutter-oil, etc.) could be washed downslope	
Extent	Local	
Probability	Probable	
Reversibility	Completely reversible	
Irreplaceable loss of resources	A marginal loss in resources	
Duration	With mitigation and completion of the construction phase the impacts would be minimal however the duration of the impacts would be long term	
Cumulative effect	Water quality impacts on downstream systems and farming operations could result in cumulative impacts. However due to the proposed layout aquatic systems have been avoided	
Intensity/magnitude	The overall intensity of the impact would be Low when compared to scale of the impact and the remaining habitat within the catchment, especially if the watercourse areas could be avoided	
Significance Rating	Impact would be considered LOW with mitigations in place based on the intensity of the impact described above.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	4	2
Reversibility	2	1
Irreplaceable loss	1	1
Duration	4	1
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-28 (Low negative)	-7 (LOW negative)
Mitigation measures	• Strict use and management of all hazardous materials used on site in line with the specific material safety data sheets, e.g. fuels must be stored within a contained / bunded site with the necessary and spill kits available. • Strict management of potential sources of pollution (e.g. litter, hydrocarbons from vehicles & machinery, cement during construction, etc.). • Containment of all contaminated water by means of careful run-off management on the development site. • Appropriate ablution facilities should be provided for construction workers during construction and on-site staff during the operation of the sites. • Strict control over the behaviour of construction workers, with regard littering, use and storage of chemicals. • Working protocols incorporating pollution control measures (including approved method statements by the contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced. Additional details	

	in this regard in contain in Section 9 of this report and have also been considered in the mitigation assessment process.

Environmental Parameter	Impact 5 – No-go alternative	
Issue/Impact/Environmental Effect/Nature	The no-go alternative assumes that no change in land use or additional activities will occur and that the status quo will persist. This includes existing activities, alien encroachment along with the impact of existing roads crossing watercourses and high level of erosion	
Extent	Local	
Probability	Probable	
Reversibility	Completely reversible	
Irreplaceable loss of resources	A marginal loss in resources	
Duration	Permanent	
Cumulative effect	Cumulative impacts can be avoided by implementing the mitigation measures by the municipality. However, if the no-go alternative is implemented the mitigation measures will not be implemented as part of this project.	
Intensity/magnitude	The overall intensity of the impact would be Low	
Significance Rating	Impact would be considered LOW based on the intensity of the impact described above	
	Pre-mitigation impact rating	
Extent	2	
Probability	4	
Reversibility	2	
Irreplaceable loss	3	
Duration	4	
Cumulative effect	1	
Intensity/magnitude	2	
Significance rating	-32 (MEDIUM negative)	
Mitigation measures	• No mitigation measures will be implemented with the no-go alternative	

9. Environmental Management plan

Note ECO/ESO is interchangeable depending on the final appointment by the contractor / client

Design Phase					
Objective	Potential Impact	Mitigation Measures	Indicator/outcomes	Responsibility	Timeframes
Ensure that the detailed design avoids all sensitive water resources if at all possible	Minimise the number of impacts on the observed watercourses that would result in the potential impacts listed in this report and section below during the construction and operational phases	it is therefore recommended that these positions are assessed in the EMP walk down phase to provide detailed mitigations to the engineers as and when required.	» The impact ratings listed in this report can be upheld and the number of Water use License would be low	Holder of the EA	Prior to construction
Construction and Operation Phase					
Objective	Potential Impact	Mitigation Measures	Indicator/outcomes	Responsibility	Timeframes
Soil erosion control, water quality management -	» Erosion and soil loss within watercourses » Negative impacts on watercourses » Disturbance to or loss of watercourses » Sedimentation of watercourse areas » Increased runoff into rivers can potentially be associated with accelerated erosion in watercourses	» Identify and demarcate construction areas for general construction work and restrict construction activity to these areas. Prevent unnecessary destructive activity within construction areas (prevent over-excavations and double handling) » Stockpile topsoil for re-use in rehabilitation phase. Maintain stockpile shape and protect from erosion. All stockpiles must be positioned at least 50m away from watercourses. Limit the height of stockpiles as far as possible in order to reduce compaction. » Disturbance of vegetation and topsoil must be kept to a practical minimum. » Rehabilitate disturbance areas as soon as construction in an area is completed with suitable means. » Any storm-water within the site must be handled in a suitable manner, i.e. trap sediments and reduce flow velocities. Any management actions must be dealt with in the SWMP typically submitted post authorisation, forming part of any WULA.	» No unacceptable levels of disturbance, soil erosion, increased siltation, soil degradation, as determined by the ECO » All excavations undertaken as per the approved Method Statement	Holder of the EA	During site establishment, construction and operational phase

Construction and Operation Phase					
Objective	Potential Impact	Mitigation Measures	Indicator/ Outcome	Responsibility	Timeframes
Management of general solid waste, hazardous waste and liquid waste to mitigate environmental impacts.	» The construction phase will include the storage and handling of a variety of chemicals including adhesives, abrasives, oils and lubricants, paints and solvents although in small amounts. The main wastes expected to be generated by the Borrow-pit / Quarry will include general solid waste, hazardous waste and liquid waste. » The watercourse areas could be impacted via: 1. Release of contaminated water from contact with spilled chemicals could impact the 2. Generation of contaminated wastes from used chemical containers 3. Inefficient use of resources resulting in excessive waste generation 4. Litter or contamination of the site or water through poor waste management practices	» Storage areas must be located more than 50 m away from the watercourse. » The storage of flammable and combustible liquids such as oils must be in designated areas which are appropriately bunded, and stored in compliance with MSDS files, as defined by the SHE Representative / ECO. » Any spills must receive the necessary clean-up action. If required, bioremediation kits are to be kept on-site and used to remediate any spills that may occur. Appropriate arrangements to be made for appropriate collection and disposal of all cleaning materials, absorbents and contaminated soils (in accordance with a waste management plan). » Any storage and disposal permits/approvals which may be required will be obtained, and the conditions attached to such permits and approvals must be complied with. » Routine servicing and maintenance of vehicles is not to take place on-site (except for emergency situations or large	» No chemical spills outside of designated storage areas » No water or soil contamination by chemical spills » No complaints received regarding waste on site or indiscriminate dumping » Internal site audits ensuring that waste segregation, recycling and reuse is occurring appropriately » Provision of all appropriate waste manifests for all waste streams » Designated areas for fires identified on site at the outset of	Holder of the EA	During site establishment, construction and operational phase

		cranes which cannot be moved off-site). If repairs of vehicles must take place on site, an appropriate drip tray must be used to contain any fuel or oils. » Transport of all hazardous substances must be in accordance with the relevant legislation and regulations. » Waste disposal records must be available for review at any time. » Construction contractors must provide specific detailed waste management plans to deal with all waste streams. » Specific areas must be designated on-site for the temporary management of various waste streams, i.e. general refuse, construction waste (wood and metal scrap) and contaminated waste. Location of such areas must seek to minimise the potential for impact on the surrounding environment, including prevention of contaminated runoff, seepage and vermin control. » Where possible, construction and general wastes on-site must be reused or recycled. Bins and skips must be available on-site for collection, separation and storage of waste streams (such as wood, metals, general refuse etc). » Disposal of waste must be in accordance with relevant legislative requirements, including the use of licensed contractors. » Hydrocarbon waste must be contained and stored in sealed containers within an appropriately bunded area. » Waste and surplus dangerous goods must be kept to a minimum and must be transported by approved waste transporters to sites designated for their disposal. » Documentation (waste manifest) must be maintained detailing the quantity, nature and fate of any hazardous waste. » An incident/complaints register must be established and maintained on-site. » Hazardous and non-hazardous waste must be separated at source. Separate waste collection bins must be provided for this purpose. These bins must be clearly marked and appropriately covered. » All solid waste collected must be disposed of at a registered waste disposal site. A certificate of disposal must be obtained and kept on file. The disposal of waste must be in accordance with all relevant legislation. Under no circumstances may solid waste be burnt or buried on site. » Supply waste collection bins at construction equipment and construction crew camps. » Construction equipment must be refuelled within designated refuelling locations, or where remote refuelling is required, appropriate drip trays must be utilised.	the construction phase » Firefighting equipment and training provided before the construction phase commences » No activity in identified no-go areas » No unacceptable levels of disturbance, soil erosion, increased siltation, soil degradation, as determined by the ECO » All excavations undertaken as per the approved Method Statement »		

		» All stored fuels to be maintained within a bund and on a sealed surface. » Fuel storage areas must be inspected regularly to ensure bund stability, integrity and function. » Construction machinery must be stored in an appropriately sealed area. » Oily water from bunds at the substation must be removed from site by licensed contractors. » Spilled cement or concrete must be cleaned up as soon as possible and disposed of at a suitably licensed waste disposal site. » Corrective action must be undertaken immediately if a complaint is received, or potential/actual leak or spill of polluting substance identified. This includes stopping the contaminant from further escaping, cleaning up the affected environment as much as practically possible and implementing preventive measures. » In the event of a major spill or leak of contaminants, the relevant administering authority must be immediately notified as per the notification of emergencies/incidents. » Any contaminated/polluted soil removed from the site must be disposed of at a licensed hazardous waste disposal facility. » Upon the completion of construction, the area will be cleared of potentially polluting materials. » Identify and demarcate construction areas for general construction work and restrict construction activity to these areas. Prevent unnecessary destructive activity within construction 7areas (prevent over-excavations and double handling) » Stockpile topsoil for re-use in rehabilitation phase. Maintain stockpile shape and protect from erosion. All stockpiles must be positioned at least 50 m away from watercourses. Limit the height of stockpiles as far as possible in order to reduce compaction. » Any excavation, including those for cables, must be supervised by the ECO/ESO within the proposed watercourses. Disturbance of vegetation and topsoil must be kept to a practical minimum. » Rehabilitate disturbance areas as soon as construction in an area is completed.			

10. Conclusion and Recommendations

The study area was defined by several water courses and wetland types that were characteristic of region. This assessment however found that with the exception of BP 64.2 all are well removed from any wetlands, water courses and the modelled buffers. Two other mining areas are also located within watercourse, but these have been positioned within existing mining areas, and these should receive additional effort with regard re-establishing the watercourses post mining. None of the proposed new access roads are located within any none watercourses or wetland areas.

Further, no aquatic protected or species of special concern (flora) were observed during the site visit.

Therefore, based on the information collected the significance of the impacts assessed for the aquatic systems after mitigation would be LOW.

Figures 5 a - d further indicates the affected watercourses and those that would trigger the need for a WULA (a potential GA) in terms of Section 21 c and i of the NWA 1998, should any construction take place within these areas.

As the proposed activities have the potential to create erosion/sedimentation the following key recommendations and assumptions are reiterated:

- Vegetation clearing should occur in in a phased manner in accordance with the construction programme to minimise erosion and/or run-off. Large tracts of bare soil will either cause dust pollution or quickly erode and then cause sedimentation in the lower portions of the catchment.
- All construction materials including fuels and oil should be stored in demarcated areas that are contained within berms / bunds to avoid spread of any contamination. Washing and cleaning of equipment should also be done in berms or bunds, to trap any cement and prevent excessive soil erosion. Mechanical plant and bowsers must not be refuelled or serviced within or directly adjacent to any channel. It is therefore suggested that all construction camps, lay down areas, batching plants or areas and any stores should be more than 50m from any demarcated watercourses.
- It is also advised that an Environmental Control Officer, with a good understanding of the local flora be appointed during the construction phase. The ECO should be able to make clear recommendations with regards to the re-vegetation of the newly completed / disturbed areas, using selected species detailed in this report.
- All alien plant re-growth must be monitored, and should these alien plants reoccur these plants should be re-eradicated. The scale of the operation does however not warrant the use of a Landscape Architect and / or Landscape Contractor.
- It is further recommended that a comprehensive rehabilitation plan be developed from the project onset with particular reference to the watercourse areas (including of buffers) to ensure a net benefit to the aquatic environment when the project is decommissioned.

11. References

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12. Appendix 1 - Specialist CV

CURRICULUM VITAE
Dr Brian Michael Colloty
7212215031083

1 Rossini Rd
Pari Park
Port Elizabeth, 6070
brian@itsnet.co.za
083 498 3299

Profession: Ecologist & Environmental Assessment Practitioner (Pr. Sci. Nat. 400268/07 & EAPSA certified). Member of the South African Wetland Society
Specialisation: Ecology and conservation importance rating of inland habitats, wetlands, rivers & estuaries
Years experience: 21 years

SKILLS BASE AND CORE COMPETENCIES

- 21 years experience in environmental sensitivity and conservation assessment of aquatic and terrestrial systems inclusive of Index of Habitat Integrity (IHI), WET Tools, Riparian Vegetation Response Assessment Index (VEGRAI) for Reserve Determinations, estuarine and wetland delineation throughout Africa. Experience also includes biodiversity and ecological assessments with regard sensitive fauna and flora, within the marine, coastal and inland environments. Countries include Mozambique, Kenya, Namibia, Central African Republic, Zambia, Eritrea, Mauritius, Madagascar, Angola, Ghana, Guinea-Bissau and Sierra Leone. Current projects also span all nine provinces in South Africa.
- 12 years experience in the coordination and management of multi-disciplinary teams, such as specialist teams for small to large scale EIAs and environmental monitoring programmes, throughout Africa and inclusive of marine, coastal and inland systems. This includes project and budget management, specialist team management, client and stakeholder engagement and project reporting.
- GIS mapping and sensitivity analysis

TERTIARY EDUCATION

- 1994: B Sc Degree (Botany & Zoology) - NMMU
- 1995: B Sc Hon (Zoology) - NMMU
- 1996: M Sc (Botany - Rivers) - NMMU
- 2000: Ph D (Botany – Estuaries & Mangroves) – NMMU

EMPLOYMENT HISTORY

- 1996 – 2000 Researcher at Nelson Mandela Metropolitan University – SAB institute for Coastal Research & Management. Funded by the WRC.
- 2001 – January 2003 Training development officer AVK SA (reason for leaving – sought work back in the environmental field rather than engineering sector)
- February 2003- June 2005 Project manager & Ecologist for Strategic Environmental Focus (Pretoria) – (reason for leaving – sought work related more to experience in the coastal environment)
- July 2005 – June 2009 Principal Environmental Consultant Coastal & Environmental Services (reason for leaving – company restructuring)
- June 2009 – present Owner / Ecologist of Scherman Colloty & Associates cc

SELECTED RELEVANT PROJECT EXPERIENCE

World Bank IFC Standards

- Kenmare Mining Pilivilli, Mozambique - wetland (mangroves, peatlands and estuarine) assessment and biodiversity offset analysis - current
- Botswana South Africa 400kv transmission line (400km) biodiversity assessment on behalf of Aurecon - current
- Farim phosphate mine and port development, Guinea Bissau – biodiversity and estuarine assessment on behalf of Knight Piesold Canada – 2016.
- Tema LNG offshore pipeline EIA – marine and estuarine assessment for Quantum Power (2015).
- Colluli Potash South Boulder, Eritrea, SEIA marine baseline and hydrodynamic surveys co-ordinator and coastal vegetation specialist (coastal lagoon and marine) (on-going).
- Wetland, estuarine and riverine assessment for Addax Biofeuls Sierra Leone, Makeni for Coastal & Environmental Services: 2009
- ESHIA Project manager and long-term marine monitoring phase coordinator with regards the dredge works required in Luanda bay, Angola. Monitoring included water quality and biological changes in the bay and at the offshore disposal outfall site, 2005-2011

South African

- Wetland specialist appointed to update the Eastern Cape Biodiversity Conservation Plan, for the Province on behalf of EOH CES appointment by SANBI – current. This includes updating the National Wetland Inventory for the province, submitting the new data to CSIR/SANBI.

- Nelson Mandela Bay Municipality Baakens River Integrated Wetland Assessment (Inclusive of Rehabilitation and Monitoring Plans) for CEN IEM Unit - Current
- Rangers Biomass Gasification Project (Uitenhage), wetland assessment and wetland rehabilitation / monitoring plans for CEM IEM Unit – current.
- Gibson Bay Wind Farm implementation of the wetland management plan during the construction and operation of the wind farm (includes surface / groundwater as well wetland rehabilitation & monitoring plan) on behalf of Enel Green Power - current
- Gibson Bay Wind Farm 133kV Transmission Line wetland management plan during the construction of the transmission line (includes wetland rehabilitation & monitoring plan) on behalf of Eskom – 2016.
- Tsitsikamma Community Wind Farm implementation of the wetland management plan during the construction of the wind farm (includes surface / biomonitoring, as well wetland rehabilitation & monitoring plan) on behalf of Cennergi – completed May 2016.
- Alicedale bulk sewer pipeline for Cacadu District, wetland and water quality assessment, 2016
- Mogalakwena 33kv transmission line in the Limpopo Province, on behlaf of Aurecon, 2016
- Cape St Francis WWTW expansion wetland and passive treatment system for the Kouga Municipality, 2015
- Macindane bulk water and sewer pipelines wetland and wetland rehabilitation plan for the Indwe 2015
- Eskom Prieska to Copperton 132kV transmission line aquatic assessment, Northern Cape on behalf of Savannah Environmental 2015.
- Joe Slovo sewer pipeline upgrade wetland assessment for Nelson Mandela Bay Municipality 2014
- Cape Recife Waste Water Treatment Works expansion and pipeline aquatic assessment for Nelson Mandela Bay Municipality 2013
- Pola park bulk sewer line upgrade aquatic assessment for Nelson Mandela Bay Municipality 2013
- Transnet Freight Rail – Swazi Rail Link (Current) wetland and ecological assessment on behalf of Aurecon for the proposed rail upgrade from Ermelo to Richards Bay
- Eskom Transmission wetland and ecological assessment for the proposed transmission line between Pietermaritzburg and Richards Bay on behalf of Aurecon (2012).
- Port Durnford Exarro Sands biodiversity assessment for the proposed mineral sands mine on behalf of Exxaro (2009)
- Fairbreeze Mine Exxaro (Mtunzini) wetland assessment on behalf of Strategic Environmental Services (2007).
- Wetland assessment for Richards Bay Minerals (2013) – Zulti North haul road on behalf of RBM.
- Biodiversity and aquatic assessments for 85 renewable projects in the past four years in the Western, Eastern, Northern Cape, KwaZulu-Natal and Free State provinces. Clients included RES-SA, RedCap, ACED Renewables, Mainstream Renewable, GDF Suez, Globeleq, ENEL, Abengoa amongst others. Particular aquatic sensitivity assessment and Water Use License Applications on behalf of Mainstream Renewable Energy (8 wind farms and 3 PV facilities.), Cennergi / Exxaro (2 Wind farm), WKN Wind current (2 wind farms & 2 PV facilities), ACED (6 wind farms) and Windlab (3 Wind farms) were also conducted. Several of these projects also required the assessment of the proposed transmission lines and switching stations, which were conducted on behalf of Eskom.
- Vegetation assessments on the Great Brak rivers for Department of Water and Sanitation, 2006 and the Gouritz Water Management Area (2014)
- Proposed FibreCo fibre optic cable vegetation assessment along the N2, PE to Cape Town, 2012 on behalf of SRK (2013).

APPENDIX C2 -
ECOLOGICAL IMPACT ASSESSMENT

MINING APPLICATION FOR BORROW PITS AND QUARRIES BETWEEN ZANDKRAAL AND WINBURG SOUTH, FREE STATE, SOUTH AFRICA

DRAFT ECOLOGICAL IMPACT ASSESSMENT

Prepared for:

SMEC South Africa (Pty) Ltd

Under the direction of:
The South African National Roads Agency SOC Ltd
Eastern Region
52 Van Eck Place,
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Prepared by:

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September 2020

Contact Details: Ecological Specialist

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Nahoon, East London, 5210

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The contents of this specialist report complies with the legislated requirements as described in Appendix 6 of the National Environmental Management Act (No 107 of 1998; NEMA as amended) Regulations as amended in 2014.

THE PROJECT TEAM

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; (b) a declaration that the specialist is independent in a form as may be specified by the competent authority;

A. Details of specialist

Mr Roy de Kock M.Sc., *Pri.Sci.Nat.*
(Initial report writing)
Roy is a Senior Consultant holding a BSc Honours in Geology and an MSc in Botany from the Nelson Mandela Metropolitan University in Port Elizabeth. His MSc thesis focused on Rehabilitation Ecology using an open-cast mine as a case study. He has been working for CES since 2010 and is based at the East London branch where he focuses on Vegetation, Biodiversity, Ecological and Agricultural Assessments, Geological and Geotechnical analysis, Environmental Management Plans, mining applications and various environmental impact studies. Roy has worked on numerous projects in South Africa and Africa at large. Roy is registered with the South African Council for Natural Scientific Professional (SACNASP).

Dr Alan Carter *Pri.Sci.Nat.*
(Final report writing and review)
Alan is the executive of the EOH East London Office. He holds a PhD in Marine Biology and is a certified Public Accountant, with extensive training and experience in both financial accounting and environmental science disciplines with international accounting firms in South Africa and the USA. He has 25 years' experience in environmental management and has specialist skills in sanitation, coastal environments and industrial waste. Dr Carter is registered as a Professional Natural Scientist under the South African Council for Natural Scientific Professions (SACNASP). He is also registered as an EAP by the Environmental Assessment Practitioners of South Africa (EAPSA).

B. Declaration

Role on Study Team	Declaration of independence
Report Writer	• I, **Alan Carter**, declare that, in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Amended Environmental Impact Assessment Regulations, 2017; • I act as the independent specialist in this application; • I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant; • I declare that there are no circumstances that may compromise my objectivity in performing such work; • I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity; • I will comply with the Act, Regulations and all other applicable legislation; • I have no, and will not engage in, conflicting interests in the undertaking of the activity;

	• I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; • All the particulars furnished by me in this report are true and correct; and • I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act. ________________________________ NAME & SURNAME

TABLE OF CONTENTS

1. INTRODUCTION

1. (1) A specialist report prepared in terms of these Regulations must contain—
   (c) an indication of the scope of, and the purpose for which, the report was prepared;
   (cA) an indication of the quality and age of base data used for the specialist report;
   (d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;
   (i) a description of any assumptions made and any uncertainties or gaps in knowledge;
   (o) a description of any consultation process that was undertaken during the course of preparing the specialist report;
   (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.

1.1. Project description

SANRAL proposes to upgrade the National Route 1, Section 16 (N1-16) from Zandkraal (KM 33.8) to Windburg South (KM 78.0). The project involves construction of a new carriageway, the expansion and maintenance of existing pipe culverts, the installation of stormwater drainage infrastructure and the construction of various bridges. Fifteen (15) borrow pits and two (2) quarries are required to supply the necessary material for the upgrade.

1.2. Project location

The proposed borrow pits and quarries are located across twenty (20) farm portions (Figure 1.1), along National Route 1 in the Masilonyana Local Municipality in the Free State Province between Zandkraal and Winburg South.

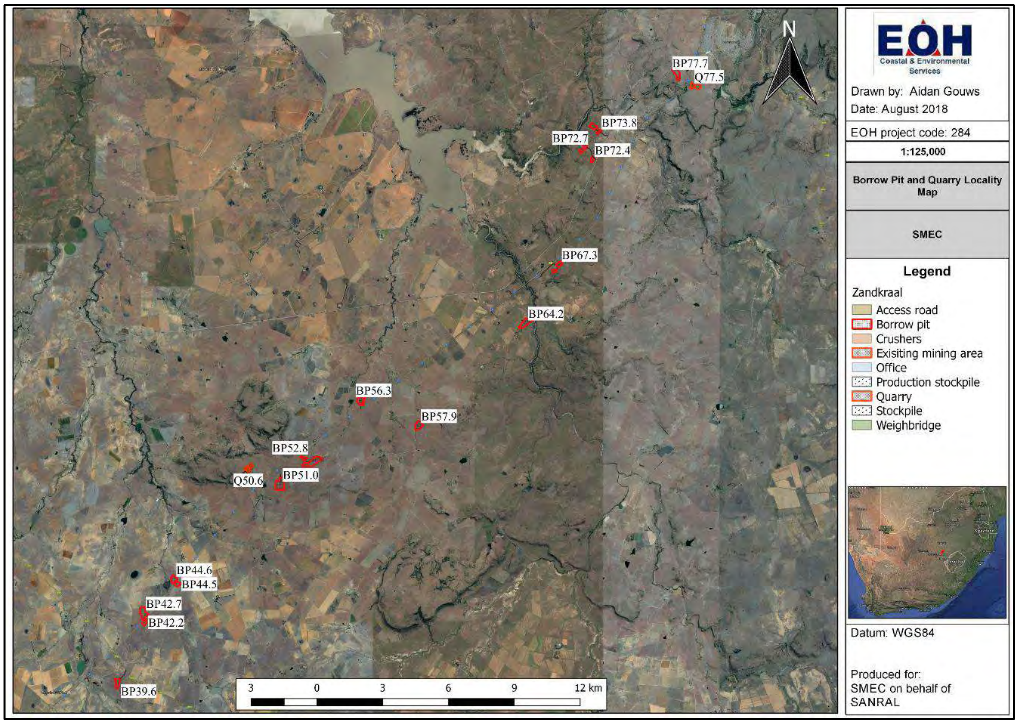


Figure 1.1 Proposed location of the borrow pits and quarries.

1.3. Alternatives

The report did not assess any alternatives, except for the "no-go" alternative.

1.4. Objectives

The main objective of this report is to assess the ecological environment as well as the potential impact that the proposed borrow pits and quarries may have on the ecological environment.

The following terms of reference were used to inform this study:

- Undertake a desktop assessment of the biodiversity and conservation value of the study area in terms of the relevant conservation plans;
- Identify any significant landscape features of rare or important vegetation/faunal associations such as seasonal wetlands, seeps or rocky areas that might support rare or important species;
- Place the project area within the biodiversity context of the wider area (i.e. provide the "broad overview");
- Describe the impacts of current land use, so that the potential impacts from the development on the natural environment can be understood in this context;
- Provide a detailed description of the ecological (fauna and flora) environment within the area and immediately surrounding the footprint of the proposed borrow pits/quarries and consider terrestrial fauna and flora;
- Assess the extent of alien flora and faunal species over the site, and associated risks of alien invasion as a result of the project;
- Provide a sensitivity map of the concession area in order for the proponent to better place the layout of the project's infrastructure;
- Review relevant legislation, policies, guidelines and standards;
- An assessment of the potential direct and indirect impacts resulting from the proposed mining areas and associated infrastructure, both on the footprint and the immediate surrounding area during construction and operation;
- A detailed description of appropriate mitigation measures that can be adopted to reduce negative impacts for each phase of the project, where required;
- Address all ecological issues and concerns raised by I&APs during the EIA process;
- Checklists of floral and faunal groups identified in the region to date, highlighting sensitive species and their possible areas of distribution. This aspect of the report will specifically include the identification of:
  a) Areas of high biodiversity;
  b) The presence of species of conservation concern;
  c) Habitat associations and conservation status of the identified fauna and flora;
  d) The presence of areas sensitive to invasion by alien species; and
  e) The presence of conservation areas and sensitive habitats where disturbance should be avoided or minimised.

1.5. Approach

The study sites for the proposed borrow pits and quarries and surrounding areas were assessed using a two-phased approach. Firstly, a desktop assessment of the sites was conducted in terms of current relevant vegetation and biodiversity programmes and plans. This included the consideration of:

- The South African Vegetation Map (Mucina and Rutherford, 2012);
- Department of Agriculture, Fisheries and Forestry (DAFF) - Indigenous forest maps;
- National Freshwater Ecosystem Priority Areas (NFEPA) - Water bodies and wetlands;
- National Environmental Management Biodiversity Act (NEMBA) - Biodiversity Regulations; and
- Plants of Southern Africa (POSA) – Quarter degree square level.

A single site visit of the proposed borrow pits and quarries was conducted on the 6th November 2018. The site visit was used to conduct floral surveys and to identify potential impacts of the proposed mining activities on the surrounding natural environment and to inform the significance of the potential impacts identified.

1.6. Assumptions and limitations

This report is based on currently available information and, as a resu. In addition, data analysed in this report was generated based on a single site survey of plant and animal species conducted in November 2018 (late spring). As a result, the sampling reflects an indicative representation of what pants may occur onsite as some flowering plant species may have be dormant during the survey.

2. Assessment methodology

Appendix 6
Specialist Reports
1. (1) A specialist report prepared in terms of these Regulations must contain—
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;

The aim of this assessment is to identify areas of ecological importance and to evaluate these in terms of their conservation importance. In order to do so, the ecological sensitivity of the area is assessed as well as an identification of potential plant and animal Species of Conservation Concern (SCC) that may occur in habitats present in the area. To a large extent, the condition and sensitivity of the vegetation will also determine areas with high biodiversity. This study also aims at identifying areas of high sensitivity and those that may be subject to significant impacts as a result of the mining activities.

The approach to determining the ecological sensitivity of the study area is described below. Zones of LOW, MODERATE and HIGH sensitive areas were identified by the presence or lack of the following:

- Degree of disturbance and transformation;
- Presence of plant and faunal Species of Conservation Concern (SCC);
- Vegetation types (which also constitute faunal habitats) of conservation concern;
- Areas of high biodiversity;
- The presence of important process areas such as:
    - Ecological corridorsand
    - Topographical features (especially steep and rocky slopes that provide niche habitats for both plants and animals).

A Geographical Information System (GIS) map was then produced depicting the different zones of sensitivity using available aerial imagery and relating this to the information gathered from the field survey.

It is not the aim of this study to produce a complete list of all plant and animal species occurring in the region, but rather to examine a representative sample. It is however, important to note that areas of high sensitivity as well as SCC have been identified as far as possible, either from records from the site or a review of their habitat requirements, and whether or not these habitats occur within the site.

2.1. Species of Conservation Concern (SCC)

Data on the known distribution and conservation status for each potential plant SCC needs to be obtained in order to develop a list of SCC. These plant species are those that are subject to significant impacts from any proposed activity. In general these will be species that are already known to be threatened or at risk. Efforts to provide the conservation status ('red list' status) of individual species may provide additional valuable information on SCC (see http://www.iucnredlist.org/). Species of Conservation Concern (SCC) have been identified by means of a combination of applicable legislation, guidelines and conservation status lists. The following lists were utilised to cross reference conservation and protection statuses of various species:

- National Environmental Management: Biodiversity Act (No. 10 of 2004) - Chapter 4, Part 2
- Endangered and Protected Flora in the 1974 Provincial Nature Conservation Ordinance (PNCO) – Schedule 3 and 4
- 1976 List of Protected Trees (Government Gazette No. 9542 Schedule A) in the 1998 National Forest Act (NFA) as amended in November 2014
- SA Red List

The South African Red List of plants uses the internationally recognised IUCN Red List Categories and Criteria to measure a species risk of extinction (Table 2.1). Since the Red List of South African plants are used widely for conservation practices throughout South Africa, this list has been modified to identify species that are at low risk of extinction but of high conservation importance.

Species that are afforded special protection, which are protected by CITES (Convention on International Trade in Endangered Species of Wild Flora and Fauna) are also regarded as SCC (see http://www.cites.org/).

Definitions:

The South African (SA) Red List system contains nine categories, with the main purpose of classifying species from lowest (Least Concern) to highest (Critically Endangered) threat in terms of risk of extinction (see Figure 2.1). Species that are at high risk of extinction are placed in one of three categories: Vulnerable (VU), Endangered (EN) or Critically Endangered (CR). If a species is classified into one of these three categories, it is considered as an SCC.

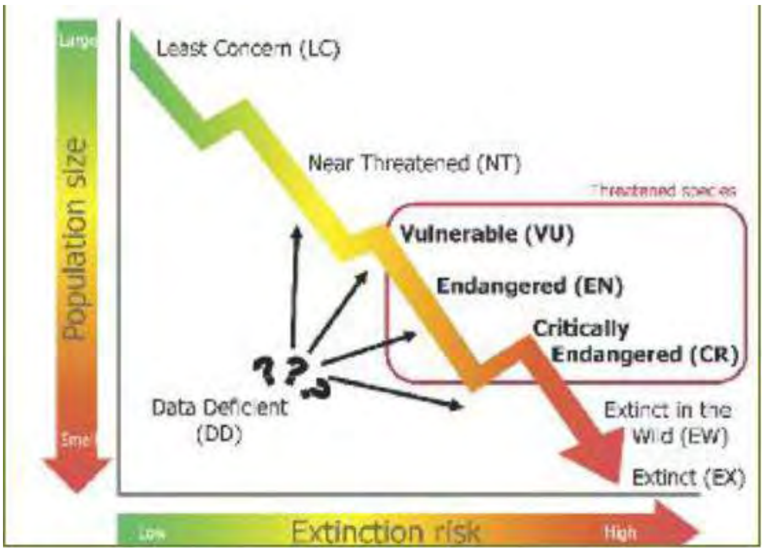


Figure 2.1: The SA Red List system categorizes species according to their risk of extinction *(Source: SA Red Data Guidelines)*.

A species' classification is guided by five criteria relating to different biological factors that indicate danger of extinction (Table 2.2). A species should always be evaluated against all five criteria, but available data only need to meet the requirements for at least one criterion in order to classify a species as threatened. A species is always classified in the highest category of threat for which it meets the quantitative thresholds of at least one criterion.

The management guidelines for threatened species are provided in Table 2.1 below (Source: SA Red Data Guidelines):

Table 2.1: Guidelines for the management of the various categories

Status	Criterion*	Guidelines for Recommendation
[a] Please notify the Threatened Species Programme immediately and provide details of the location, size and threats to the subpopulation. The fact that a subpopulation of the species was found at a site zoned for development means that its Red List status has to be reviewed and is likely to be upgraded.		
** Refer to Table 2.2 for criteria descriptions*		
[a]Critically Endangered	E	No further loss of natural habitat should be permitted as the species is on the brink of extinction, and all other known subpopulations have been lost. The subpopulation in question is likely to be newly discovered and the only remaining subpopulation of this species.
Critically Endangered	A,B,C,D	No further loss of natural habitat should be permitted as the species is on the verge of extinction.
Endangered	B,C,D	No further loss of habitat should be permitted as the species is likely to go extinct in the near future if current pressures continue. All remaining subpopulations have to be conserved if this species is to survive in the long term.
Endangered	A	If the species has a restricted range (< 2 000 km^2), recommend no further loss of habitat. If range size is larger, the species is possibly long- lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of the National Environmental Management: Protected Areas Act (Act 57 of 2003), and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
[a]Vulnerable	D	This species either constitutes less than 1 000 individuals or is known from a very restricted range. No further loss of habitat should be permitted as the species' status will immediately become either Critically Endangered or Endangered, should habitat be lost.
Vulnerable	B,C	The species is approaching extinction but there are still a number of subpopulations in existence. Recommend no further loss of habitat as this will increase the extinction risk of the species.
Vulnerable	A	If the species has a restricted range, < 2 000 km^2, recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered under certain circumstances, such as the implementation of an offset whereby another viable, known subpopulation is formally conserved in terms of the Protected

Status	Criterion*	Guidelines for Recommendation
		Areas Act, and provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
[a]Data Deficient	D	This species is very poorly known, with insufficient information on its habitat, population status or distribution to assess it. However, it is highly likely to be threatened. If a Data Deficient species will be affected by a proposed activity, the subpopulation should be well surveyed and the data sent to the Threatened Species Programme. The species will be reassessed and the new status of the species, with a recommendation, will be provided within a short timeframe.
Data Deficient		There is uncertainty regarding the taxonomic status of this species, but it is likely to be threatened. Contact the taxonomist working on this group to resolve its taxonomic status; the species will then be reassessed by the Threatened Species Programme.
[a]Near Threatened	D	Currently known from fewer than 10 locations, therefore preferably recommend no loss of habitat. Should loss of this species' habitat be considered, then an offset that includes conserving another viable subpopulation (in terms of the Protected Areas Act) should be implemented, provided that the subpopulation to be destroyed does not occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
Near Threatened	B,C	The species is approaching thresholds for listing as threatened but there are still a number of subpopulations in existence and therefore there is need to minimise loss of habitat. Conservation of subpopulations is essential if they occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant spatial biodiversity plan or (iii) on a site associated with additional ecological sensitivities.
Near Threatened	A	If the species has a restricted range, < 2 000 km^2, then recommend no further loss of habitat. If range size is larger, the species is possibly long-lived but widespread, and limited habitat loss may be considered. Conservation of subpopulations is essential if they occur (i) within a threatened ecosystem or (ii) within an area required for biodiversity conservation in terms of a relevant biodiversity conservation plan or (iii) on a site associated with additional ecological sensitivities.
[a]Critically Rare		This is a highly range-restricted species, known from a single site, and therefore no loss of habitat should be permitted as it may lead to extinction of the species. The Threatened Species Programme is not aware of any current threats to this species and should be notified without delay.
[a]Rare		The species is likely to have a restricted range, or be highly habitat specific, or have small numbers of individuals, all of which makes it vulnerable to extinction should it lose habitat. Recommend no loss of habitat. The Threatened Species Programme is not aware of any current threats to this species and should be notified without delay.

Status	Criterion*	Guidelines for Recommendation
Declining		The species is declining but the population has not yet reached a threshold of concern; limited loss of habitat may be permitted. Should the species is known to be used for traditional medicine and if individuals will not be conserved *in situ*, plants should be rescued and used as mother stock for medicinal plant cultivation programmes.

Table 2.2: The biological indicators of extinction risk as contained in each of the five SANBI criteria

Criterion	Biological indicator	Risk factor	Quantitative thresholds CR	EN	VU
A	Large and rapid reduction in population size relative to the life history of the species	Proportion by which population is reduced	>80%	>50%	>30%
B	Small geographic range and decline, population fluctuation or fragmentation	Extent of occurrence (EOO) Area of occupancy (AOO)	<100 km^2 <10 km^2	<5 000 km^2 <500 km^2	<20 000 km^2 <2 000 km^2
C	Small population size and decline	Population size Number of mature individuals in largest subpopulation Proportion of population in largest subpopulation	<250 <50 >90%	<2 500 <250 >95%	<10 000 <1 000 100%
D	Critically small population size or very restricted distribution	Population size Area of occupancy (AOO) Number of locations	<50	<250	<1 000 <20 km^2 Five or fewer
E	Quantitative analysis of extinction risk	Probability of extinction over a specified time period	50%	20%	10%

2.2. Sampling protocol

Each of the 15 borrow pits and 2 quarries were inspected to evaluate vegetation ecosystems and to provide more detailed information on the plant (and animals if noted) communities present. The site inspection took into account the amount of time available for the study and limitations such as the seasonality of animals and vegetation.

Vegetation communities were described according to the dominant species recorded from each type. These were mapped and assigned a sensitivity score.

2.3. Vegetation mapping

Mucina and Rutherford (2006) developed the National Vegetation map as part of a South African National Biodiversity Institute (SANBI) funded project: "It was compiled in order to provide floristically based vegetation units of South Africa, Lesotho and Swaziland at a greater level of detail than had been available before." The map was developed using a wealth of data from several contributors and has allowed for the best national vegetation map to date, the last being that of Acocks developed over 50 years ago. The SANBI Vegetation map informs finer scale bioregional plans such as in fall STEP. This SANBI Vegetation map project has two main aims:

- To determine the variation in and units of southern African vegetation based on the analysis and synthesis of data from vegetation studies throughout the region, and
- To compile a vegetation map. The aim of the map was to accurately reflect the distribution and variation on the vegetation and indicate the relationship of the vegetation with the environment.

For this reason the collective expertise of vegetation scientists from universities and state departments were harnessed to make this project as comprehensive as possible.

The map and accompanying book describes each vegetation type in detail, along with the most important species including endemic species and those that are biogeographically important. This is the most comprehensive data for vegetation types in South Africa. This is compared to actual conditions of vegetation observed onsite during the site assessment through mapping from aerial photographs, satellite images, literature descriptions (e.g. SANBI and OFS Critical Biodiversity Area Maps) and related data gathered on the ground.

2.4. Sensitivity assessment

The sensitivity assessment approach entails identifying zones of **HIGH**, **MODERATE** and **LOW** sensitivity according to a system developed by CES and used in numerous ecological studies. It must be noted that the sensitivity zonings in this study are based solely on ecological characteristics and social and economic factors have not been taken into consideration. The sensitivity analysis described here is based on 11 criteria which are considered to be of importance in determining ecosystem and landscape sensitivity. The method predominantly involves identifying sensitive vegetation or habitat types, topography and land transformation, biodiversity patterns (hotspots) and biodiversity process areas (ecological infrastructure and corridors) (Table 2.3).

Although very simple, this method of analysis provides a good, yet conservative and precautionary assessment of the ecological sensitivity.

Table 2.3: Criteria used for the analysis of the sensitivity of the area.

CRITERIA		LOW SENSITIVITY	MODERATE SENSITIVITY	HIGH SENSITIVITY
1	**Topography**	Level or even	Undulating; fairly steep slopes	Complex and uneven with steep slopes
2	**Vegetation** - Extent or habitat type in the region	Extensive	Restricted to a particular region / zone	Restricted to a specific locality / site
3	**Conservation status** of fauna / flora or habitats	Well conserved independent of conservation value	Not well conserved, moderate conservation value	Not conserved - has a high conservation value
4	**Species of special concern** - Presence and number	None, although occasional regional endemics	No endangered or vulnerable species, some indeterminate or rare endemics	One or more endangered and vulnerable species, or more than 2 endemics or rare species
5	**Habitat fragmentation** leading to loss of viable populations	Extensive areas of preferred habitat present elsewhere in region not	Reasonably extensive areas of preferred habitat elsewhere and habitat susceptible to fragmentation	Limited areas of this habitat, susceptible to fragmentation

CRITERIA		LOW SENSITIVITY	MODERATE SENSITIVITY	HIGH SENSITIVITY
		susceptible to fragmentation		
6	**Biodiversity** contribution	Low diversity or species richness	Moderate diversity, and moderately high species richness	High species diversity, complex plant and animal communities
7	**Erosion potential** or instability of the region	Very stable and an area not subjected to erosion	Some possibility of erosion or change due to episodic events	Large possibility of erosion, change to the site or destruction due to climatic or other factors
8	**Rehabilitation** potential of the area or region	Site is easily rehabilitated	There is some degree of difficulty in rehabilitation of the site	Site is difficult to rehabilitate due to the terrain, type of habitat or species required to reintroduce
9	**Disturbance** due to human habitation or other influences (alien invasive species)	Site is very disturbed or degraded	There is some degree of disturbance of the site	The site is hardly or very slightly impacted upon by human disturbance
10	**Ecological function** in the landscape (corridor, niche habitats)	Low ecological function. No corridors or niche habitats	N/A (There are NO moderate ecological functions. It is considered either high or low)	High ecological function. Portions of entire sections of the site contains corridors or niche habitats
11	**Ecological services** (food, water filter, grazing, etc.)	Low to no ecological services on site	Some sections of the site contain ecological services	Most of the site contains ecological services

A sensitivity map was developed with the aid of a satellite image so that the sensitive regions and vegetation types could be plotted (see Chapter 6). The following was also taken into account:

2.4.1. Biodiversity Regulations

National:
The National Environmental Management: Biodiversity Act, (Act No. 10 OF 2004) (NEM:BA) provides a National List of Ecosystems that are threatened and in need of protection – GN 1002 of 2011. These areas are included in the sensitivity map.

Provincial:

Terrestrial Critical Biodiversity Areas for the Free State (2015)

The Critical Biodiversity Areas map for the Free State was completed in 2015. It accounts for terrestrial areas only. The inclusion of the aquatic component was limited to the Freshwater Ecosystem Priority Areas (FEPA) catchments (included in the cost layer and for the identification of Ecological Support Areas (ESAs)) and wetland clusters (included in the ESAs only).

A key output is a map indicating Critical Biodiversity Areas (CBAs) and ESAs. CBAs are areas that are important for conserving biodiversity while ESAs are areas that are important to ensure the long term persistence of species or functioning of other important ecosystems. Degradation of CBAs or ESAs could potentially result in the loss of important biodiversity features and/or their supporting ecosystems.

The various map categories include **Protected areas, CBA 1, CBA 2, ESA 1, ESA 2** and **degraded areas**.

2.4.1. Protected areas

The National Environmental Management Protected Areas Act (Act No 57 of 2003; NEMPAA) was developed to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. All protected areas within 15 km of the study site were listed. Impacts were identified and mitigations proposed.

The goal of the National Protected Areas Expansion Strategy (NPAES) is to achieve cost-effective protected area expansion for ecological sustainability and increased resilience to climate change. It sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. The NPAES has classified protected areas into three categories: formally protected areas, informally protected areas and focus areas. Focus areas are large, intact and unfragmented areas suitable for the creation or expansion of large protected areas.

2.5. Impact assessment

2.5.1. Impact rating methodology

To ensure a direct comparison between various specialist studies, a standard rating scale has been defined by CES and will be used to assess and quantify the identified impacts in the overall EIA process.

CES has developed an evaluation criteria of impacts in accordance with the requirements outlined in Appendix 2 of the EIA Regulations (2014, as amended). This scale takes into consideration the following variables:

The following standard rating scales have been defined for assessing and quantifying the identified impacts. This is necessary since impacts have a number of parameters that need to be assessed.

Eight factors are considered when assessing the significance of the identified issues and impacts, namely:

- **Nature:** negative or positive impact on the environment.
- **Type:** direct, indirect and/or cumulative effect of impact on the environment.

EFFECT

- **Duration:** - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.
- **Extent:** - the spatial scale defines the physical extent of the impact.
- **Probability:** - the likelihood of impacts taking place as a result of project actions arising from the various alternatives. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident) and may or may not result from the proposed development and alternatives. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.
- **Severity:** - the severity (or also consequence) scale (see Table 2.5 below) is used in order to objectively evaluate how severe a number of negative impacts might be on the issue under consideration, or how beneficial a number of positive impacts might be on the issue under consideration.

REVERSIBILITY / MITIGATION

- **Reversibility / Mitigation** – The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. The four categories used are listed and explained in Table 2.4 below. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

OVERALL SIGNIFICANCE

- **Significance:** - Each of the above criterion (points 3-6 above) are ranked with scores assigned, as presented in Table 2.4 to determine the overall significance of an activity. The total scores recorded for the effect (which includes scores for duration; extent; probability and severity) and reversibility / mitigation are then read off the matrix presented in Table 2.6, to determine the overall significance of the issue. The overall significance is either negative or positive.

The impact is first classified as a positive (+) or negative (-) impact. The impact then undergoes an evaluation according to a set of criteria.

Table 2.4: Ranking of Evaluation Criteria.

Effect	**Duration**	
	Short term	Less than 5 years
	Medium term	Between 5-20 years
	Long term	More than 20 years
	Permanent	Over 40 years or resulting in a permanent and lasting loss
	Extent	
	Localised	Impacts affect a small area of a few hectares in extent. Often only a portion of the project area.
	Study area	The proposed site and its immediate surroundings.
	Municipal	Impacts affect the Nelson Mandela Bay Metropolitan Municipality, or any towns within the municipality.
	Regional	Impacts affect the wider area or the Eastern Cape Province as a whole.
	National	Impacts affect the entire country.

	International/Global	Impacts affect other countries or have a global influence.
	Consequence	
	Slight	Slight impacts or benefits on the affected system(s) or party(ies)
	Moderate	Moderate impacts or benefits on the affected system(s) or party(ies)
	Severe/ Beneficial	Severe impacts or benefits on the affected system(s) or party(ies)
	Probability	
	Definite	More than 90% sure of a particular fact. Should have substantial supportive data.
	Probable	Over 70% sure of a particular fact, or of the likelihood of that impact occurring.
	Possible	Only over 40% sure of a particular fact, or of the likelihood of an impact occurring.
	Unsure/Unlikely	Less than 40% sure of a particular fact, or of the likelihood of an impact occurring.
Reversibility/ Mitigation	**Impact Reversibility / Mitigation**	
	Easy	The impact can be easily, effectively and cost effectively mitigated/reversed
	Moderate	The impact can be effectively mitigated/reversed without much difficulty or cost
	Difficult	The impact could be mitigated/reversed but there will be some difficultly in ensuring effectiveness and/or implementation, and significant costs
	Very Difficult	The impact could be mitigated/reversed but it would be very difficult to ensure effectiveness, technically very challenging and financially very costly

Table 2.5: Impacts Severity Rating.

Impact severity *(The severity of negative impacts, or how beneficial positive impacts would be on a affected system or affected party)*	
Very severe	**Very beneficial**
An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example the permanent loss of land.	A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit. For example the vast improvement of sewage effluent quality.
Severe	**Beneficial**
Long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.	A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.
Moderately severe	**Moderately beneficial**
Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing a sewage treatment facility where there was vegetation with a low conservation value.	A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a 'slight' improvement in sewage effluent quality.
Slight	**Slightly beneficial**

Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.	A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.
No effect	**Don't know/Can't know**
The system(s) or party(ies) is not affected by the proposed development.	In certain cases it may not be possible to determine the severity of an impact.

Table 2.6: Overall Significance Rating.

OVERALL SIGNIFICANCE *(THE COMBINATION OF ALL THE ABOVE CRITERIA AS AN OVERALL SIGNIFICANCE)*	
VERY HIGH NEGATIVE	**VERY BENEFICIAL (VERY HIGH +)**
These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects. Example: The loss of a species would be viewed by informed society as being of VERY HIGH significance. Example: The establishment of a large amount of infrastructure in a rural area, which previously had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.	
HIGH NEGATIVE	**BENEFICIAL (HIGH +)**
These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light. Example: The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated. Example: The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops in the soil) would be HIGH.	
MODERATE NEGATIVE	**SOME BENEFITS (MODERATE +)**
These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are real but not substantial. Example: The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant.	
LOW NEGATIVE	**FEW BENEFITS (LOW +)**
These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are not substantial and are likely to have little real effect. Example: The temporary changes in the water table of a wetland habitat, as these systems are adapted to fluctuating water levels. Example: The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people who live some distance away.	
NO SIGNIFICANCE	
There are no primary or secondary effects at all that are important to scientists or the public. Example: A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.	
DON'T KNOW	
In certain cases it may not be possible to determine the significance of an impact. For example, the primary or secondary impacts on the social or natural environment given the available information. Example: The effect of a development on people's psychological perspective of the environment.	

Cumulative Impacts:

Cumulative impacts affect the significance ranking of an impact because the impact is taken in consideration of both onsite and offsite sources. For example, pollution making its way into a river from a development may be within acceptable national standards. Activities in the surrounding area may also create pollution which does not exceed these standards. However, if both onsite and offsite activities take place simultaneously, the total pollution level may exceed the standards. For this reason it is important to consider impacts in terms of their cumulative nature.

Seasonality:

Although seasonality is not considered in the ranking of the significance, it may influence the evaluation during various times of the year. As seasonality will only influence certain impacts, it will only be considered for these, with management measures being imposed accordingly (i.e. dust suppression measures being implemented during the dry season).

3. RELEVANT LEGISLATION

Environmental legislation relevant to the proposed borrow pits and quarry sites is summarised in Table 3.1 below. Biodiversity Plans and Programmes are discussed in Chapter 5 where they are used to describe the desktop ecological conditions of the study area.

Table 3.1. Environmental legislation considered in the preparation of the Ecological Assessment for the proposed project.

Title of Environmental legislation, policy or guideline	Implications for the upgrade of the R336
Constitution Act (No. 108 of 1996)	- Obligation to ensure that the proposed borrow pits and quarry sites will not result in pollution and ecological degradation; and - Obligation to ensure that the proposed borrow pits and quarry sites are ecologically sustainable, while demonstrating economic and social development.
National Environmental Management Act (NEMA) (No. 107 of 1998)	- The developer of the proposed borrow pits and quarry sites must apply the NEMA principles, the fair decision-making and conflict management procedures that are provided for in NEMA; and - The developer must apply the principles of Integrated Environmental Management and consider, investigate and assess the potential impact of existing and planned activities on the environment, socio-economic conditions and the cultural heritage.
National Environment Management: Biodiversity Act (NEMBA) (No. 10 of 2004)	- The developer of the proposed borrow pits and quarry sites must: o Conserve endangered ecosystems and protect and promote biodiversity; o Assess the impacts of the proposed development on endangered ecosystems; o Obtain permits to remove or damage protected species; and o Clear all alien vegetation using appropriate means.
Conservation of Agricultural Resources Act (CARA) (No. 43 Of 1983)	- The objectives of this Act are to provide for the conservation of the natural agricultural resources by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants.
National Environmental Management: Protected Areas Act (NEMPAA) (No. 57 of 2003)	- The objective of this Act is to provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; and - In terms of Section 50 (1) (a) (ii) of this Act, the management authority may "*Carry out or allow an activity in the reserve aimed at raising revenue*". However, Section 50 (2) states that such activity may not negatively affect the survival of any species in, or significantly disrupt the integrity of the ecological system of the nature reserve. Furthermore, in terms Section 51 (a), the Minister

Title of Environmental legislation, policy or guideline	Implications for the upgrade of the R336
	or MEC is responsible for the regulations or restrictions of the development and other activities in a protected environment, "*which may be inappropriate for the area, given the purpose for which the area was declared*".
National Water Act (No. 36 of 1998)	- The Act provides details of measures intended to ensure the comprehensive protection of all water resources, including the water reserve and water quality. The current proposed mining activities will likely trigger the need for a water-use license according to Sections 21 (c) and (i) of the Act.
National Forest Act (84 of 1998)	- The Act requires that a permit be obtained should any forests or protected trees be removed during the construction phase of the proposed borrow pits and quarry sites.

4. DESCRIPTION OF THE BIOPHYSICAL ENVIRONMENT

The proposed borrow pits and quarry sites (study area) and surrounding areas were described using a two-phased approach. Firstly, a desktop assessment of the site was conducted in terms of current vegetation classifications, biodiversity programmes and plans. This was followed by a site visit in order to assess the actual ecological state, current land-use, identify potential sensitive ecosystems and identify plant species associated with the proposed project activities (see Chapter 5).

4.1. Background and Literature review

Published literature on the ecology of the study area was referenced in order to describe the study site in the context of the region and the Free State. The following applicable documents/plans are included:

- SANBI vegetation (Mucina & Rutherford, 2012);
- Free State Critical Biodiversity Areas Map (2017);
- The National Freshwater Ecosystem Priority Areas (NFEPA);
- National Protected Areas Act (No. 57 of 2003; NEMPAA);
- National Protected Areas Expansion Strategy (NPAES);
- Review of the SANBI Red Data List (Plants);
- Convention on International Trade in Endangered Species (CITES);
- International Union for Conservation of Nature (IUCN);
- Provincial Nature Conservation Ordinance (PNCO);
- National Biodiversity Management: Biodiversity Act (NEMBA) List of Threatened or Protected Species;
- National Biodiversity Management: Biodiversity Act (NEMBA) List of Alien Invasive Vegetation;
- National Biodiversity Management: Biodiversity Act (NEMBA) National List of Ecosystems that are Threatened and in need of protection; and
- Department of Agriculture, Forestry and Fisheries (DAFF) List of Protected Trees (National Forestry Act, No 84 of 1998; NFA).

4.2. Climate

The study area is located close to the Winburg area in the Free State Province of South Africa. Winburg normally receives about 447 mm of rain per year, with most rainfall occuring mainly during mid-summer. Figure 4.1 (lower left) shows the average rainfall values for Winburg per month. It receives the lowest rainfall (1 mm) in June and the highest (80 mm) in January. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Winburg range from 16.2°C in June to 28.7°C in January. The region is the coldest during June when the mercury drops to 0°C on average during the night. Consult the chart below (lower right) for an indication of the monthly variation of average minimum daily temperatures.

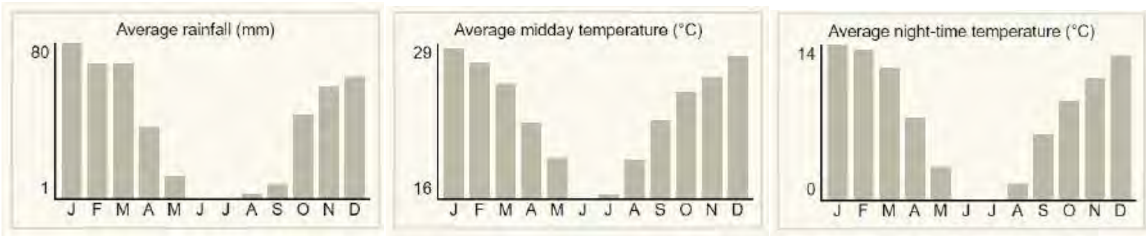


Figure 4.1: Average rainfall and temperature in Winburg (http://www.saexplorer.co.za).

4.3. Topography

The topography of the proposed borrow pits and quarry sites can broadly be described as gently undulating with elevations ranging from about 1460 m.a.s.l. to about 1380 m.a.s.l. (Figure 4.2).

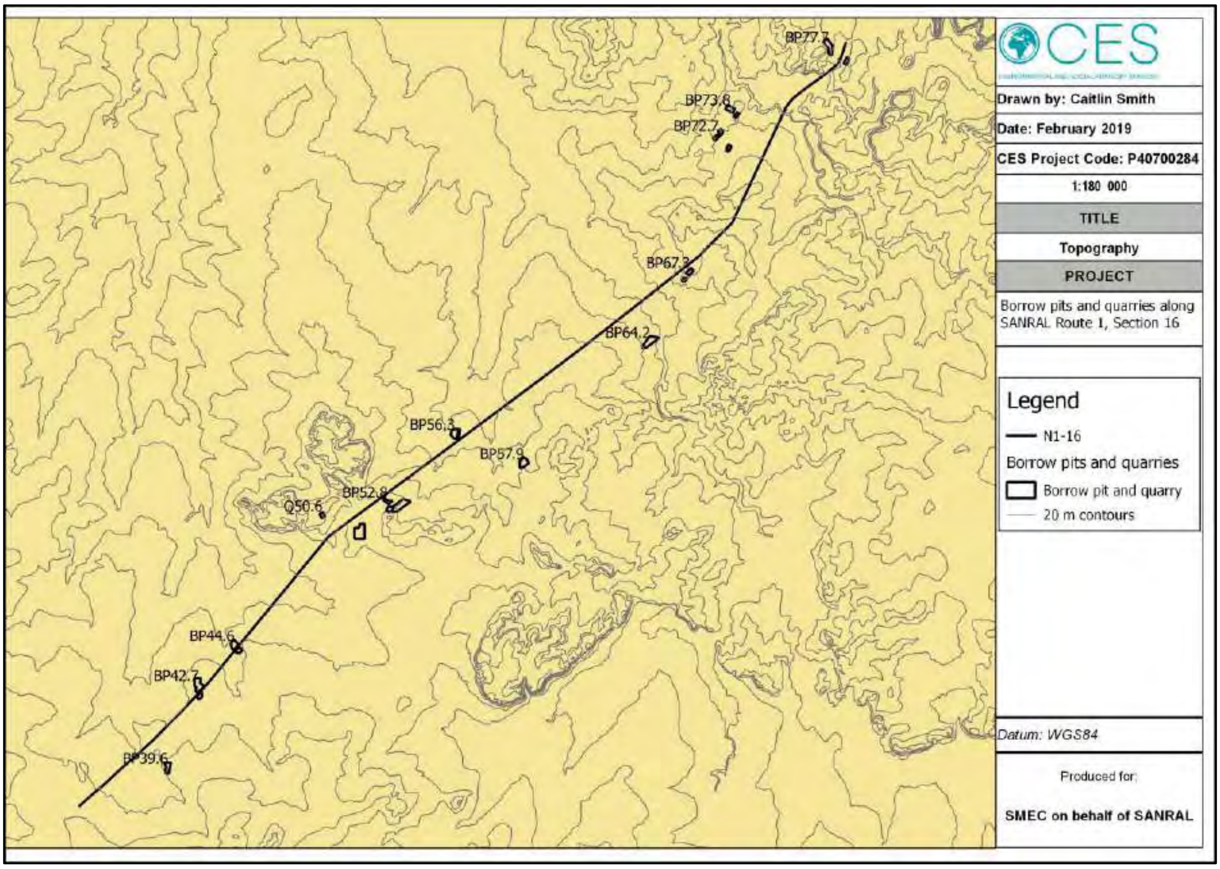


Figure 4.2: Topography of the proposed borrow pits and quarry sites.

4.4. Geology and Soils

The proposed borrow pits and quarry sites are underlain by mudstones and arenites of the Beaufort Group, Karoo Supergroup. Karoo dolerite intrusions are also present surrounding the mining sites (Figure 4.3).

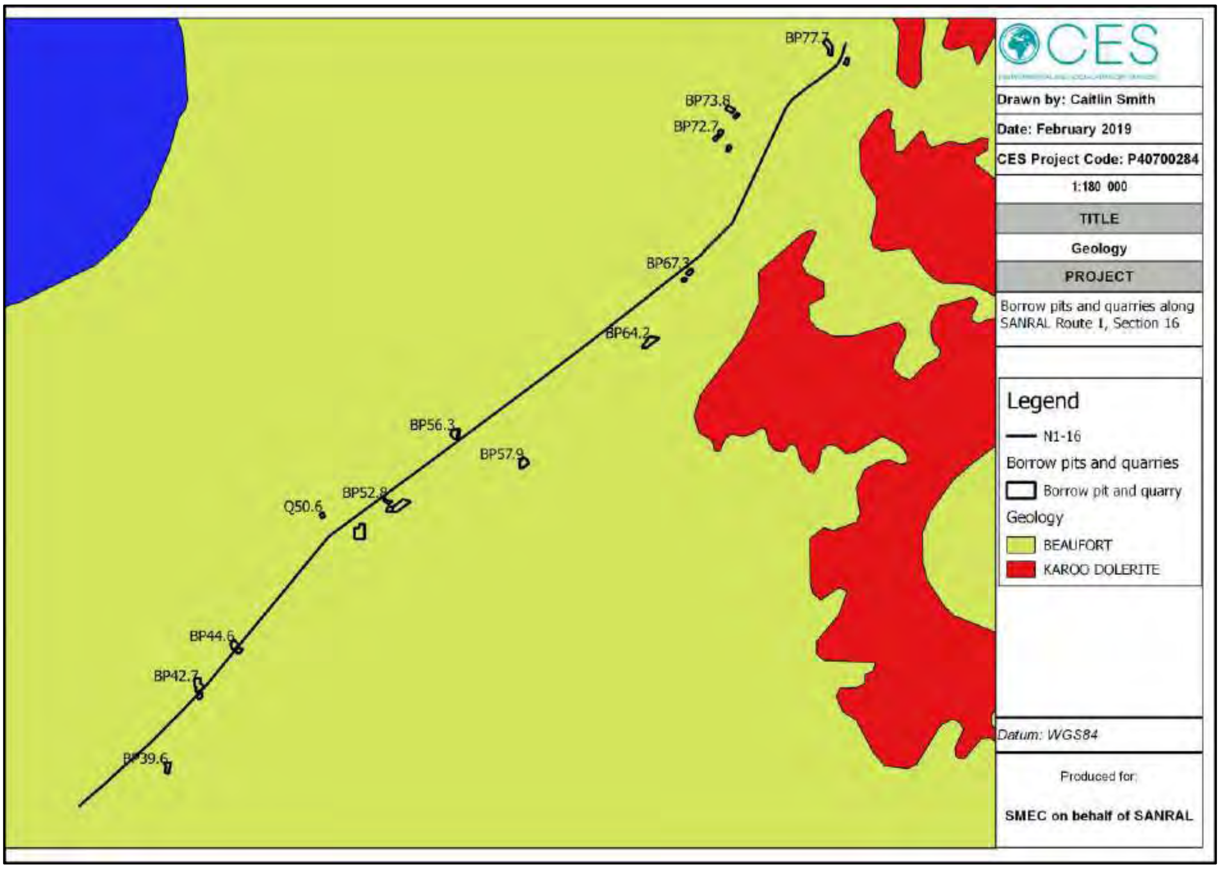


Figure 4.3: Geology of the study area.

According to the Soter soil association map (Figure 4.4), the soils in the study area are described as soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils (association of Leptosols, Regosols, Calcisols and Durisols) as well as black and red, strongly structured clayey soils with high base status (association of Vertisols, Phaoezems, Kastanozems and Nitisols).

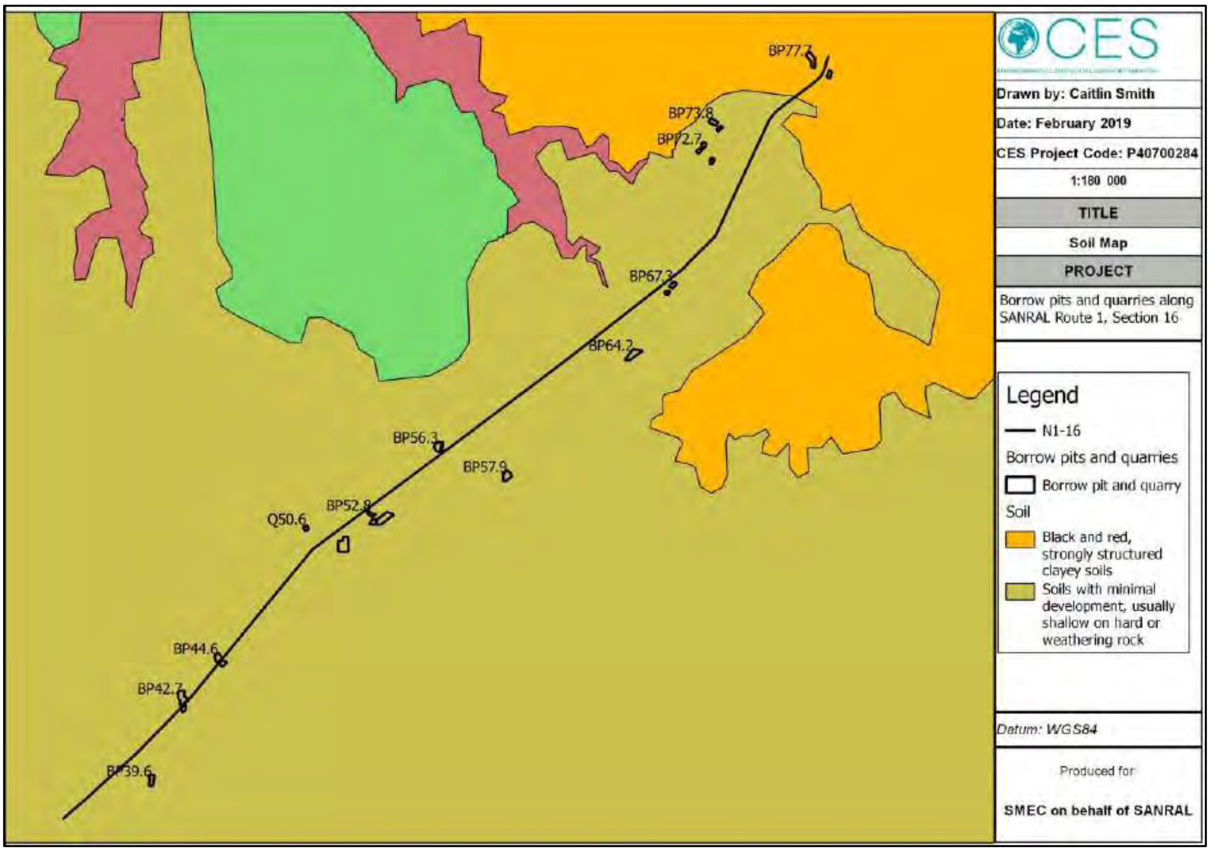


Figure 4.4: SOTER soil association map of the proposed borrow pits and quarry sites.

4.5. Rivers and wetlands

The proposed borrow pits and quarry sites areas are located in close proximity to a number of rivers and wetlands (Figure 4.5).

4.5.1 National Freshwater Ecosystem Priority Areas (2011-2014)

The National Freshwater Ecosystem Priority Areas (NFEPA) project provides strategic spatial priorities for conserving South Africa's freshwater ecosystems and supports sustainable use of water resources. These priority areas are called Freshwater Ecosystem Priority Areas, or 'FEPAs'.

FEPAs were identified based on:

- Representation of ecosystem types and flagship free-flowing rivers;
- Maintenance of water supply areas in areas with high water yield;
- Identification of connected ecosystems;
- Representation of threatened and near-threatened fish species and associated migration corridors; and
- Preferential identification of FEPAs that overlapped with:
  - o Any free-flowing river,
  - o Priority estuaries identified in the National Biodiversity Assessment 2011,
  - o Existing protected areas and focus areas for protected area expansion identified in the National Protected Area Expansion Strategy.

The proposed borrow pits and quarry sites are located in proximity of a number of NFEPA rivers, namely the Taaibosspruit, Vaalbankspruit, Groot-Vet, Klein-Vet and Laaispruit Rivers. The Taaibosspruit River is classified as an **Upstream Management Area**. The Vaalbankspruit River is classified as a **FEPA** river.

The Groot-Vet, Klein-Vet and Laaispruit Rivers are not classified.

Upstream Management Areas are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. Upstream Management Areas are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.

River FEPAs achieve biodiversity targets for river ecosystems and threatened/near threatened fish species, and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources.

Figure 4.5 below shows the location of the proposed borrow pits and quarry sites relative to rivers and wetlands. It should be noted that none of the proposed sites straddles a water course.

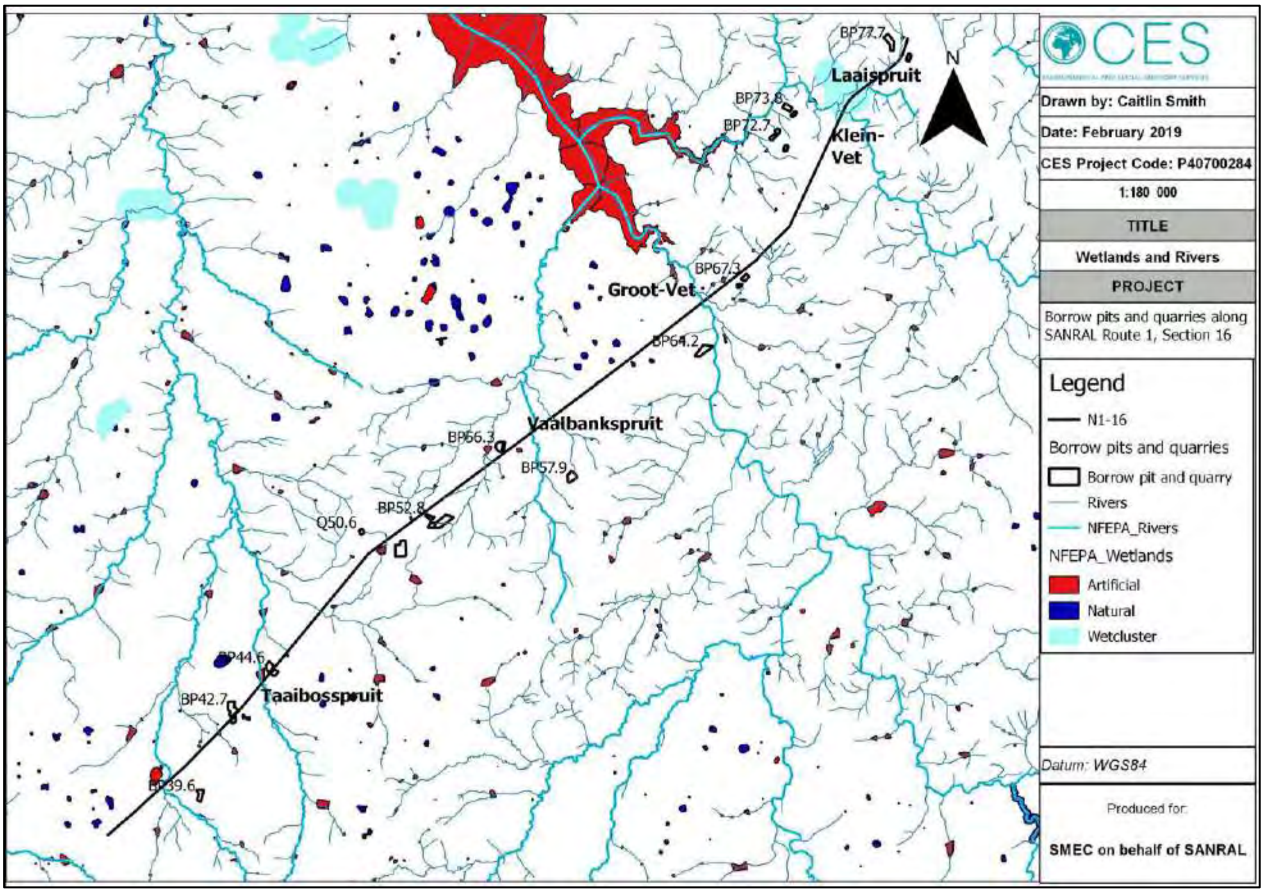


Figure 4.5. Rivers and wetlands surrounding the project site.

4.5.2 Wetlands

Wetlands in South Africa have been mapped on a broad-scale by various stakeholders and have been included in the National Freshwater Ecosystem Priority Assessment (NFEPA, 2011-2014). Due to the broad-scale nature of the NFEPA map it is not spatially accurate and therefore some error is expected. The location of NFEPA wetlands was derived from the National Land Cover 2000 (Van Den Berg et al., 2008) and inland water features from the Department of Land Affairs' Chief Directorate: Surveys and Mapping (DLA-CDSM). All wetlands are classified as either 'natural' or 'artificial' water bodies.

The NFEPA wetland map identifies important or sensitive wetlands and wetland clusters. A wetland cluster is a group of wetlands all within 1 km of each other and which are surrounded by relatively natural vegetation. Wetland clusters allow for important ecological processes such as the migration of insects and frogs between the wetlands.

'Wetland FEPAs' were identified by NFEPA using ranks that were based on a combination of special features and modelled wetland condition. Special features included expert knowledge on features of conservation importance (e.g. Ramsar wetland status, extensive intact peat wetlands, presence of rare plants and animals) as well as available spatial data on the occurrence of threatened frogs and wetland-dependent birds. Although wetland condition was a factor in selection of wetland FEPAs, wetlands did not have to be in a good condition to be chosen as a FEPA. Wetland FEPAs currently in a good ecological condition should be managed to maintain this condition. Those currently in a condition lower than good should be rehabilitated to the best attainable ecological condition.

A number of artificial wetlands (dams) are located within 500 m of the proposed borrow pits and quarry sites (Figure 4.6 to 4.9 below). None of these wetlands will be directly impacted by the mining activities.

Only 1 natural wetland is located in the vicinity of the mining areas (wetland 1 in Figure 4.6), but will not be impacted by mining activities. This wetland is located within 500 m of BP42.2 and BP42.7 and is classified as a **Dry Grassland Group 4 Flat Wetland**. The NFEPA wetland condition for this wetland is listed as AB- natural or good.

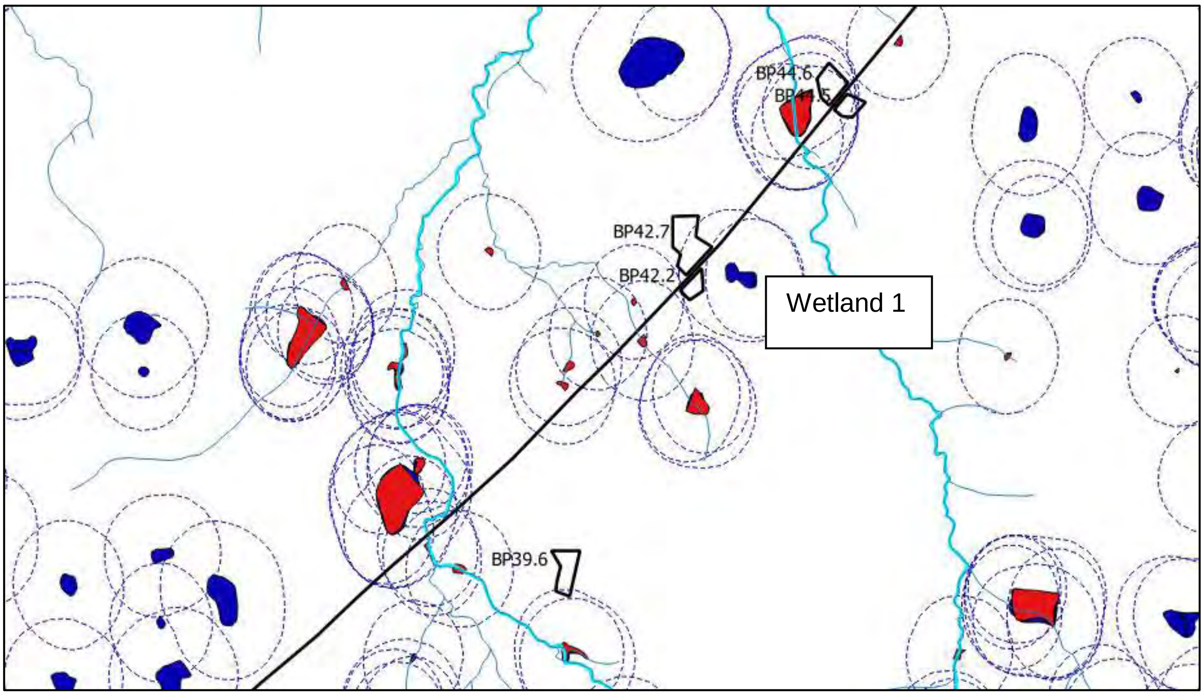


Figure 4.6 Close up wetland map 1 (with 500 m wetland buffer).

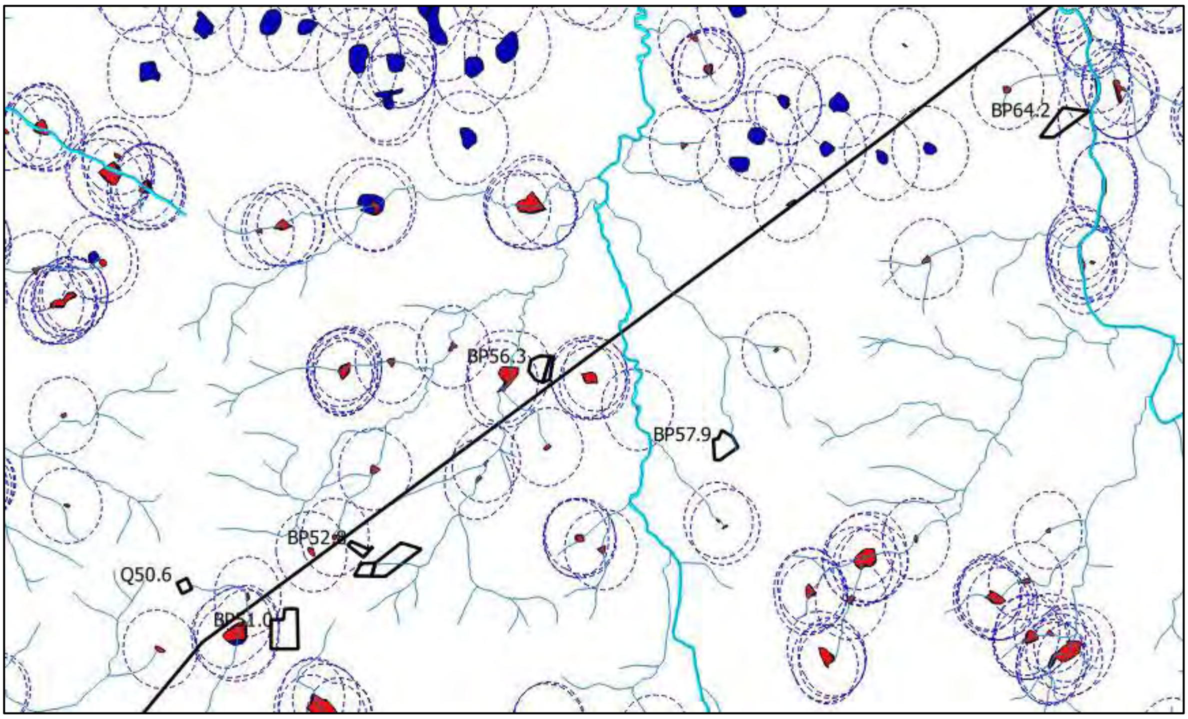


Figure 4.7 Close up wetland map 2 (with 500 m wetland buffer).

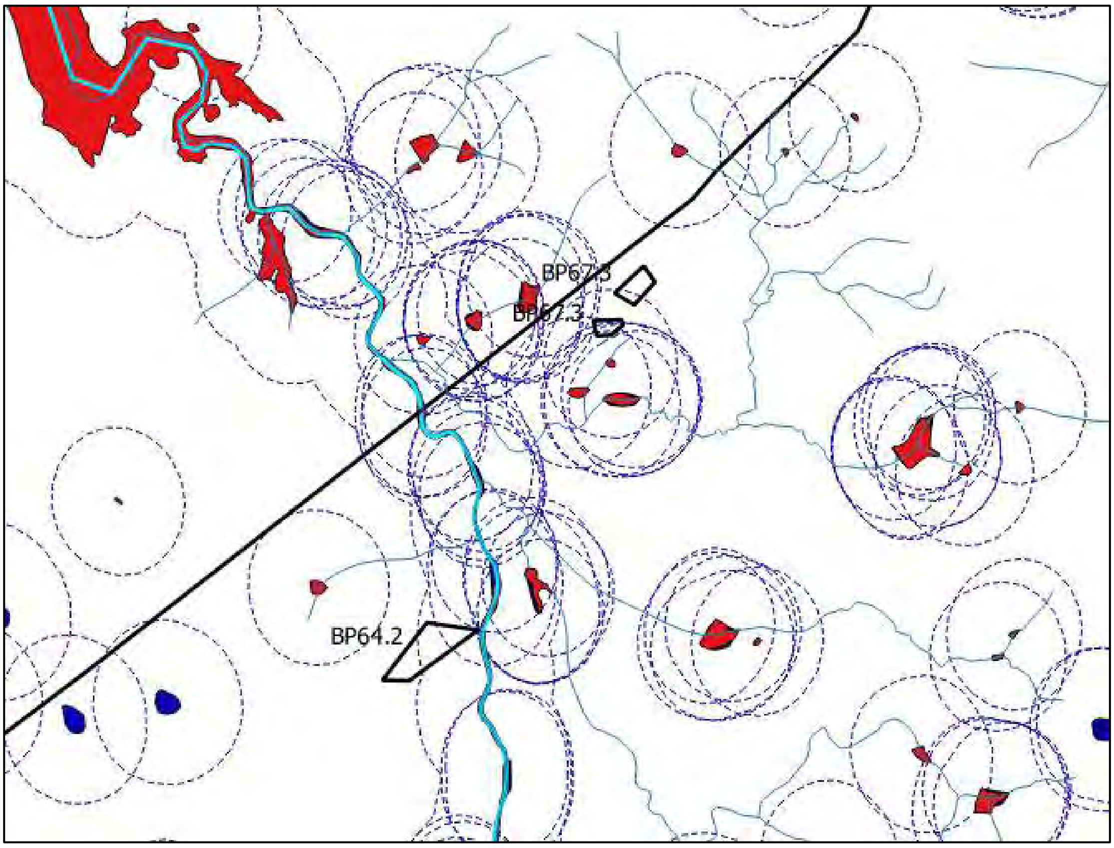


Figure 4.8 Close up wetland map 3 (with 500 m wetland buffer).

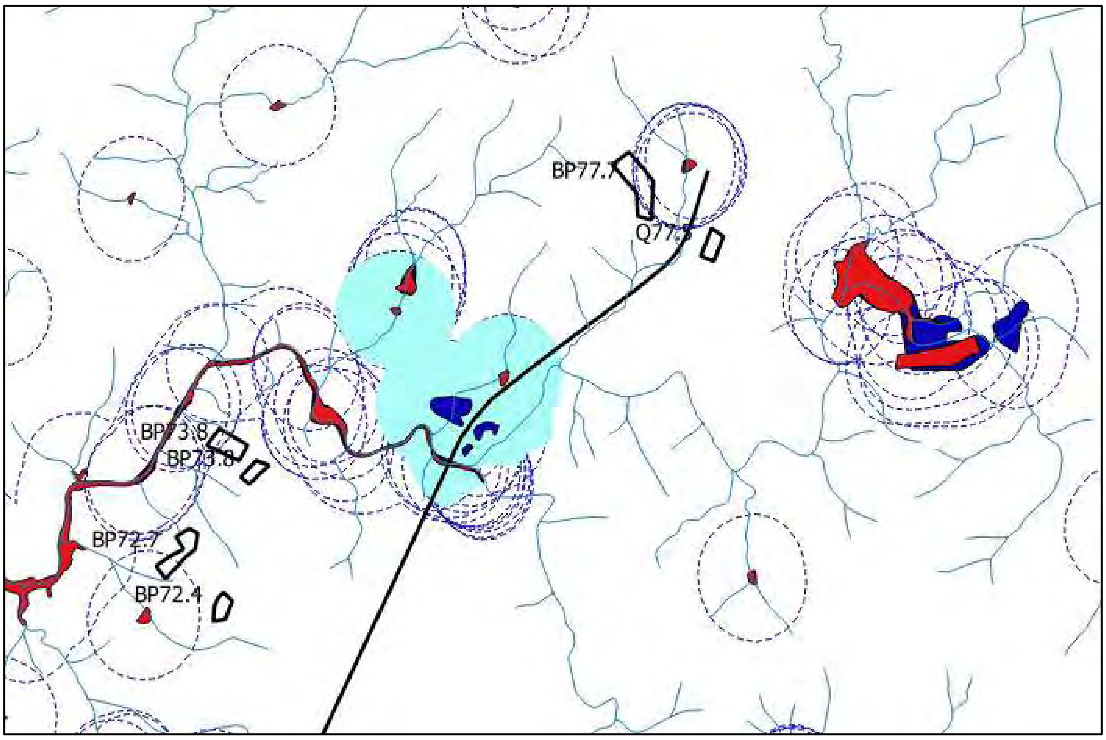


Figure 4.9 Close up wetland map 4 (with 500 m wetland buffer).

4.6. Land cover

The South African Land cover Map provides a key information requirement for a wide range of landscape planning, inventory and management activities. The recent global availability of Landsat 8 satellite imagery offered the opportunity to create a new, national land cover dataset for South Africa, circa 2013-14, replacing and updating the previous 1994 and 2000 South African National Land cover datasets. The land cover for the proposed borrow pits and quarry sites has been illustrated in Figure 4.10 below. Table 4.1 provides a description of each of the land cover classes dentified in Figure 4.10.

The proposed borrow pits and quarry sites are located within and surrounded by dense bush/thicket, woodland and open bushland, grassland, low shrubland, cultivated land, forest plantations, existing mine areas and bare areas.

Table 4.1 Land cover classes for the area surrounding the borrow pits/quarries.

Class number	Class name	Definition
5	Dense Bush, Thicket & Tall Dense Shrubs	Natural / semi-natural tree and / or bush dominated areas, where typically canopy heights are between 2 - 5 m, and canopy density is typically > ± 75%, but may include localised sparser areas down to ± 60%22. Includes dense bush, thicket, closed woodland, tall, dense shrubs, scrub forest and mangrove swamps. Can include self-seeded bush encroachment areas if sufficient canopy density.
6	Woodland and Open Bushland	Natural / semi-natural tree and / or bush dominated areas, where typically canopy heights are between ± 2 - 5 m, and canopy densities typically between 40 - 75%, but may include localised sparser areas down to ± 15 - 20 %28. Includes sparse – open bushland and woodland, including transitional wooded grassland areas. Can include self-seeded bush encroachment areas if canopy density is within indicated range. In the arid western regions (i.e. Northern Cape), this cover class may be associated with a transitional bush / shrub cover that is lower than typical Open Bush / Woodland cover but higher and/or more dense than typical Low Shrub cover.
7	Grassland	Natural / semi-natural grass dominated areas, where typically the tree and / or bush canopy densities are typically < ± 20 %, but may include localised denser areas up to ± 40 %, (regardless of canopy heights)7. Includes open grassland, and sparse bushland and woodland areas, including transitional wooded grasslands. May include planted pasture (i.e. grazing) if not irrigated. Irrigated pastures will typically be classified as cultivated, and urban parks and golf courses etc under urban.
9	Low Shrubland: Other	Cultivated lands used primarily for the production of rain-fed, annual crops for commercial markets. Typically represented by large field units, often in dense local or regional clusters. In most cases the defined cultivated extent represents the actual cultivated or potentially extent.
12	Cultivated land	Cultivated land used for the production of rain-fed, annual crops for commercial markets.
32	Forest plantations: Mature trees	Planted forestry plantations used for growing commercial timber tree species. The class represents mature tree stands which have approximately 70% or greater tree canopy closure (regardless of canopy height), on all the multi-date Landsat images in

Class number	Class name	Definition
		the 2013-14 analysis period. The class includes spatially smaller woodlots and windbreaks with the same cover characteristics.
35	Mine (1) Bare	Mining activity footprint, based on pure, non-vegetated, bare ground surfaces. Includes extraction pits, tailings, waste dumps and associated surface infrastructure such as roads and buildings (unless otherwise indicated), for both active and abandoned mining activities. Class may include open cast pits, sand mines, quarries and borrow pits etc.
36	Mine (semi-bare)	Mining activity footprint, based on semi-bare ground surfaces, which may be sparsely vegetated. Includes extraction pits, tailings, waste dumps and associated surface infrastructure such as roads and buildings (unless otherwise indicated) and surrounding dust-impacted areas, for both active and abandoned mining activities. Class may include open cast pits, sand mines, quarries and borrow pits, etc.
41	Bare	Bare, non-vegetated ground, with little or very sparse vegetation cover (i.e. typically < ± 5 - 10 % vegetation cover), occurring as a result of either natural or man-induced processes. Includes but not limited to natural rock exposures, dry river beds, dry pans, coastal dunes and beaches, sand and rocky desert areas, very sparse low shrublands and grasslands, surface (sheet) erosion areas, severely degraded areas, and major road networks etc. May also include long-term wildfire scars in some mountainous areas in the western Cape.

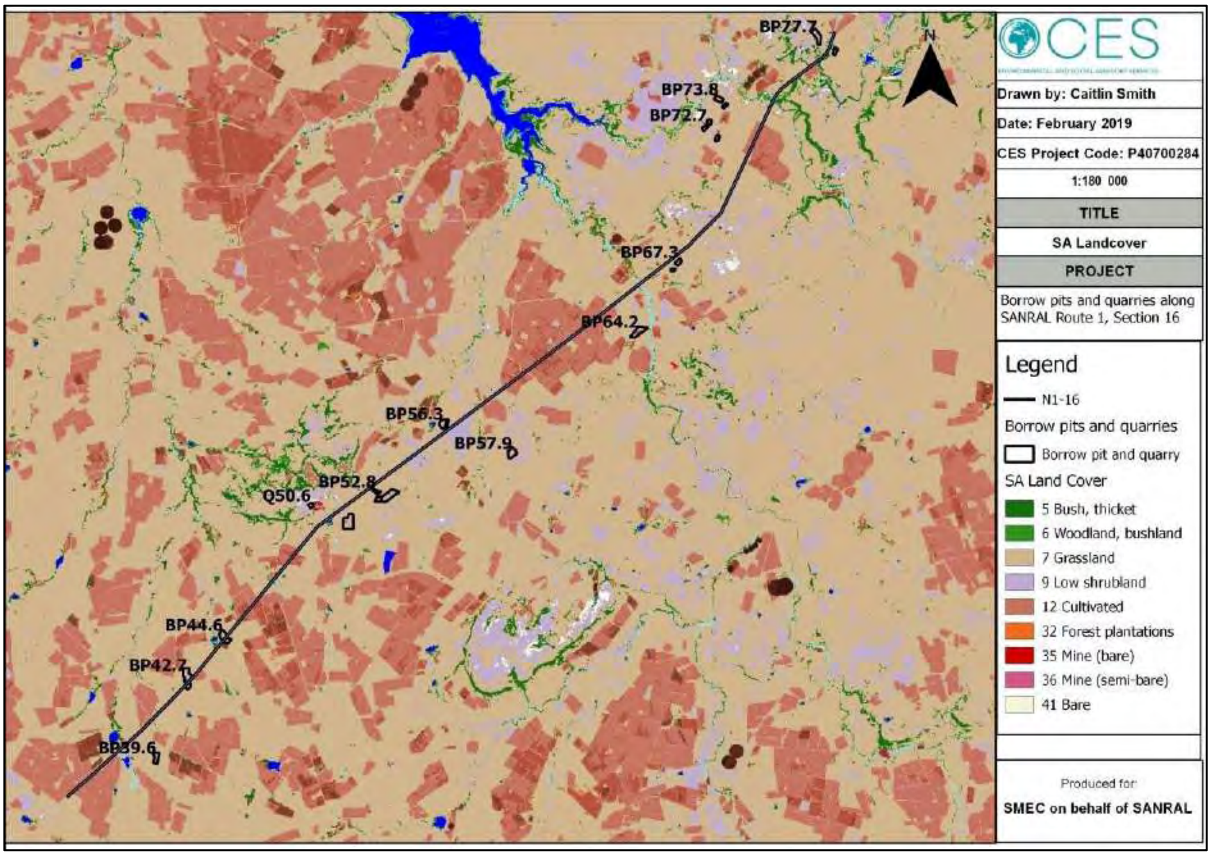


Figure 4.10 Land cover map of the proposed borrow pits and quarry sites.

4.7. Vegetation and floristics

4.7.1. SANBI classification (Mucina and Rutherford, 2018)

The vegetation of the area where the proposed borrow pits and quarry sites will be located is described by the South African National Biodiversity Institute (SANBI) National Vegetation Map as **Central Free State Grassland** and **Winburg Grassy Shrubland** (Figure 4.11).

Central Free State Grassland is distributed in the Free State Province and marginally into Gauteng. There is a broad zone from around Sasolburg in to the north to Dewetsdorp in the south. It is characterised by undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* while *Eragrostis curvula* and *E. chloromelas* become dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with heavy clayed soils are prone to *Acacia karroo* encroachment. This vegetation type is classified as **Vulnerable**.

Winburg Grassy Shrubland is distributed in the Free State Province. There are a series of larger patches between Trompsburg through Bloemfontein and Winburg to Ventersburg. The landscape is characterised by solitary hills, slopes and escarpments of mesas creating a mosaic of habitats ranging from open grassland to shrubland. Tall shrubs and sometimes small trees are sheltered against frequent periods of frost during the winter months and regular veld fires in late winter to early spring. The medium-height evergreen shrublands are dominated by a combination of *Olea europaea* subsp. *africana*, *Euclea crispa* subsp. *crispa*, *Gymnosporia buxifolia*, *Diospyros lycioides*, *Rhus burchellii*, *R.*

ciliate, *R.erosa* (mainly in the south), *Clutia pulchella* and *Grewia occidentalis*. Trees such as *R. lancea*, *Celtis africana* and *Ziziphus mucronata* are found in more deeply incised drainage lines. This vegetation type is classified as **Least Threatened**.

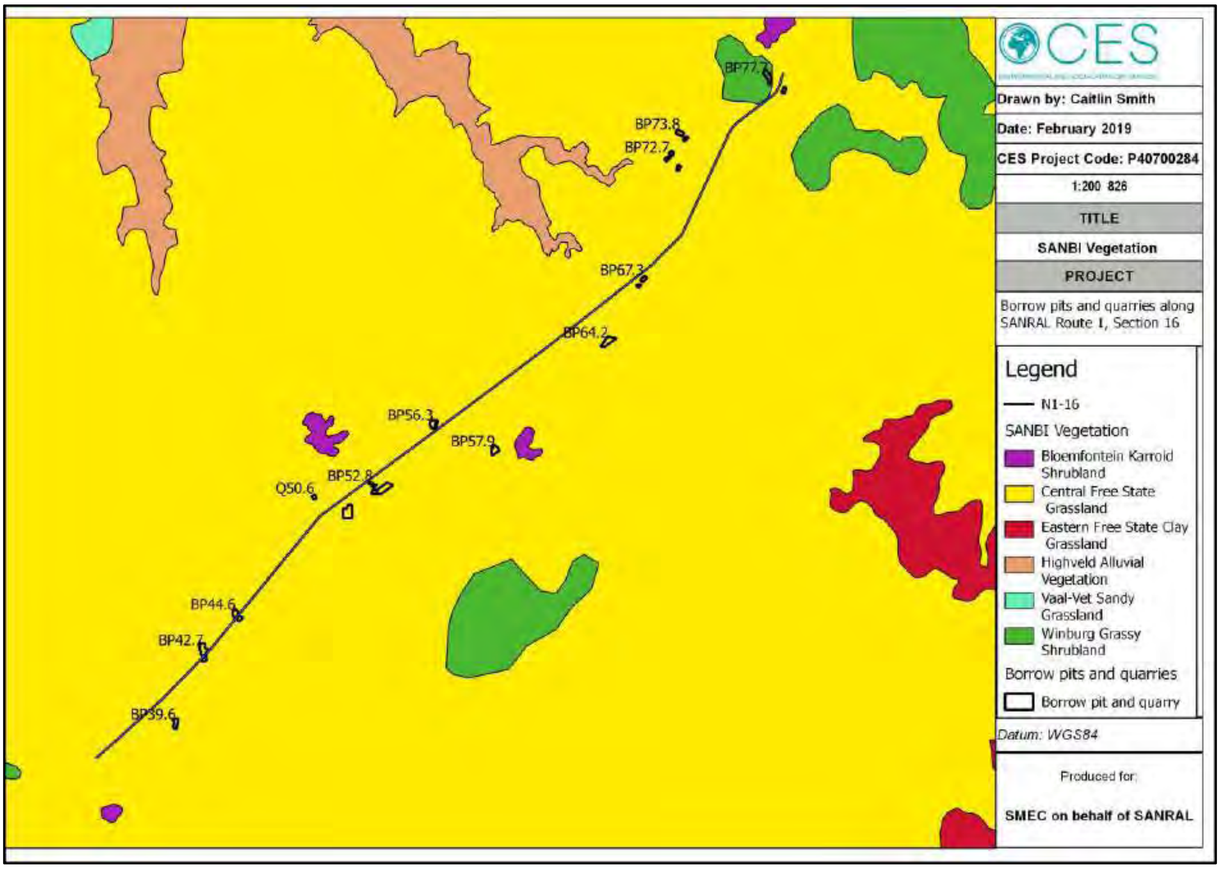


Figure 4.11 SANBI vegetation map of the study area.

4.7.2 Forest classification (NFA)

No natural forest will be impacted by the proposed borrow pits and quarry sites and there are no forest patches in the vicinity of the borrow pits/quarries.

4.8. Biodiversity indicators

South Africa's policy and legislative framework for biodiversity is well developed, providing a strong basis for the conservation and sustainable use of biodiversity. South Africa is one of the few countries in the world to have a Biodiversity Act and a National Biodiversity Institute.

Key components of the national policy and legislative framework for biodiversity include:

1. The White Paper on the Conservation and Sustainable Use of South Africa's Biological Diversity (1997)
2. The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA)
3. NEMBA List of Ecosystems in need of Protection
4. NEMBA List of Threatened or Protected Species

5. NEMBA List of Alien Invasive Species
6. The National Environmental Management: Protected Areas Act (Act 57 of 2003) (NEMPAA)
7. The National Biodiversity Strategy and Action Plan (NBSAP) (2015)
8. The National Spatial Biodiversity Assessment (2004, currently being reviewed and updated) (NSBA)
9. The National Biodiversity Framework (2008) (NBF)
10. The National Protected Area Expansion Strategy (2008) (NPAES)
11. Important Bird Areas (2015)

In addition to national legislation, some of South Africa's nine provinces have their own provincial biodiversity legislation, as nature conservation is a concurrent function of national and provincial government in terms of the Constitution (Act 108 of 1996). The Free State Terrestrial CBA map covers the Free State Province.

4.8.1 Free State Terrestrial Critical Biodiversity Areas (CBAs) (2015)

The Department of Economic, Small Business Development, Tourism and Environmental Affairs (DESTEA) developed the Free State Terrestrial CBA Map in 2015. Figure 4.12 illustrates that none of the proposed borrow pits and quarry sites are located within a CBA, but fall within Ecological Support Areas (ESA) 1 and 2. A description of these classes is provided below.

<table>
<tr><th>CBA Map Category</th><th>Description</th><th>Desired State</th></tr>
<tr><td>ESA 1</td><td rowspan="2">Areas that support the ecological functioning of protected areas or CBAs, or provide important ecological infrastructure.</td><td>Maintain in at least a semi-natural ecological condition.</td></tr>
<tr><td>ESA 2</td><td>No further intensification of land use.</td></tr>
</table>

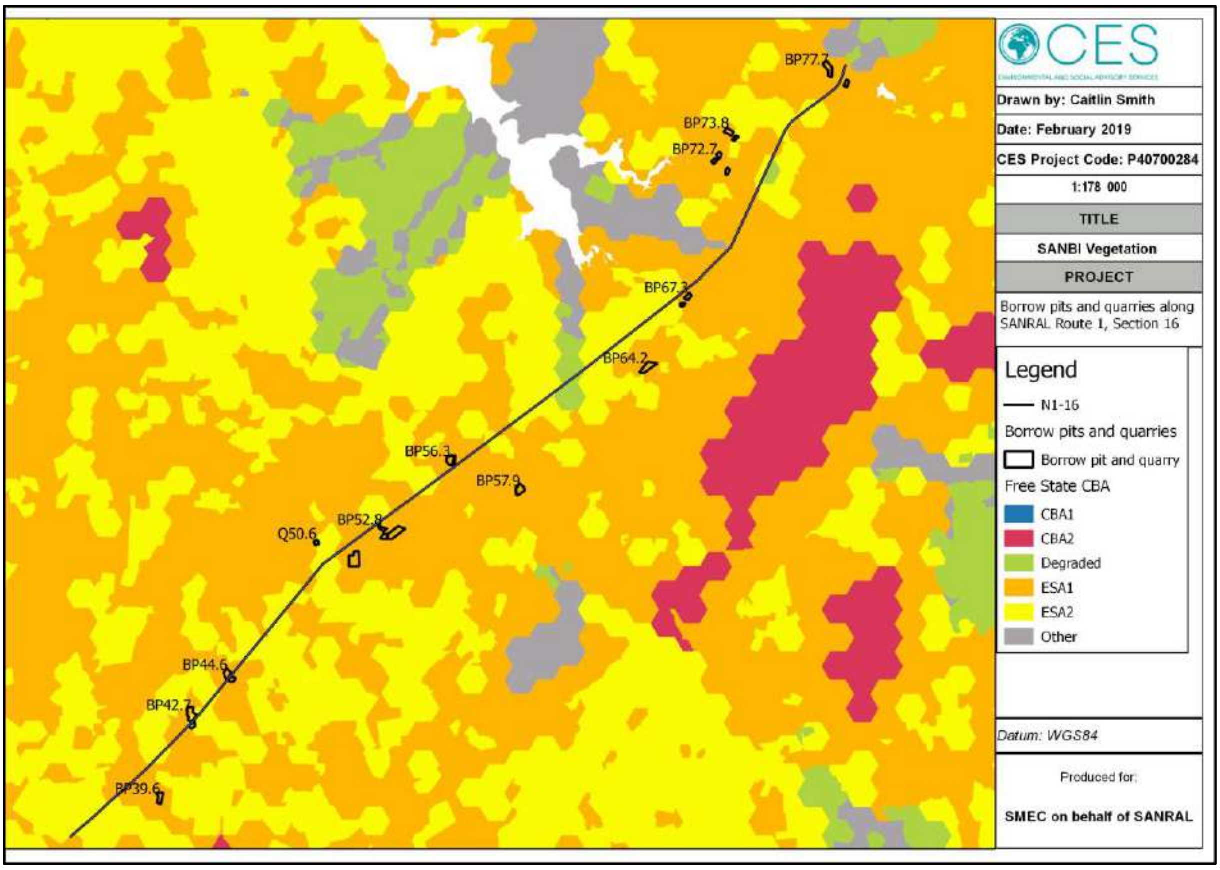


Figure 4.12 Terrestrial CBA map of the project area.

4.8.2. Threatened Ecosystems

The National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEMBA) has released a national list of ecosystems that are threatened and in need of protection (GN. 1002 of 2011). The proposed project is NOT located in any threatened ecosystem as classified by NEMBA.

4.8.3 Protected areas

None of the proposed borrow pits and quarry sites falls within a protected area but some sites to the north east are located in close proximity to the **Freestate Highveld Grasslands NPAES Focus Area** (Figure 4.13).

Focus areas are large, intact and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large protected areas. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES.

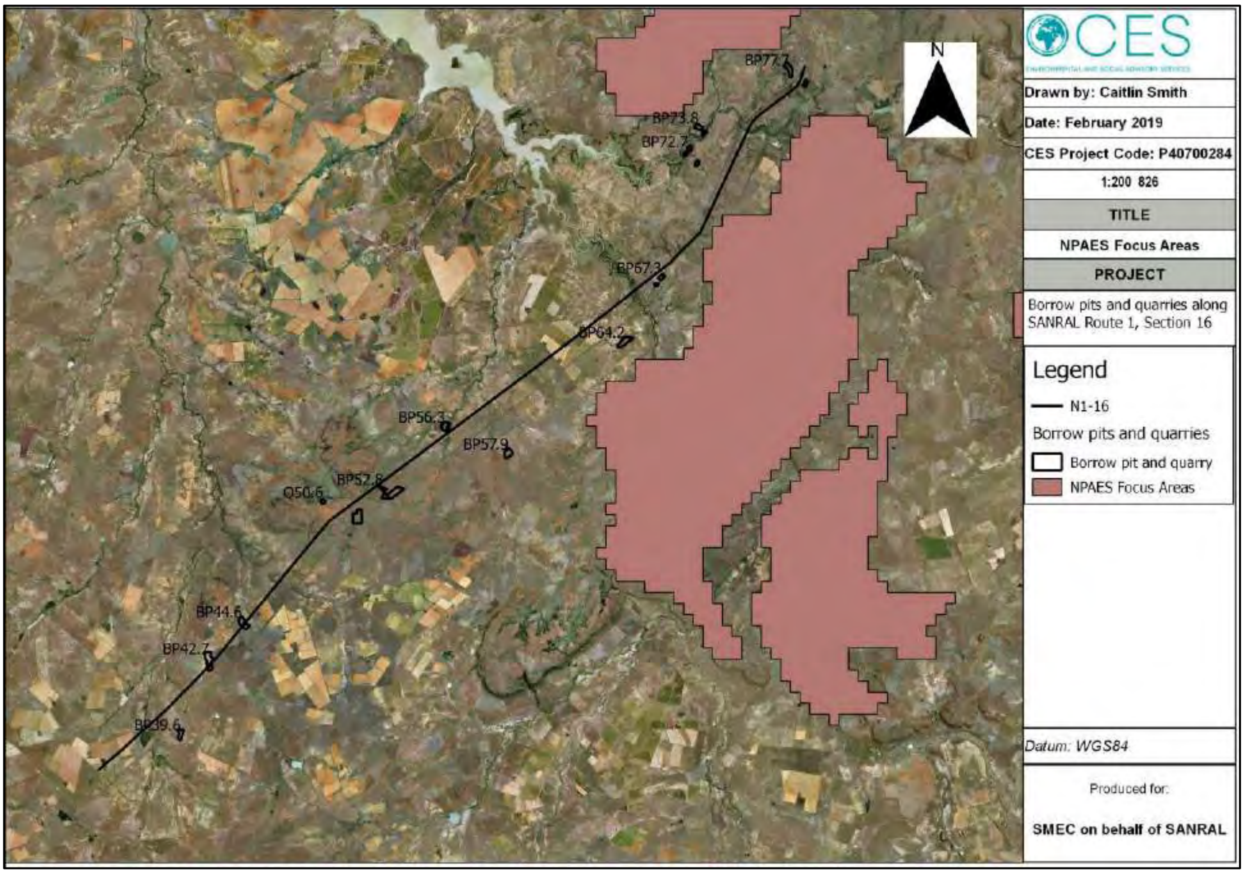


Figure 4.10 NPAES Focus Areas surrounding the mining areas.

4.8.4. Floristics

The following list of potential plant Species of Conservation Concern (SCC) has been derived from current literature for possible vegetation that may be found in the proposed borrow pits and quarry sites (although none were seen during the site assessments):

Family	*Species*	Threat status	PNCO	CITES	DAFF
Amaryllidaceae	*Haemanthus humilis*	Protected (PNCO)	Schedule 4 - protected	-	-

4.9 Fauna

4.9.1 Birds

According to the South African Bird Atlas Project 2 (SABAP 2) (http://sabap2.adu.org.za) 210 bird species may occur in the project area. Of these species, six were found to be near threatened, two are vulnerable and one is endangered (see table below).

Common name	Species name	Threat status
Yellow-billed Stork	*Mycteria ibis*	Near threatened
Greater Flamingo	*Phoenicopterus ruber*	Near threatened
Secretarybird	*Sagittarius serpentarius*	Near threatened

Falcon, Lanner	*Falco biarmicus*	Near threatened
Kestrel, Lesser	*Falco naumanni*	Vulnerable
Crane, Blue	*Anthropoides paradiseus*	Vulnerable
Korhaan, Blue	*Eupodotis caerulescens*	Near threatened
Lark, Melodious	*Mirafra cheniana*	Near threatened
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*	Endangered

4.9.2 Reptiles and amphibians

South Africa has 350 species of reptiles, comprising 213 lizards, 9 worm lizards, 105 snakes, 13 terrestrial tortoises, 5 freshwater terrapins, 2 breeding species of sea turtle and 1 crocodile (Branch, 1998). Amphibians and certain reptiles are sensitive to habitat change and are therefore good indicators of land transformation.

According to the Southern African Frog Atlas Project (SAFAP) and the South African Reptile Conservation Assessment map (SARCA: http://vmus.adu.org.za), 7 amphibian species and 20 reptile species may occur in the project area. A complete list of amphibians and reptiles that may occur on the project site is listed in Appendix 1. However, none were seen during the site assessments.

4.9.3 Mammals

Large game makes up less than 15% of the mammal species in South Africa and a much smaller percentage in numbers and biomass. In developed and farming areas, this percentage is greatly reduced, with the vast majority of mammals present being small or medium-sized.

A list of possible mammals that may occur in the project area (according to the Mammal Map species list: http://vmus.adu.org.za/) is listed in Appendix 1. One species on the list is listed as vulnerable but was not seen during the site assessments:

Common name	Species name	Threat status
Southern African Tsessebe	Damaliscus lunatus lunatus	Vulnerable

5. SITE INVESTIGATION

A site investigation of the proposed borrow pits and quarry sites was conducted in November 2018 in order to:

- Verify desktop findings;
- Assess the actual ecological state;
- Assess the current land-use;
- Identify potential sensitive ecosystems;
- Identify plant species communities associated with the proposed project activities.

The site visit also served to inform potential impacts of the proposed proposed borrow pits and quarry sites and to inform the significance of these impacts on the surrounding ecological environment. Vegetation was assessed within entire project boundary of each of the proposed borrow pits and quarry sites.

5.1. Vegetation survey

All of the proposed borrow pits and quarry sites except for Site Q77.5 and Site Q50.6, occur on open grassland dominated by *Themeda triandra*. Site Q77.5 and Site Q50.6 occur on an existing borrow pit sites.

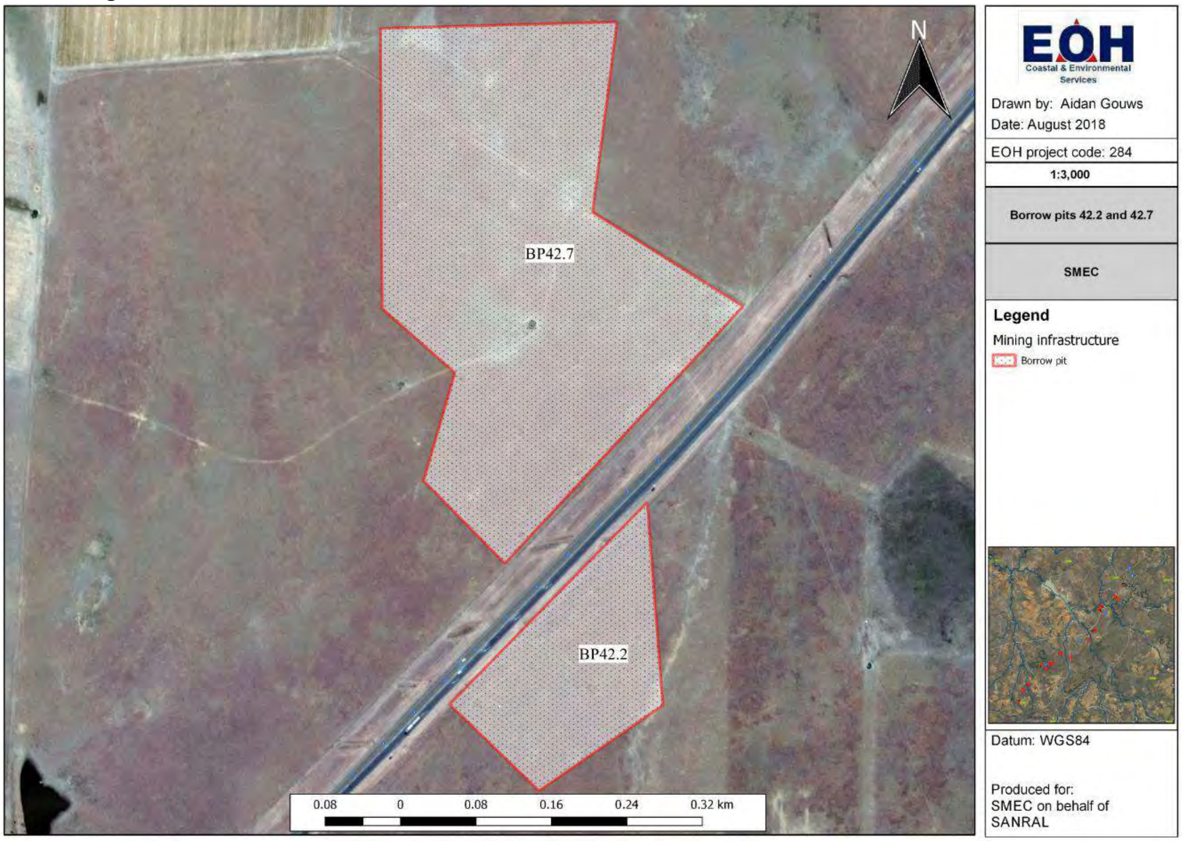
Figure 5.1: Aerial image of the proposed borrow pits and quarry sites.

5.2.1 Borrow pit/quarry site descriptions

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 39.6	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra.* No SCC were observed. An artificial wetland/dam is located 500m to the south of the site boundary.	
Aerial map of the site:		

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP42.2	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra.* No SCC were observed. Grasses appeared to be short and may imply recent grazing. This is the only mining site that occurs within 500m of a natural wetland. The wetland is located 240m to the east of the site boundary.	

Aerial image of the site:



BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 42.7	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra.* No SCC were observed. The site appears to be completely unimpacted by grazing and contains fully grown grasses.	
Aerial image of the site: **See previous aerial image.**		

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 44.5	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra.* No SCC were observed. An artificial dam is located approx. 216m to the northwest of the site boundary. The N1 forms the northern boundary of the site and is also located between the noted artificial dam and the mining site.	

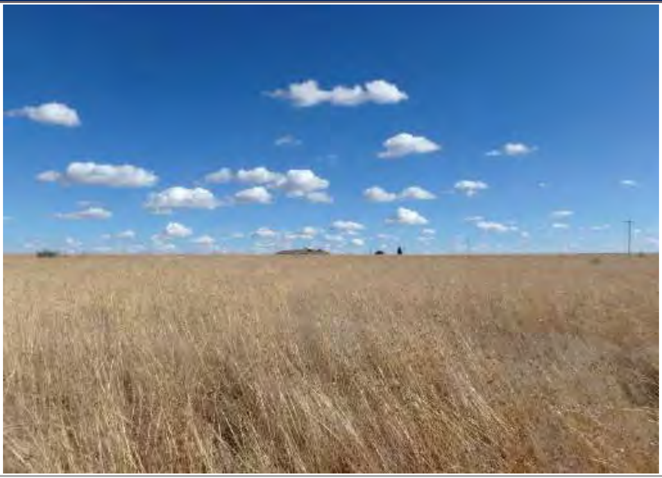
Aerial image of the site:

<table>
<tr><td>BP 44.6</td><td>The site occurs on a flat area consisting of natural grassland dominated by Themeda triandra. No SCC were observed.

An artificial dam is located approx. 40m to the west of the site boundary. Small Acacia karroo schrubs are scattered near the dam.</td><td></td></tr>
<tr><td colspan="3">Aerial image of the site:
See previous aerial image.</td></tr>
</table>

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
Q 50.6	The site is an existing quarry and will be expanded to more than double its existing size. The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra.* No SCC were observed. Small *Acacia karroo* schrubs and trees are scattered near the proposed stockpile area.	

Aerial image of the site:

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 51.0	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra.* No SCC were observed. An artificial wetland/dam is located 450m to the west of the site boundary.	

Aerial image of the site:

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 52.8	The site consists of 2 portions which are located near a rocky outcrop constaining scattered *Acacia karroo* trees and schrubs interspersed with *Themeda triandra* grasses. A large portion of the site is located on a flat plan surrounding the outcrop. A drainage system is located 170m to the east of the site boundary but no surface water were observed. a small artificial wetland/dam is also located 270m to the west of the site boundary. No SCC were observed on site.	

Aerial image of the site:

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 56.3	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra.* No SCC were observed. An artificial wetland/dam is located 150m to the west of the site boundary.	

Aerial image of the site:

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 57.9	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra* and scattered *Acacia karroo* trees. No SCC were observed. An artificial wetland/dam is located 100m to north of the site boundary. A gravel road forms the western boundary of the site.	
Aerial image of the site:		

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 64.2	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra* and scattered *Acacia karroo* trees. No SCC were observed. A small farm dam is located in the centre of the site. the dam was dry during the site visit. The Groot-Vet River lays a 100m to the east of the site boundary.	
Aerial image of the site:		

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 67.3	The site consists of 2 portions that occur on a flat area consisting of natural grassland dominated by *Themeda triandra* and scattered *Acacia karroo* trees. No SCC were observed. No water features will be impacted.	
Aerial image of the site: 		

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 72.4	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra*. No SCC were observed. An artificial wetland/dam is locted about 250m to the southwest of the site boundary.	

Aerial image of the site:

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 72.7	The site occurs on a flat area consisting of natural grassland dominated by *Themeda triandra* and scattered *Acacia karroo* trees. No SCC were observed. An artificial wetland/dam is locted 320m to the southwest of the site boundary.	
Aerial image of the site: **See previous aerial image.**		

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 73.8	The site consist of 2 portions that occur on a flat area consisting of natural grassland dominated by *Themeda triandra* and scattered *Acacia karroo* trees. No SCC were observed. No water features will be impacted.	

Aerial image of the site:

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
Q 77.5	The site consist of 2 portions. The western portion is an existing quarry that has not been rehabilitated and is filled with water. Scattered *Acacia karoo* occur around the quarry hole. The eastern portion is a new site that consist of *T. triandra* dominated gressland. No SCC were observed in either portion. No water features will be impacted.	

Aerial image of the site:

BORROW PIT/QUARRY NAME	DESCRIPTION	PHOTOGRAPH
BP 77.7	The site occurs on a flat area consisting of natural grassland consisting of predominantly *Themeda triandra*. Other species like *Eragrostis curvula* were also observed. Scattered trees occur ranging between *Acacia karroo, Olea eoropaea and Gymnosporia buxifolia* species. No SCC were observed. An artificial wetland/dam is locted 370m to the east of the site boundary.	
Aerial image of the site: 		

5.2.1 Plant and animal species observed

A detailed list of plant species potentially occurring within the proposed borrow pits and quarry sites is provided at Appendix A. This list is based on a combination of potential species that may occur on each site (derived from POSA, which is managed by SANBI) and observations made during the site visit.

The tabvle below lists the key plant species that were observed within each mining site. Alien and invasive plants were rare with only a few species observed. **No plant or animal SCC were observed in any of the proposed mining sites**.

SPECIES NAME	COMMON NAME	MINING SITE OCCURENCE	PROTECTION STATUS
Themeda triandra		All mining sites	LC
Eragrostis curvula		BP77.7	LC
Vachellia karroo	Thorn tree	All mining sites	LC
Solanum capense			Alien invasive
Cirsium vulgare			Alien invasive
Opuntia ficus-indica	Prickly pear		Alien invasive
Gymnosporia buxifolia			
Olea europaea	Olive tree		

▪

5 SENSITIVITY ASSESSMENT

Appendix 6
Specialist Reports
1. (1) A specialist report prepared in terms of these Regulations must contain—
   (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;
   (g) an identification of any areas to be avoided, including buffers;
   (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;

6.1. Conservation and spatial planning tools

Several conservation planning tools are available for the study area. These tools allow for the potential identification of any sensitive and important areas from an ecological perspective at the early stage of a development and allow for the fine-tuning of plans and infrastructure layouts.

The following tools were identified as relevant to the site and are summarised below:

- SANBI Vegetation threat status;
- NEMBA Protected Ecosystems; and

The conservation status of the Central Free State Grassland vegetation type that occurs within the project site (Mucina and Rutherford, 2012) is considered as **Vulnerable**. Winburg Grassy Shrubland is considered **Least Threatened**. The study area was not classified by NEMBA (National list of ecosystems that are threatened and in need of protection; 2014) in terms of the list of threatened ecosystems.

None of the proposed borrow pits and quarry sites is located within a Critical Biodiversity Area (CBA) according to the Free State Terrestrial CBAs (2015) map but they are located in Ecological Support Areas (ESA) 1 and 2.

6.2. Sensitivity allocation

Sensitivity was determined based on the methodology presented in Table 6.1, for all thre ESA 1 and 2 areas. The following sensitivity criteria were allocated for all the proposed mining areas. The allocation of criteria was based on both the desktop biophysical description of the site as well as observations made during the site visit.

Table 6.1. Criteria used for the analysis of the sensitivity of the proposed borrow pit and quarry sites.

CRITERIA		LOW SENSITIVITY	MODERATE SENSITIVITY	HIGH SENSITIVITY
1	**Topography**	Level or even	Undulating; fairly steep slopes	Complex and uneven with steep slopes
2	**Vegetation** - Extent or habitat type in the region	Extensive throughout the region	Restricted to a particular region / zone	Restricted to a specific locality / site
3	**Conservation status** of fauna / flora or habitats	Well conserved/ independent of conservation value	Not well conserved, moderate conservation value	Not conserved - has a high conservation value
4	**Species of Conservation Concern** - Presence and number	No Species of Conservation Concern were observed on any of the sites assessed.	No Species of Conservation Concern, some indeterminate or rare endemics	One or more Species of Conservation Concern, or more than 2 endemics or rare species
5	**Habitat fragmentation** leading to loss of viable populations	Extensive areas of preferred habitat present elsewhere in region not susceptible to fragmentation	Reasonably extensive areas of preferred habitat elsewhere and habitat susceptible to fragmentation	Limited areas of this habitat, susceptible to fragmentation
6	**Biodiversity** contribution	Low diversity or species richness	Moderate diversity, and moderately high species richness	High diversity and species richness
7	**Erosion potential** or instability of the region	Very stable and an area not subjected to erosion	Some possibility of erosion or change due to episodic events	Large possibility of erosion, change to the site or destruction due to climatic or other factors
8	**Rehabilitation** potential of the area or region	Site is easily rehabilitated	There is some degree of difficulty in rehabilitation of the site	Site is difficult to rehabilitate due to the terrain, type of habitat or species required to reintroduce
9	**Disturbance** due to human habitation or other influences (alien invasive species)	Site is very disturbed or degraded **(For Q77.5 only)**	There is some degree of disturbance of the site	The site is hardly or very slightly impacted upon by human disturbance
10	**Ecological function**	Habitat widely represented in the	Intermediate role in ecological function	Key habitat involved in ecological processes

	CRITERIA	LOW SENSITIVITY	MODERATE SENSITIVITY	HIGH SENSITIVITY
		landscape not specifically harbouring any unique habitat feature,etc.		(ecological corridors and network areas or key niche habitats)
11	**Ecological Services**	Little to no ecological services	Some ecological services.	Various ecological services. Areas should be conserved.

Low sensitivity
BP 77.7 and Q77.5 are allocated a low sensitivity for the following reasons:
- BP 77,7 is located on least concerned Winburg Grassy Shrubland. This vegetation type is widely distributed in the Free State and Gauteng; and
- Q77,5 is located on transformed land. The site was previously used for mining and was not rehabilitated afterwards.

Moderate sensitivity
The following mining sites are allocated a moderate sensitivity because of the following reasons:
- The site is located on Central Free State Grassland which has a vulnerable classification by SANBI;
- The site lis located within 500m of an artificial wetland/dam; and
- The site is either undisturbed or slighty disturbed.

– BP 73,8;
– BP 72,7;
– BP 72,4;
– BP 67,3;
– BP 57,9;
– BP 52,8;
– BP 51,0;
– BP 50,6;
– BP 44,5;
– BP 42,7;
– BP 42,2;
– BP 39,6

High sensitivity:
The following mining sites are allocated a high sensitivity because of the following reasons:
- The site is located on Central Free State Grassland which has a vulnerable classification by SANBI;
- The site lis located within 250m of an artificial wetland/dam;
- The site is located within 500m of a natural wetland; and
- The site is located within 200m of a river.

– BP44.6;
– BP56.3;
– BP64.2.

No mining sites were located within a water course but it is important to note that the following mining sites are located within 500m of a wetland (natural or artificial) and will require a General

Authorisation from the Department of Human Settlements, Water and Sanitation (DHSWS) prior to commencement of mining.

- BP 73,8;
- BP 72,7;
- BP 72,4;
- BP 67,3;
- BP 64,2;
- BP 56,3;
- BP 52,8;
- BP 51,0;
- BP 44,6;
- BP 44,5;
- BP 42,7;
- BP 42,2;
- BP 39,6

7. ALIEN INVASIVE SPECIES

An "*invasive species*" is any species whose establishment and spread outside of its natural distribution range (i) threatens ecosystems, habitats or other species or has a demonstrable potential to threaten ecosystems, habitats or other species; and (ii) may result in economic or environmental harm or harm to human health. Invasive alien plant species are globally considered as one of the greatest threats to the environment, biodiversity, ecosystem integrity and the economy.

According to the Conservation of Agricultural Resources Act (No. 43 of 1983 - Regulation 15, 30 March 2001) (CARA), for agricultural land, and the National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEMBA), for natural areas, invasive alien plant species should be controlled and eradicated with an emphasis on urgent action in biodiversity priority areas. NEMBA published a list of Alien and Invasive Species (No. 599) in 2014 which regulates the management of alien and invasive plants in natural environments.

Alien and invasive plant species were identified within the proposed site. As seen in section 5 of this report, the site was dominated by many common indigenous species; however only invasive *Opuntia ficus-indica* (NEMBA Category 1b; CARA Category 1) was present on some of the mining sites.

7.1. Discussion

The alien and invasive plant identified within the area was classified as Category 1b as per Notice 1 of GN. 599 of 2014 of NEMBA:

7.1.1. Category 1b invasive species

Plants classified as Category 1b alien invasive species are prohibited from:

- Being imported into the Republic;
- Growing or in any other way propagating any specimen;
- Conveying, moving or otherwise translocating any specimen;
- Spreading or allowing the spread of any specimen; and
- Releasing any specimen.

All Category 1b alien and invasive plant species must be controlled during all phases of development according to the recommendations outline in the Environmental Management Plan (EMP).

One (1) Category 1b species was identified on site, namely, *Opuntia ficus-indica.*

7.1.2. Conservation of Agricultural Resources Act categories

Category 1: Declared weeds
These are prohibited plants, which must be controlled or eradicated where possible (except in biocontrol reserves, which are areas designated for the breeding of biocontrol agents).

One (1) category 1 plant was found on site, namely, *Opuntia ficus-indica.*

8. IMPACTS ON ECOLOGICAL ENVIRONMENT MAY BE AFFECTED

Appendix 6
Specialist Reports
1. (1) A specialist report prepared in terms of these Regulations must contain—
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;
(k) any mitigation measures for inclusion in the EMPr;

8.1. Issues identified

Table 8.1 below lists all the issues identified during the ecological assessment of the proposed mining areas.

Table 8.1. Issues identified during all phases of the project.

MIND MAP: Ecological impacts for all phases of the project.					
THEMES	CATEGORIES/ISSUES	PLANNING & DESIGN PHASE	CONSTRUCTION (PRE-MINING) PHASE	MINING PHASE	DECOMISSIONING PHASE
Legislation	Legal and policy compliance	X	X	X	
Physical	Watercourses		X	X	
	Stormwater Management	X	X	X	X
	Erosion Management	X	X	X	X
	Material stockpiling			X	
	Rehabilitation of disturbed areas		X	X	X
Biological	Natural vegetation	X	X	X	
	Species of Conservation Concern (SCC)		X	X	
	Control of alien plant species	X	X	X	X
	Wildlife mortalities		X	X	
	Loss/fragmentation of habitats			X	

8.2. Impact assessment

The impacts identified in Section 8.1 are assessed in terms of the criteria described in Section 2.5 and are summarised in Tables 8.2- 8.4 below.

Eight factors are considered when assessing the significance of the identified issues and impacts, namely:

- **Nature:** negative or positive impact on the environment.
- **Type:** direct, indirect and/or cumulative effect of impact on the environment.

EFFECT

- **Duration:** - the temporal scale defines the significance of the impact at various time scales, as an indication of the duration of the impact.
- **Extent:** - the spatial scale defines the physical extent of the impact.
- **Probability:** - the likelihood of impacts taking place as a result of project actions arising from the various alternatives. There is no doubt that some impacts would occur (e.g. loss of vegetation), but other impacts are not as likely to occur (e.g. vehicle accident) and may or may not result from the proposed development and alternatives. Although some impacts may have a severe effect, the likelihood of them occurring may affect their overall significance.
- **Severity:** - the severity (or also consequence) scale (see Table 2.5 below) is used in order to objectively evaluate how severe a number of negative impacts might be on the issue under consideration, or how beneficial a number of positive impacts might be on the issue under consideration.

REVERSIBILITY / MITIGATION

- **Reversibility / Mitigation** – The degree of difficulty of reversing and/or mitigating the various impacts ranges from very difficult to easily achievable. The four categories used are listed and explained in Table 2.4 below. Both the practical feasibility of the measure, the potential cost and the potential effectiveness is taken into consideration when determining the appropriate degree of difficulty.

OVERALL SIGNIFICANCE

- **Significance:** - Each of the above criterion (points 3-6 above) are ranked with scores assigned, as presented in Table 2.4 to determine the overall significance of an activity. The total scores recorded for the effect (which includes scores for duration; extent; probability and severity) and reversibility / mitigation are then read off the matrix presented in Table 2.6, to determine the overall significance of the issue. The overall significance is either negative or positive.

Table 8.2. Assessment of impacts during the Planning & Design Phase

ISSUE	NATURE OF IMPACT	TYPE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (PROBABILITY)	SEVERITY / BENEFICIAL SCALE	REVERSIBILITY / MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
PLANNING & DESIGN PHASE										
	Legislation									
Legal and policy compliance	During the Planning and Design Phase, failure to adhere to existing policies and legal obligations will lead to the project conflicting with local, provincial and national policies, legislation, etc. This could result in a lack of institutional support for the project, overall project failure and undue disturbance to the natural environment.	**Direct, Cumulative**	**Localised**	**Short-term**	**Possible**	**Severe**	**Easy**	**HIGH NEGATIVE**	- All legal matters pertaining to permitting must be completed prior to any mining activity.	**LOW NEGATIVE**
	Biophysical Environment									
Stormwater and erosion management	During the Planning and Design Phase an inadequate management of stormwater can result in erosion, loss of valuable topsoil and sedimentation of nearby watercourses. In addition, the failure to plan for the rehabilitation of impacted areas will lead to ongoing erosion of disturbed areas and unnecessary loss of valuable soil.	**Direct Indirect Cumulative**	**Study area**	**Medium-term**	**Probable**	**Moderately severe**	**Moderate**	**MODERATE NEGATIVE**	- A Stormwater and Erosion Management Plan must be developed and implemented to control runoff and prevent erosion and loss of soil and sedimentation of watercourses during all phases of the project. - A Rehabilitation Plan must be developed for implementation during construction and operational phases.	**LOW NEGATIVE**
Terrestrial and aquatic habitats	During the planning and design phase the inappropriate design of the project infrastructure and demarcation of project boundaries will lead to the unnecessary loss of natural vegetation and aquatic habitats.	**Direct, indirect, cumulative**	**Localised**	**Permanent**	**Definite**	**Severe**	**Easy**	**MODERATE NEGATIVE**	- Project infrastructure and mining activities must be designed in such a way as to minimise the impact on surrounding terrestrial and aquatic habitsts. - The boundary of the mining areas must be demarcated to ensure minimal loss of intact natural terrestrial and aquatic (i.e.	**LOW NEGATIVE**

ISSUE	NATURE OF IMPACT	TYPE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (PROBABILITY)	SEVERITY / BENEFICIAL SCALE	REVERSIBILITY / MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
									wetlands and watercourses) habitats.	
Control of alien species	During the planning and design phase failure to plan for the removal and management of alien vegetation will result in the invasion of alien vegetation in sensitive areas during the construction and operational phases. In addition, failure to plan for the rehabilitation of impacted areas will lead to the establishment of alien vegetation.	**Indirect**	**Study area**	**Medium-term**	**Probable**	**Moderately severe**	**Moderate**	**MODERATE NEGATIVE**	- An Alien Vegetation Management Plan and Rehabilitation Plan must be developed to mitigate the establishment and spread of undesirable alien plant species during all phases of the project.	**LOW NEGATIVE**

Table 8.3. Assessment of impacts during the Construction Phase

ISSUE	NATURE OF IMPACT	TYPE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (PROBABILITY)	SEVERITY / BENEFICIAL SCALE	REVERSIBILITY / MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
CONSTRUCTION PHASE										
	Legislation									
Legislation and policy compliance	During the construction phase, failure to adhere to all permits, authorisations and regulations will lead to financial penalties and the EA being revoked.	**Direct, Cumulative**	**Localised**	**Short-term**	**Possible**	**Severe**	**Easy**	**HIGH NEGATIVE**	- Appropriate removal permits must be secured in the event that any SCC are identified during the construction phase that require removal.	**LOW NEGATIVE**
	Biophysical Environment									
Terrestrial and aquatic habitats	During the construction phase encroachment into natural vegetation, wetlands and riparian areas could result in the unnecessary degradation of terrestrial and aquatic habitats.	**Indirect Cumulative**	**Study area**	**Long-term**	**Possible**	**Moderately severe**	**Easy**	**MODERATE NEGATIVE**	- Construction activities must be restricted to the demarcated mining project footprints. - The appointed ECO must ensure that the project footprint has been properly demarked and that activities are restricted to the demarkaed areas. - Surrounding terrestrial and aquatic habitats (i.e. watercourses and wetlands, whether artificial or natural) must be avoided.	**LOW NEGATIVE**
Stormwater and erosion management	During the Construction Phase, loss of soil due to soil erosion and soil compression during construction could lead to an increase in non-permeable surfaces and result in increased storm water runoff.	**Direct**	**Study area**	**Short-term**	**Possible**	**Moderately severe**	**Moderate**	**MODERATE NEGATIVE**	- A Stormwater and Erosion Management Plan must be implemented during the construction phase. - Appropriate stormwater structures must be used during the construction phase. - The Stormwater and Erosion Management Plan and	**LOW NEGATIVE**

ISSUE	NATURE OF IMPACT	TYPE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (PROBABILITY)	SEVERITY / BENEFICIAL SCALE	REVERSIBILITY / MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
									Rehabilitation Plan must be approved by the appointed ECO prior to implementation.	
	In addition, the clearance of vegetation and construction activities could result in the erosion of topsoil in the project site.							**MODERATE NEGATIVE**	- Disurbed areas must be rehabilitated as soon as possible after construction. - Regular monitoring for erosion after construction must take place to ensure that no erosion problems have developed as result of the disturbance. - All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and vegetation techniques. - All cleared areas (not used for the development footprint) should be vegetated with indigenous perennial shrubs and grasses from the local area as soon as possible. - Natural vegetation that was removed onsite may be used as soil stabilisers by placing them on cleared areas if natural recovery is slow.	**LOW NEGATIVE**
	During the construction phase, the poor rehabilitation of impacted areas will lead to erosion of disturbed areas and unnecessary loss of valuable soil.	**Direct, Indirect, Cumulative**	**Localised**	**Long-term**	**Probable**	**Moderately severe**		**MODERATE NEGATIVE**	- Only topsoil from the project site, which has been appropriately stored, must be used for rehabilitation. - All temporarily impacted areas must be rehabilitated with indigenous vegetation as soon as construction in the particular area or phase of work is complete, i.e. rehabilitation is on-going throughout construction.	**LOW NEGATIVE**

ISSUE	NATURE OF IMPACT	TYPE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (PROBABILITY)	SEVERITY / BENEFICIAL SCALE	REVERSIBILITY / MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
									- Restoration must be conducted as per the approved Erosion Management Plans.	
Rehabilitation of disturbed areas	During the construction phase poor rehabilitation of disturbed areas will lead to the permanent degradation of ecosystems and allow infestation of alien vegetation.	**Direct, Indirect, Cumulative**	**Localised**	**Long-term**	**Probable**	**Moderately severe**	**Moderate**	**MODERATE NEGATIVE**	- All temporarily impacted areas must be rehabilitated with indigenous vegetation as soon as construction in the particular area or phase of work is complete. Restoration must be conducted as per a Rehabilitation Management Plan. - Only topsoil from the development site, which has been appropriately stored, must be used for rehabilitation.	**LOW NEGATIVE**
Species of Conservation Concern	During the construction phase, activities will permanently damage or destroy plant SCC present on site.	**Direct**	**Project level**	**Permanent**	**Possible**	**Severe**	**Moderate**	**MODERATE NEGATIVE**	- Should any SCC be noted on site by the ECO the necessary permits must be obtained in to remove them. - Once removed the, the SCC must be taken to a suitable habitat or nursery for the duration of the construction phase. - All rescued SCC must be replanted within the site where it was originally found or in close proximity during rehabilitation.	**LOW NEGATIVE**
Control of Alien Species	During the construction phase, the removal of natural vegetation creates open habitats that favour the establishment of undesirable alien plant species in areas that are typically very difficult to	**Indirect**	**Study area**	**Long-term**	**Probable**	**Moderately severe**	**Moderate**	**MODERATE NEGATIVE**	- The approved Alien Vegetation Management Plan must be implemented during the construction phase to reduce the establishment and spread of undesirable alien plant species. - Alien plants must be removed from the site through	**LOW NEGATIVE**

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ISSUE	NATURE OF IMPACT	TYPE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (PROBABILITY)	SEVERITY / BENEFICIAL SCALE	REVERSIBILITY / MITIGATION	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
	eradicate and will pose a threat to neighbouring ecosystems								appropriate methods such as hand pulling, application of chemicals, cutting, etc. in accordance with the NEMBA: Alien Invasive Species Regulations.	
	During the construction phase poor rehabilitation of disturbed areas will lead to the permanent degradation of ecosystems as well as allow alien vegetation species to expand.	**Direct, Indirect, Cumulative**	**Localised**	**Long-term**	**Probable**	**Moderately severe**		**MODERATE NEGATIVE**	- Only topsoil from the project site, which has been appropriately stored, must be used for rehabilitation. - All temporarily impacted areas must be rehabilitated with indigenous vegetation as soon as construction in the particular area or phase of work is complete, i.e. rehabilitation is on-going throughout construction. - Restoration must be conducted as per the approved Erosion and Alien Vegetation Management Plans.	**LOW NEGATIVE**
Wildlife mortalities	During the construction phase, vehicles, crew and materials will result in animal fatalities through opportunistic hunting, collisions, accidents or baiting and trapping.	**Direct**	**Project level**	**Short term**	**Possible**	**Moderately severe**		**MODERATE NEGATIVE**	- All staff on site must be trained regarding the proper management and response should animals be encountered on site. - No hunting, baiting or trapping must be permitted on site on on adjacent land.	**LOW NEGATIVE**

Table 8.4. Assessment of impacts during the Operational Phase

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
OPERATIONAL PHASE (MINING PHASE)									
Legislation									
Legislation and policy compliance	During the operation phase, failure to adhere to all permits, authorisations and regulations will lead to financial penalties and the EA being revoked.	**Direct, Cumulative**	**Localised**	**Short-term**	**Probable**	**Moderately severe**	**HIGH NEGATIVE**	- All legal matters pertaining to permitting, authorisations and regulations must be adhered to during the mining phase. - The borrow pit and quarry operator(s) must appoint an Environmental Officer (EO) respionsible for ensuring compliance with the conditions of the mining permit during operatiponal phase.	**LOW NEGATIVE**
Biophysical environment									
Watercourses	During the operational phase encroachment into wetland and riparian areas will result in the unnecessary degradation of aquatic habitats.	**Indirect Cumulative**	**Study area**	**Long-term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	- Mining activities must be kept to the approved and demarcated footprint of each borrow pit and quarry. - Surrounding watercourses and wetlands (artificial or natural) must be avoided.	**LOW NEGATIVE**

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
Material stockpiling	During the operation phase, stockpiling of mining material within 32 m of watercourses will result in erosion and mobilisation of the materials into nearby watercourses, resulting in sedimentation and a decrease in water quality and aquatic habitat.	**Direct, Indirect, Cumulative**	**Study area**	**Medium-term**	**Possible**	**Moderately negative**	**MODERATE NEGATIVE**	- No mining material must be stored within 32 m of any watercourse. - Stockpiles within 50 m of watercourses must be monitored for erosion and mobilisation of materials towards watercourses. If this is noted by the EO, suitable cut-off drains or berms must be placed between the stockpile area and the watercourse.	**LOW NEGATIVE**
Stormwater management	During the Operation Phase, failure to monitor and maintain the stormwater management system can result in ongoing erosion and sedimentation of nearby watercourses.	**Direct**	**Study area**	**Long-term**	**Probable**	**Moderately severe**	**MODERATE NEGATIVE**	- Stormwater management structures must be monitored and maintained throughout the operation phase.	**LOW NEGATIVE**
Rehabilitation of disturbed areas	During the operational phase, the poor rehabilitation of impacted areas will lead to further erosion of disturbed areas and unnecessary loss of valuable soil.	**Direct, Indirect, Cumulative**	**Localised**	**Long-term**	**Probable**	**Moderately severe**	**MODERATE NEGATIVE**	- All cleared areas must be continuously rehabilitated with indigenous vegetation for 6 months after the Operational Phase of the project begins, or until such time that the EO is satisfied that all affected areas have been rehabilitated.	**LOW NEGATIVE**
Biological environment									
Natural vegetation	During the operation phase the clearing of natural vegetation outside the approved mining footprint will lead to the unnecessary loss of natural	**Direct, Indirect, Cumulative**	**Localised**	**Medium-term**	**Possible**	**Severe**	**MODERATE NEGATIVE**	- The mining footprint must be surveyed and demarcated prior to mining commencing.	**LOW NEGATIVE**

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ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
	vegetation and habitat for other taxonomic groups.							- No mining activities must be allowed outside the demarcated footprint. - No mining activities must be allowed where untransformed areas of natural vegetation occur. - Mining activities must be limited to the absolute necessary area only. - Where vegetation has been cleared, site rehabilitation in terms of soil stabilisation and vegetation must be undertaken. - Cleared vegetation must not be piled on top of natural vegetation but must be stockpiled temporarily on bare ground and removed to a registered landfill site. Alternatively, cleared vegetation may be mulched and used as ground cover during rehabilitation. - The contractor's staff must not harvest any natural vegetation.	
Control of Alien Species	During the operational phase the loss of natural vegetation will increase the potential invasion by alien plant species. This, coupled with the lack of implementation of an alien vegetation management plan will result in large scale alien plant invasion.	**Indirect**	**Study area**	**Long-term**	**Probable**	**Moderately severe**	**MODERATE NEGATIVE**	- The approved Alien Vegetation Management Plan must be implemented to reduce the establishment and spread of undesirable alien plant species. - Alien plants must be removed from the site through appropriate methods such as hand pulling, application of	**LOW NEGATIVE**

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
								chemicals, cutting etc. as in accordance to the NEMBA: Alien Invasive Species Regulations.	
	When mining is complete poor rehabilitation of disturbed areas will lead to the permanent degradation of ecosystems as well as allow alien vegetation species to expand.	**Direct, Indirect, Cumulative**	**Localised**	**Long-term**	**Probable**	**Moderately severe**	**MODERATE NEGATIVE**	- Only topsoil from the mining site, which has been appropriately stored, must be used for rehabilitation. - All temporarily impacted areas must be rehabilitated with indigenous vegetation as soon as mining in the particular area is complete. - Restoration must be conducted as per the approved Erosion and Alien Vegetation Management Plans.	**LOW NEGATIVE**
Wildlife mortalities	During the operation phase, vehicles, crew and materials will increase animal fatalities through opportunistic hunting, collisions, accidents or baiting and trapping.	**Direct**	**Project level**	**Short term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	- All staff on site must be trained regarding the proper management and response should animals be encountered. - No hunting, baiting or trapping must be permitted on site or on adjacent land.	**LOW NEGATIVE**
Loss/fragmentation of habitats	During operation, the loss of vegetation coincides with the loss of faunal habitat, reducing breeding and rearing localities. Endangered or rare faunal populations will permanently disappear or diminish in size.	**Direct**	**Project level**	**Long term**	**Possible**	**Moderately severe**	**MODERATE NEGATIVE**	- The clearance of vegetation within aquatic habitats must be avoided as far as possible. - Should avoidance be impractical, vegetation clearance must be minimised as much as possible. - Indigenous tree species should be pruned using loppers or saws where they	**LOW NEGATIVE**

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPATIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITY / BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
								pose safety threats. If their presence compromises safety mandates entirely, fell and stump treat with appropriate herbicide.	

Table 8.7. Assessment of the No-Go alternative

ISSUE	DESCRIPTION OF IMPACT	NATURE OF IMPACT	SPTIAL SCALE (EXTENT)	TEMPORAL SCALE (DURATION)	CERTAINTY SCALE (LIKELIHOOD)	SEVERITTY/ BENEFICIAL SCALE	SIGNIFICANCE PRE-MITIGATION	MITIGATION MEASURES	SIGNIFICANCE POST-MITIGATION
Biophysical environment									
No development of mining sites for the road upgrade.	Should the project not proceed, the current land use will remain the same (grassland and shrubland). There will be no vegetation removal.	**Direct Cumulative**	**Study area**	**Long-Term**	**Possible**	**Slightly Beneficial**	**FEW BENEFTIS**	- N/A	**FEW BENEFITS**

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9. IMPACT STATEMENT, RECOMMENDATIONS AND CONCLUSIONS

Appendix 6
Specialist Reports
1. (1) A specialist report prepared in terms of these Regulations must contain—
(l) any conditions for inclusion in the environmental authorisation;
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;
(n) a reasoned opinion—
(i) whether the proposed activity, activities or portions thereof should be authorised;
(iA) 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;

9.1. Conclusions

The project involves the use of fifteen (15) borrow pits and two (2) quarries to supply the necessary material for the upgrade of National Route 1, Section 16 (N1-16) from Zandkraal (KM 33.8) to Windburg South (KM 78.0). CES Environmental and Social Advisory Services was appointed to conduct an Ecological Impact Assessment for the project.

Table 9.1 summarises the change in impacts from pre- to post- mitigation for the proposed mining areas. The majority of the impacts were identified as MODERATE to LOW and will be reduced to a LOW significance if the mitigation measures as proposed in this report are adhered to. Impacts identified as HIGH, mostly relating to legal compliance, will also be redcued to LOW if the mitigation measures as proposed in this report are adhered to.

Table 9.1: Assessment of pre- and post-mitigation impact significance.

	PRE-MITIGATION			POST-MITIGATION		
	LOW	MODERATE	HIGH	LOW	MODERATE	HIGH
Planning and Design	0	6	1	7	0	0
Construction	0	10	1	11	0	0
Operational	0	9	1	10	0	0
TOTAL	0	25	3	28	0	0

9.1.2. Cumulative impact

The following cumulative impacts were identified for the project:

Theme	Description of Impact	Cumulative impact
Legislation	Failure to adhere to existing policies and legal obligations will result in lack of institutional support for the project, overall project failure and undue disturbance to the natural environment. Furthermore, the failure to adhere to all permits, authorisations and regulations may lead to financial penalties and the EA being revoked.	Failure to adhere to legal obligations, to obtain permits, authorisations, etc. could result in severe undue damage to the environment.
Stormwater management	An inadequate stormwater management plan will result in erosion and sedimentation of nearby watercourses.	Sedimentation of nearby and downstream watercourses as a result of a lack of stormwater control.
Natural Vegetation	Inappropriate design of the project infrastructure and demarcation of project boundaries as well as the clearance of natural vegetation outside of the demarcated project boundary will lead to the unnecessary loss of natural vegetation and habitat supporting other taxonomic groups.	Unnecessary loss of natural vegetation resulting in the loss of habitat/ habitat corridors leading to the potential permanent loss of vegetation.
Alien Invasive Managment	The removal of natural vegetation creates open habitats that favour the establishment of undesirable alien plant species in areas that are typically very difficult to eradicate and will pose a threat to neighbouring ecosystems. Together with poor rehabilitation of disturbed areas this will lead to the permanent degradation of ecosystems as well as allow alien vegetation species to expand.	Establishment of alien invasive vegetation and permanent degradation of ecosystems.
Watercourses	Encroachment into wetland and riparian areas will result in the unnecessary degradation of aquatic habitat.	Long-term degradation of drainage lines and surrounding watercourses.
Erosion Management	Inadequate erosion management plans will result in the loss of valuable top soil and result in increased soil erosion.	Permanent loss of fertile topsoil.
Material stockpiles	Stockpiling of construction and mining materials within 32 m of dams or other watercourses will result in erosion and mobilisation of the materials into the nearby dams and drainage lines, resulting in sedimentation and a decrease in water quality and aquatic habitat.	Long-term sedimentation and degradation of watercourses.
Rehabilitation	Poor rehabilitation of impacted areas will lead to erosion of disturbed areas and unnecessary loss of valuable soil.	Long-term erosion of surrounding areas and establishment of alien invasive vegetation.

9.1.4. Alternatives

Only the preferred alternative was assessed. No other alternatives were proposed.

9.2. Recommendation

The following recommendations must be included into the final EMPr:

- The project mining sites must be demarcated prior to commencement of activities on site. All areas outside the demarcated areas will be considered as No-Go areas during construction and mining.
- A qualified, independent Environmental Control Officer (ECO) must be appointed prior to commencement of any activity on site.
- The borrow pit and quarry operator(s) must appoint an Environmental Officer (EO) responsible for ensuring compliance with the conditions of the mining permit during operatiponal phase.
- All mitigation measures indicated in this report must be included into the EMPr.
- The following Management Plans must be developed prior to clearing and implemented during construction and operation of the proposed borrow pits and quarries. These management plans must be incorporated into the EMPr:
    - Storm Water Management Plan;
    - Erosion Management Plan;
    - Rehabilitation Management Plan; and
    - Alien Vegetation Management Plan.
- A General Authorisatiuon from the Department of Water and Sanitation must be applied for all mining sites within 500m of a wetland or water course. This must be done prior to the commencement of mining.

9.2.1. Mitigation measures

All the mitigation measures provided below are to be implemented during the planning and design, construction and operational phases of the proposed project.

PLANNING & DESIGN PHASE

Legal and policy compliance
- All legal matters pertaining to permitting must be completed prior to any mining activity.

Stormwater and erosion management
- A Stormwater and Erosion Management Plan must be developed and implemented to control runoff and prevent erosion and loss of soil and sedimentation of watercourses during all phases of the project.
- A Rehabilitation Plan must be developed for implementation during construction and operational phases.

Terrestrial and aquatic habitats
- Project infrastructure and mining activities must be designed in such a way as to minimise the impact on surrounding terrestrial and aquatic habitsts.
- The boundary of the mining areas must be demarcated to ensure minimal loss of intact natural terrestrial and aquatic (i.e. wetlands and watercourses) habitats.

Control of alien species

- An Alien Vegetation Management Plan and Rehabilitation Plan must be developed to mitigate the establishment and spread of undesirable alien plant species during all phases of the project.

CONSTRUCTION PHASE

Legislation and policy compliance

- Appropriate removal permits must be secured in the event that any SCC are identified during the construction phase that require removal.

Terrestrial and aquatic habitats

- Construction activities must be restricted to the demarcated mining project footprints.
- The appointed ECO must ensure that the project footprint has been properly demarked and that activities are restricted to the demarkaed areas.
- Surrounding terrestrial and aquatic habitats (i.e. watercourses and wetlands, whether artificial or natural) must be avoided.

Stormwater and erosion management

- A Stormwater and Erosion Management Plan must be implemented during the construction phase.
- Appropriate stormwater structures must be used during the construction phase.
- The Stormwater and Erosion Management Plan and Rehabilitation Plan must be approved by the appointed ECO prior to implementation.
- Disturbed areas must be rehabilitated as soon as possible after construction.
- Regular monitoring for erosion after construction must take place to ensure that no erosion problems have developed as result of the disturbance.
- All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and vegetation techniques.
- All cleared areas (not used for the development footprint) should be vegetated with indigenous perennial shrubs and grasses from the local area as soon as possible.
- Natural vegetation that was removed onsite may be used as soil stabilisers by placing them on cleared areas if natural recovery is slow.
- Only topsoil from the project site, which has been appropriately stored, must be used for rehabilitation.
- All temporarily impacted areas must be rehabilitated with indigenous vegetation as soon as construction in the particular area or phase of work is complete, i.e. rehabilitation is on-going throughout construction.
- Restoration must be conducted as per the approved Erosion Management Plans.

Rehabilitation of disturbed areas

- All temporarily impacted areas must be rehabilitated with indigenous vegetation as soon as construction in the particular area or phase of work is complete. Restoration must be conducted as per a Rehabilitation Management Plan.
- Only topsoil from the development site, which has been appropriately stored, must be used for rehabilitation.

Species of Conservation Concern

- Should any SCC be noted on site by the ECO the necessary permits must be obtained in to remove them.
- Once removed the, the SCC must be taken to a suitable habitat or nursery for the duration of the construction phase.
- All rescued SCC must be replanted within the site where it was originally found or in close proximity during rehabilitation.

Control of Alien Species

- The approved Alien Vegetation Management Plan must be implemented during the construction phase to reduce the establishment and spread of undesirable alien plant species.
- Alien plants must be removed from the site through appropriate methods such as hand pulling, application of chemicals, cutting, etc. in accordance with the NEMBA: Alien Invasive Species Regulations.
- Only topsoil from the project site, which has been appropriately stored, must be used for rehabilitation.
- All temporarily impacted areas must be rehabilitated with indigenous vegetation as soon as construction in the particular area or phase of work is complete, i.e. rehabilitation is on-going throughout construction.
- Restoration must be conducted as per the approved Erosion and Alien Vegetation Management Plans.

Wildlife mortalities

- All staff on site must be trained regarding the proper management and response should animals be encountered on site.
- No hunting, baiting or trapping must be permitted on site and on adjacent land.

OPERATIONAL PHASE (MINING PHASE)

Legislation and policy compliance

- All legal matters pertaining to permitting, authorisations and regulations must be adhered to during the mining phase.
- The borrow pit and quarry operator(s) must appoint an Environmental Officer (EO) responsible for ensuring compliance with the conditions of the mining permit during operational phase.

Watercourses

- Mining activities must be kept to the approved and demarcated footprint of each borrow pit and quarry.
- Surrounding watercourses and wetlands (artificial or natural) must be avoided.

Material stockpiling

- No mining material must be stored within 32 m of any watercourse.
- Stockpiles within 50 m of watercourses must be monitored for erosion and mobilisation of materials towards watercourses. If this is noted by the EO, suitable cut-off drains or berms must be placed between the stockpile area and the watercourse.

Stormwater management

- Stormwater management structures must be monitored and maintained throughout the operation phase.

Rehabilitation of disturbed areas

- All cleared areas must be continuously rehabilitated with indigenous vegetation for 6 months after the Operational Phase of the project begins, or until such time that the EO is satisfied that all affected areas have been rehabilitated.

Natural vegetation

- The mining footprint must be surveyed and demarcated prior to mining commencing.
- No mining activities must be allowed outside the demarcated footprint.
- No mining activities must be allowed where untransformed areas of natural vegetation occur.
- Mining activities must be limited to the absolute necessary area only.
- Where vegetation has been cleared, site rehabilitation in terms of soil stabilisation and vegetation must be undertaken.
- Cleared vegetation must not be piled on top of natural vegetation but must be stockpiled temporarily on bare ground and removed to a registered landfill site. Alternatively, cleared vegetation may be mulched and used as ground cover during rehabilitation.
- The contractor's staff must not harvest any natural vegetation.

Control of Alien Species

- The approved Alien Vegetation Management Plan must be implemented to reduce the establishment and spread of undesirable alien plant species.
- Alien plants must be removed from the site through appropriate methods such as hand pulling, application of chemicals, cutting etc. as in accordance to the NEMBA: Alien Invasive Species Regulations.
- Only topsoil from the mining site, which has been appropriately stored, must be used for rehabilitation.
- All temporarily impacted areas must be rehabilitated with indigenous vegetation as soon as mining in the particular area is complete.
- Restoration must be conducted as per the approved Erosion and Alien Vegetation Management Plans.

Wildlife mortalities

- All staff on site must be trained regarding the proper management and response should animals be encountered.
- No hunting, baiting or trapping must be permitted on site or on adjacent land.

Loss/fragmentation of habitats

- The clearance of vegetation within aquatic habitats must be avoided as far as possible.
- Should avoidance be impractical, vegetation clearance must be minimised as much as possible.
- Indigenous tree species should be pruned using loppers or saws where they pose safety threats. If their presence compromises safety mandates entirely, fell and stump treat with appropriate herbicide.

9.2.2. Ecological Statement and Opinion of the Specialist

The ecological impacts of all aspects of the proposed quarries and borrow pits for the National Route 1, Section 16 Road Upgrade were assessed and considered to be ecological acceptable, provided that mitigation measures outlined in this report are implemented. Implementation of recommended mitigation measures coupled with comprehensive rehabilitation and monitoring in terms of re-vegetation and restoration is an important element of the mitigation strategy. Implementing the recommended mitigation measures will reduce overall impacts from MODERATE and HIGH to 100% LOW.

All areas demarcated as HIGH sensitivity in Section 6 of this report should be avoided; specifically alterations to the rivers and any surrounding wetlands should be avoided. The application of the appropriate mitigation measures provided in Section 8 is of critical importance for the integrity of the environment to be sustained throughout the project.

Minor location deviations from the proposed works are deemed acceptable provided that they are approved by the appointed ECO and the recommended mitigation measures contained in this report are implemented for such deviations.

The proposed project is **NOT considered to be Fatally Flawed**.

The **No-Go option** refers to the proposed borrow pits/quarries not being mined. This option will therefore have no negative impact on the local vegetation/fauna if it does not go ahead.

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11. Appendix 1 – List of plant and animal species

List of plant species that may potentially occur on site (http://newposa.sanbi.org/sanbi/Explore):

Family	Species	Threat status
Campanulaceae	*Wahlenbergia albens*	LC
Solanaceae	*Solanum campylacanthum*	LC
Scrophulariaceae	*Aptosimum procumbens*	LC
Rhamnaceae	*Ziziphus mucronata*	LC
Solanaceae	*Lycium pilifolium*	LC
Amaranthaceae	*Chenopodium album*	Weed (naturalised)
Asteraceae	*Senecio hieracioides*	LC
Apocynaceae	*Stenostelma capense*	LC
Aspleniaceae	*Asplenium cordatum*	LC
Asteraceae	*Felicia muricata*	LC
Aspleniaceae	*Asplenium sp.*	
Rhamnaceae	*Scutia myrtina*	LC
Lamiaceae	*Salvia runcinata*	LC
Pteridaceae	*Cheilanthes involuta*	LC
Poaceae	*Eragrostis obtusa*	LC
Amaryllidaceae	*Haemanthus humilis*	Protected (PNCO)
Aizoaceae	*Ruschia sp.*	
Scrophulariaceae	*Selago sp.*	
Ranunculaceae	*Clematis brachiata*	LC
Anacardiaceae	*Searsia burchellii*	LC
Asteraceae	*Garuleum woodii*	LC
Malvaceae	*Hibiscus pusillus*	LC
Amaranthaceae	*Gomphrena celosioides*	
Scrophulariaceae	*Selago saxatilis*	LC
Malvaceae	*Hermannia gariepina*	LC
Apiaceae	*Chamarea sp.*	
Asteraceae	*Cineraria lyratiformis*	LC
Poaceae	*Eragrostis gummiflua*	LC
Dipsacaceae	*Scabiosa columbaria*	LC
Anacampserotaceae	*Anacampseros ustulata*	LC
Poaceae	*Digitaria eriantha*	LC
Euphorbiaceae	*Euphorbia rhombifolia*	LC
Pteridaceae	*Cheilanthes eckloniana*	LC
Pedaliaceae	*Pterodiscus speciosus*	LC

Family	Species	Threat status
Asteraceae	*Euryops empetrifolius*	LC
Rubiaceae	*Anthospermum rigidum*	LC
Geraniaceae	*Monsonia angustifolia*	LC
Cyperaceae	*Cyperus longus* var. *tenuiflorus*	Not evaluated
Nyctaginaceae	*Commicarpus pentandrus*	LC
Solanaceae	*Lycium horridum*	LC
Rubiaceae	*Galium capense* subsp. *garipense* var. *garipense*	Not evaluated
Convolvulaceae	*Cuscuta campestris*	NEMBA Cat 1b alien invasive; CARA Cat 1 alien invasive
Asphodelaceae	*Bulbine abyssinica*	LC
Aizoaceae	*Ruschia indurata*	LC
Amaranthaceae	*Salsola geminiflora*	LC
Poaceae	*Pennisetum setaceum*	NEMBA Cat 1b alien invasive; CARA Cat 1 alien invasive
Fabaceae	*Indigofera alternans* var. *alternans*	LC
Poaceae	*Eragrostis plana*	
Pteridaceae	*Pellaea calomelanos*	LC
Poaceae	*Andropogon appendiculatus*	LC
Scrophulariaceae	*Gomphostigma virgatum*	LC
Euphorbiaceae	*Euphorbia mauritanica*	LC
Commelinaceae	*Commelina africana* var. *barberae*	LC
Aizoaceae	*Chasmatophyllum musculinum*	LC
Asteraceae	*Berkheya onopordifolia* var. *onopordifolia*	LC
Scrophulariaceae	*Aptosimum elongatum*	LC
Apocynaceae	*Brachystelma circinatum*	LC
Aizoaceae	*Hereroa glenensis*	LC
Poaceae	*Aristida congesta* subsp. *barbicollis*	LC
Crassulaceae	*Crassula dependens Bolus*	LC
Anemiaceae	*Mohria vestita Baker*	LC
Poaceae	*Andropogon schirensis*	LC
Pteridaceae	*Cheilanthes hirta* var. *hirta*	LC
Aizoaceae	*Ruschia hamata*	LC
Aspleniaceae	*Asplenium aethiopicum*	LC
Asteraceae	*Pentzia globosa*	LC

List of bird species (SABAP):

Common name	Scientific name	Threat status
Ostrich, Common	*Struthio camelus*	
Grebe, Great Crested	*Podiceps cristatus*	
Grebe, Little	*Tachybaptus ruficollis*	
Cormorant, White-breasted	*Phalacrocorax carbo*	
Cormorant, Reed	*Phalacrocorax africanus*	
Darter, African	*Anhinga rufa*	
Heron, Grey	*Ardea cinerea*	
Heron, Black-headed	*Ardea melanocephala*	
Heron, Goliath	*Ardea goliath*	
Egret, Great	*Egretta alba*	
Egret, Little	*Egretta garzetta*	
Egret, Yellow-billed	*Egretta intermedia*	
Egret, Cattle	*Bubulcus ibis*	
Heron, Squacco	*Ardeola ralloides*	
Night-Heron, Black-crowned	*Nycticorax nycticorax*	
Hamerkop, Hamerkop	*Scopus umbretta*	
Stork, Yellow-billed	*Mycteria ibis*	NT
Ibis, African Sacred	*Threskiornis aethiopicus*	
Ibis, Glossy	*Plegadis falcinellus*	
Ibis, Hadeda	*Bostrychia hagedash*	
Spoonbill, African	*Platalea alba*	
Flamingo, Greater	*Phoenicopterus ruber*	NT
Flamingo, Lesser	*Phoenicopterus minor*	
Goose, Spur-winged	*Plectropterus gambensis*	
Goose, Egyptian	*Alopochen aegyptiacus*	
Shelduck, South African	*Tadorna cana*	
Shoveler, Cape	*Anas smithii*	
Duck, African Black	*Anas sparsa*	
Duck, Yellow-billed	*Anas undulata*	
Teal, Red-billed	*Anas erythrorhyncha*	
Teal, Cape	*Anas capensis*	
Duck, White-faced	*Dendrocygna viduata*	
Pochard, Southern	*Netta erythrophthalma*	
Duck, Maccoa	*Oxyura maccoa*	

Common name	Scientific name	Threat status
Secretarybird	*Sagittarius serpentarius*	NT
Falcon, Lanner	*Falco biarmicus*	NT
Falcon, Amur	*Falco amurensis*	
Kestrel, Greater	*Falco rupicoloides*	
Kestrel, Rock	*Falco rupicolus*	
Kestrel, Lesser	*Falco naumanni*	VU
Kite, Black-shouldered	*Elanus caeruleus*	
Fish-eagle, African	*Haliaeetus vocifer*	
Buzzard, Steppe	*Buteo vulpinus*	
Goshawk, Southern Pale Chanting	*Melierax canorus*	
Harrier-Hawk, African	*Polyboroides typus*	
Harrier, Black	*Circus maurus*	
Francolin, Orange River	*Scleroptila levaillantoides*	
Spurfowl, Natal	*Pternistis natalensis*	
Spurfowl, Swainson's	*Pternistis swainsonii*	
Quail, Common	*Coturnix coturnix*	
Guineafowl, Helmeted	*Numida meleagris*	
Moorhen, Common	*Gallinula chloropus*	
Coot, Red-knobbed	*Fulica cristata*	
Crane, Blue	*Anthropoides paradiseus*	VU
Korhaan, Blue	*Eupodotis caerulescens*	NT
Plover, Common Ringed	*Charadrius hiaticula*	
Plover, Kittlitz's	*Charadrius pecuarius*	
Plover, Three-banded	*Charadrius tricollaris*	
Lapwing, Crowned	*Vanellus coronatus*	
Lapwing, Blacksmith	*Vanellus armatus*	
Snipe, African	*Gallinago nigripennis*	
Sandpiper, Curlew	*Calidris ferruginea*	
Stint, Little	*Calidris minuta*	
Ruff, Ruff	*Philomachus pugnax*	
Sandpiper, Common	*Actitis hypoleucos*	
Sandpiper, Marsh	*Tringa stagnatilis*	
Greenshank, Common	*Tringa nebularia*	
Sandpiper, Wood	*Tringa glareola*	
Avocet, Pied	*Recurvirostra avosetta*	
Stilt, Black-winged	*Himantopus himantopus*	
Thick-knee, Spotted	*Burhinus capensis*	

Common name	Scientific name	Threat status
Pratincole, Black-winged	*Glareola nordmanni*	
Gull, Grey-headed	*Larus cirrocephalus*	
Tern, Caspian	*Sterna caspia*	
Tern, White-winged	*Chlidonias leucopterus*	
Tern, Whiskered	*Chlidonias hybrida*	
Pigeon, Speckled	*Columba guinea*	
Dove, Red-eyed	*Streptopelia semitorquata*	
Turtle-dove, Cape	*Streptopelia capicola*	
Dove, Laughing	*Streptopelia senegalensis*	
Dove, Namaqua	*Oena capensis*	
Cuckoo, Jacobin	*Clamator jacobinus*	
Cuckoo, Diderick	*Chrysococcyx caprius*	
Owl, Barn	*Tyto alba*	
Eagle-owl, Spotted	*Bubo africanus*	
Nightjar, Rufous-cheeked	*Caprimulgus rufigena*	
Swift, Common	*Apus apus*	
Swift, African Black	*Apus barbatus*	
Swift, White-rumped	*Apus caffer*	
Swift, Horus	*Apus horus*	
Swift, Little	*Apus affinis*	
Swift, Alpine	*Tachymarptis melba*	
Mousebird, Speckled	*Colius striatus*	
Mousebird, White-backed	*Colius colius*	
Mousebird, Red-faced	*Urocolius indicus*	
Kingfisher, Pied	*Ceryle rudis*	
Kingfisher, Giant	*Megaceryle maximus*	
Kingfisher, Malachite	*Alcedo cristata*	
Kingfisher, Brown-hooded	*Halcyon albiventris*	
Bee-eater, European	*Merops apiaster*	
Bee-eater, White-fronted	*Merops bullockoides*	
Hoopoe, African	*Upupa africana*	
Wood-hoopoe, Green	*Phoeniculus purpureus*	
Scimitarbill, Common	*Rhinopomastus cyanomelas*	
Barbet, Black-collared	*Lybius torquatus*	
Barbet, Acacia Pied	*Tricholaema leucomelas*	
Barbet, Crested	*Trachyphonus vaillantii*	
Honeyguide, Greater	*Indicator indicator*	

Common name	Scientific name	Threat status
Honeyguide, Lesser	*Indicator minor*	
Woodpecker, Cardinal	*Dendropicos fuscescens*	
Wryneck, Red-throated	*Jynx ruficollis*	
Lark, Melodious	*Mirafra cheniana*	NT
Lark, Rufous-naped	*Mirafra africana*	
Lark, Sabota	*Calendulauda sabota*	
Lark, Spike-heeled	*Chersomanes albofasciata*	
Sparrowlark, Chestnut-backed	*Eremopterix leucotis*	
Sparrowlark, Grey-backed	*Eremopterix verticalis*	
Lark, Red-capped	*Calandrella cinerea*	
Swallow, Barn	*Hirundo rustica*	
Swallow, White-throated	*Hirundo albigularis*	
Swallow, Pearl-breasted	*Hirundo dimidiata*	
Swallow, Red-breasted	*Hirundo semirufa*	
Swallow, Greater Striped	*Hirundo cucullata*	
Cliff-swallow, South African	*Hirundo spilodera*	
Martin, Rock	*Hirundo fuligula*	
Martin, Brown-throated	*Riparia paludicola*	
Martin, Banded	*Riparia cincta*	
Tit, Ashy	*Parus cinerascens*	
Crow, Pied	*Corvus albus*	
Bulbul, African Red-eyed	*Pycnonotus nigricans*	
Wheatear, Mountain	*Oenanthe monticola*	
Chat, Familiar	*Cercomela familiaris*	
Chat, Sickle-winged	*Cercomela sinuata*	
Chat, Anteating	*Myrmecocichla formicivora*	
Stonechat, African	*Saxicola torquatus*	
Robin-chat, Cape	*Cossypha caffra*	
Scrub-robin, Karoo	*Cercotrichas coryphoeus*	
Scrub-robin, Kalahari	*Cercotrichas paena*	
Warbler, Willow	*Phylloscopus trochilus*	
Swamp-warbler, Lesser	*Acrocephalus gracilirostris*	
Reed-warbler, African	*Acrocephalus baeticatus*	
Crombec, Long-billed	*Sylvietta rufescens*	
Cisticola, Zitting	*Cisticola juncidis*	
Cisticola, Desert	*Cisticola aridulus*	
Cisticola, Cloud	*Cisticola textrix*	

Common name	Scientific name	Threat status
Neddicky, Neddicky	*Cisticola fulvicapilla*	
Cisticola, Grey-backed	*Cisticola subruficapilla*	
Cisticola, Levaillant's	*Cisticola tinniens*	
Prinia, Black-chested	*Prinia flavicans*	
Flycatcher, Spotted	*Muscicapa striata*	
Tit-babbler, Chestnut-vented	*Parisoma subcaeruleum*	
Flycatcher, Fiscal	*Sigelus silens*	
Batis, Pririt	*Batis pririt*	
Flycatcher, Fairy	*Stenostira scita*	
Paradise-flycatcher, African	*Terpsiphone viridis*	
Wagtail, Cape	*Motacilla capensis*	
Pipit, African	*Anthus cinnamomeus*	
Pipit, Plain-backed	*Anthus leucophrys*	
Pipit, African Rock	*Anthus crenatus*	
Longclaw, Cape	*Macronyx capensis*	
Fiscal, Common (Southern)	*Lanius collaris*	
Shrike, Red-backed	*Lanius collurio*	
Tchagra, Brown-crowned	*Tchagra australis*	
Bokmakierie, Bokmakierie	*Telophorus zeylonus*	
Myna, Common	*Acridotheres tristis*	
Starling, Wattled	*Creatophora cinerea*	
Starling, Cape Glossy	*Lamprotornis nitens*	
Starling, Red-winged	*Onychognathus morio*	
Starling, Pied	*Spreo bicolor*	
Sunbird, White-bellied	*Cinnyris talatala*	
Sparrow-weaver, White-browed	*Plocepasser mahali*	
Sparrow, House	*Passer domesticus*	
Sparrow, Cape	*Passer melanurus*	
Finch, Scaly-feathered	*Sporopipes squamifrons*	
Weaver, Cape	*Ploceus capensis*	
Masked-weaver, Southern	*Ploceus velatus*	
Quelea, Red-billed	*Quelea quelea*	
Bishop, Southern Red	*Euplectes orix*	
Bishop, Yellow-crowned	*Euplectes afer*	
Widowbird, Long-tailed	*Euplectes progne*	
Finch, Red-headed	*Amadina erythrocephala*	
Pytilia, Green-winged	*Pytilia melba*	

Common name	Scientific name	Threat status
Firefinch, Red-billed	*Lagonosticta senegala*	
Waxbill, Blue	*Uraeginthus angolensis*	
Waxbill, Violet-eared	*Granatina granatina*	
Waxbill, Black-faced	*Estrilda erythronotos*	
Waxbill, Common	*Estrilda astrild*	
Quailfinch, African	*Ortygospiza atricollis*	
Whydah, Pin-tailed	*Vidua macroura*	
Whydah, Shaft-tailed	*Vidua regia*	
Canary, Cape	*Serinus canicollis*	
Canary, Black-throated	*Crithagra atrogularis*	
Canary, Yellow	*Crithagra flaviventris*	
Seedeater, Streaky-headed	*Crithagra gularis*	
Bunting, Lark-like	*Emberiza impetuani*	
Bunting, Cinnamon-breasted	*Emberiza tahapisi*	
Bunting, Cape	*Emberiza capensis*	
Dove, Rock	*Columba livia*	
Korhaan, Northern Black	*Afrotis afraoides*	
Thrush, Karoo	*Turdus smithi*	
Thrush, Olive	*Turdus olivaceus*	
White-eye, Orange River	*Zosterops pallidus*	
White-eye, Cape	*Zosterops virens*	
Lark, Eastern Clapper	*Mirafra fasciolata*	
Lark, Eastern Long-billed	*Certhilauda semitorquata*	
Korhaan, Southern Black	*Afrotis afra*	
Lark, Cape Clapper	*Mirafra apiata*	
Sparrow, Southern Grey-headed	*Passer diffusus*	
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*	EN

List of amphibians (SAFAP):

Family	Scientific name	Threat status
Bufonidae	*Bufo vertebralis*	Least Concern
Petropedetidae	*Cacosternum boettgeri*	Least Concern
Hyperoliidae	*Kassina senegalensis*	Least Concern
Ranidae	*Afrana angolensis*	Least Concern
Ranidae	*Afrana fuscigula*	Least Concern
Ranidae	*Tomopterna cryptotis*	Least Concern
Pipidae	*Xenopus laevis*	Least Concern

List of reptiles (SARCA: http://vmus.adu.org.za):

Family	Common name	Scientific name	Threat status
Agamidae	Southern Rock Agama	*Agama atra*	Least Concern (SARCA 2014)
Gekkonidae	Cape Gecko	*Pachydactylus capensis*	Least Concern (SARCA 2014)
Lamprophiidae	Sundevall's Shovel-snout	*Prosymna sundevallii*	Least Concern (SARCA 2014)
Lamprophiidae	Fork-marked Sand Snake	*Psammophis trinasalis*	Least Concern (SARCA 2014)
Scincidae	Common Variable Skink Complex	*Trachylepis varia sensu lato*	Least Concern (SARCA 2014)
Testudinidae	Leopard Tortoise	*Stigmochelys pardalis*	Least Concern (SARCA 2014)
Typhlopidae	Delalande's Beaked Blind Snake	*Rhinotyphlops lalandei*	Least Concern (SARCA 2014)
Agamidae	Southern Rock Agama	*Agama atra*	Least Concern (SARCA 2014)
Colubridae	Rhombic Egg-eater	*Dasypeltis scabra*	Least Concern (SARCA 2014)
Cordylidae	Karoo Girdled Lizard	*Karusasaurus polyzonus*	Least Concern (SARCA 2014)
Gekkonidae	Cape Gecko	*Pachydactylus capensis*	Least Concern (SARCA 2014)
Lamprophiidae	Black-headed Centipede-eater	*Aparallactus capensis*	Least Concern (SARCA 2014)
Lamprophiidae	Brown House Snake	*Boaedon capensis*	Least Concern (SARCA 2014)
Lamprophiidae	Fork-marked Sand Snake	*Psammophis trinasalis*	Least Concern (SARCA 2014)
Lamprophiidae	Spotted Grass Snake	*Psammophylax rhombeatus*	Least Concern (SARCA 2014)
Scincidae	Wahlberg's Snake-eyed Skink	*Panaspis wahlbergi*	Least Concern (SARCA 2014)
Scincidae	Speckled Rock Skink	*Trachylepis punctatissima*	Least Concern (SARCA 2014)
Scincidae	Speckled Sand Skink	*Trachylepis punctulata*	Least Concern (SARCA 2014)
Scincidae	Common Variable Skink Complex	*Trachylepis varia sensu lato*	Least Concern (SARCA 2014)
Testudinidae	Leopard Tortoise	*Stigmochelys pardalis*	Least Concern (SARCA 2014)

List of mammals (Mammal map: http://vmus.adu.org.za):

Family	Common name	Scientific name	Threat status
Bathyergidae	Southern African Mole-rate	*Cryptomys hottentotus*	Least concern
Bovidae	Black Wildebeest	*Connochaetes gnou*	Least concern
Bovidae	Springbok	*Antidorcas marsupialis*	Least concern
Bovidae	Impala	*Aepyceros melampus*	Least concern
Bovidae	Southern African Tsessebe	*Damaliscus lunatus lunatus*	Vulnerable
Bovidae	Greater Kudu	*Tragelaphus strepsiceros*	Least concern
Bovidae	Gemsbok	*Oryx gazella*	Least concern
Bovidae	Blesbok	*Damaliscus pygargus phillipsi*	Least concern
Bovidae	Steenbok	*Raphicerus campestris*	Least concern
Bovidae	Southern Reedbuck	*Redunca arundinum*	Least concern
Bovidae	Mountain Reedbuck	*Redunca fulvorufula*	Least concern
Bovidae	Common duiker	*Sylvicapra sp.*	
Muridae	Southern African Mastomys	*Mastomys coucha*	Least concern
Muridae	Xeric Four-striped Grass Rat	*Rhabdomys pumilio*	Least concern
Herpestidae	Slender Mongoose	*Herpestes sanguineus*	Least concern
Equidae	Plains zebra	*Equus quagga*	Least concern
Cervidae	Fallow Deer	*Dama dama*	NEMBA Category 2 invasive animal
Procaviidae	Cape Rock Hyrax	*Procavia capensis*	Least concern
Vespertilionidae	Unidentified Vespertilioninae	*SUBFAMILY Vespertilioninae*	

APPENDIX C3 -
ARCHAEOLOGICAL IMPACT ASSESSMENT

Exigo[3]

An EOH Company

SMEC SOUTH AFRICA: SANRAL PROPOSED MATERIAL SOURCES PROJECT ON NATIONAL ROUTE 1 SECTION 16 FROM ZANDKRAAL (KM 33.8) TO WINBURG SOUTH (KM 78.0), FREE STATE PROVINCE

Archaeological Impact Assessment

EOH

Prepared for: **SMEC South Africa**

Prepared by: **Exigo Sustainability**

ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) ON VARIOUS PROPERTIES FOR THE PROPOSED SANRAL N1 ZANDKRAAL - WINBURG MATERIAL SOURCES PROJECT, LEJWELEPUTSWA DISTRICT MUNICIPALITY, FREE STATE PROVINCE

Compiled for:
SMEC South Africa

Compiled by:

Neels Kruger

DOCUMENT DISTRIBUTION LIST

Name	Institution
Lizmary Alfirs	SMEC South Africa
Raveshanni Iyer	SMEC South Africa

DOCUMENT HISTORY

Date	Version	Status
05 December 2018	1.0	Draft

DECLARATION

I, Nelius Le Roux Kruger, declare that –

- I act as the independent specialist;
- I am conducting any work and activity relating to the proposed SANRAL N1 Zandkraal - Winburg Material Sources Project in an objective manner, even if this results in views and findings that are not favourable to the client;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have the required expertise in conducting the specialist report and I will comply with legislation, including the relevant Heritage Legislation (National Heritage Resources Act no. 25 of 1999, Human Tissue Act 65 of 1983 as amended, Removal of Graves and Dead Bodies Ordinance no. 7 of 1925, Excavations Ordinance no. 12 of 1980), the Minimum Standards: Archaeological and Palaeontological Components of Impact Assessment (SAHRA and the CRM section of ASAPA), regulations and any guidelines that have relevance to the proposed activity;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this declaration are true and correct.

____

Signature of specialist
Company: Exigo Sustainability
Date: 05 December 2018

EXECUTIVE SUMMARY

This report details the results of an Archaeological Impact Assessment (AIA) study subject to an Environmental Impact Assessment (EIA) process for the proposed SANRAL N1 Zandkraal - Winburg Material Sources Project south of Winburg in the Free State Province. The project entails the establishment of 2 quarries and 15 burrow pits on a number of properties along the N1 road. The report includes background information on the area's archaeology, its representation in Southern Africa, and the history of the larger area under investigation, survey methodology and results as well as heritage legislation and conservation policies. A copy of the report will be supplied to the Free State Provincial Heritage Resources Authority (Free State-PHRA) and recommendations contained in this document will be reviewed.

Project Title	SANRAL N1 Zandkraal - Winburg Material Sources Project
Project Location	S26.38182° E27.96623° (general locality)
1:50 000 Map Sheet	2826DA, 2826DB, 2826DC, 2826DD
Farm Portion / Parcel	Various (see later reference)
Magisterial District / Municipal Area	Lejweleputswa District Municipality
Province	Free State Province

A number of archaeological and historical studies have been conducted in this section of the Free State most of which infer a varied and rich heritage landscape. The literature shows traces of Iron Age farmer presence and a rich Colonial frontier denoting European farmer expansion. The landscape that encompasses the SANRAL N1 Zandkraal - Winburg Material Sources Project footprints seems to have been inhabited continuously for centuries in prehistoric and historical times, the remnants of which are visible in transformed agriculture and rural settlement areas. The following general recommendations are made based on general observations in the proposed SANRAL N1 Zandkraal - Winburg Material Sources Project area pertaining to a number of identified occurrences of heritage potential:

- The remains of a Contemporary Period farmstead including the ruins of a farmhouse and livestock enclosures (**Exigo-BP52.8-CP01)** in the project area is not of heritage significance and no action in terms of heritage mitigation is required for these features. However, cognisance should taken of the fact that human burials might occur in association with the farmstead at precisely undated locations.
- A number of stone heaps, enclosures and unidentified features occur across properties subject to this assessment (**Exigo-BP39.6-FT01, Exigo-BP52.8-FT01, Exigo-BP52.8-FT02, Exigo-BP56.3-FT01, Exigo-BP73.8-FT01)** and they are rated as of of low significance due to their poor state of preservation and the general absence of associated material culture. However, the possibility of some of the features indicating informal human burial sites should not be excluded and it is therefore recommended that the area be monitored by an informed ECO in order to avoid the destruction of previously undetected heritage remains or burials.
- The remains of a Historical Period dwelling or farmstead (**Exigo-BP77.7-HP01**) might afford a better understanding of social, cultural and architectural developments of the Historical period landscape around Windburg and it is rated as of medium significance. The site is located along the western periphery of the proposed BP 77.7 site on the farm Hartplaats 77 and it is primarily recommended that the burrow pit be redesigned to avoid impact on the site where a heritage conservation buffer of

at least 20m around the heritage receptor is implemented. If this measure proves unachievable it is recommended that the historical fabric of the site be conserved by means of a Phase 2 Specialist study (mapping, site sampling and possible conservation management and protection) and the necessary permits should be obtained from the relevant Heritage Resources Authorities

- A small informal cemetery holding an unknown number of graves was documented in close proximity if the proposed BP 73.8 site on the farm Kruidbaden 1245 (**Exigo-BP73.8-CE01).** The site is of high significance and as a primary measure, the Burial Grounds and Graves (BGG) Unit of SAHRA requires a 100m conservation buffer for all burials. It is therefore recommended that the burrow pit proposed for this area around the burial site be redesigned to avoid encroaching on the required 100m conservation buffer. In addition it is recommended that the burial site be fenced off with wire or palisade fencing placed no closer than 2m from the burials. An access gate should be erected and access control should be applied to the site. A heritage Site Management Plan (SMP) should be compiled for the burials to stipulate conservation measures, responsible persons and chance find procedures for further heritage mitigation. The developer should carefully liaise with the heritage specialist, SAHRA as well as local communities and possible affected parties with regards to the management and monitoring of any human grave or cemetery in order to detect and manage negative impact on the sites. **Should impact on the burial site prove inevitable, full grave relocations are recommended for these burial grounds. This measure should be undertaken by a qualified archaeologist, and in accordance with relevant legislation, permitting, statutory permissions and subject to any local and regional provisions and laws and by-laws pertaining to human remains. A full social consultation process with the Kamffer family and other affected parties should occur in conjunction with the mitigation of cemeteries and burials (see Addendum B).**
- Considering the localised nature of heritage remains, the general monitoring of the development progress by an ECO is recommended for all stages of the project. Should any subsurface palaeontological, archaeological or historical material, or burials be exposed during construction activities, all activities should be suspended and the archaeological specialist should be notified immediately
- It is essential that cognisance be taken of the larger archaeological landscape of the area in order to avoid the destruction of previously undetected heritage sites. It should be stated that the possibility of undetected archaeological remains occurring elsewhere in the project area should not be excluded. Burials and historically significant structures dating to the Colonial Period occur on farms in the area and these resources should be avoided during all phases of construction and development, including the operational phases of the development

SANRAL N1 Zandkraal - Winburg Material Sources Project Heritage Sites Locations

Site Code	Coordinate S E	Short Description	Mitigation Action
Exigo-BP73.8-CE01	S28.56765° E26.93578°	Burial Site	Site monitoring, avoidance, 100m conservation buffer, site management. Grave relocation subject to authorisations and permitting if impacted on.
Exigo-BP52.8-CP01	S28.70326° E26.80724°	Contemporary Period Structure	No further action required.
Exigo-BP39.6-FT01 Exigo-BP52.8-FT01 Exigo-BP52.8-FT02 Exigo-BP56.3-FT01 Exigo-BP73.8-FT01	S28.79169° E26.71608° S28.70259° E26.80041° S28.70326° E26.80724° S28.67986° E26.82775° S28.56863° E26.93846°	Unknown features / structures	Site monitoring.
Exigo-BP77.7-HP01	S28.54601° E26.97453°)	Historical Period Site	Avoidance, conservation buffer, site monitoring. Phase 2 documentation & destruction permitting if impacted on. General site monitoring by informed ECO.

This report details the methodology, limitations and recommendations relevant to these heritage areas, as well as areas of proposed development. It should be noted that recommendations and possible mitigation measures are valid for the duration of the development process, and mitigation measures might have to be implemented on additional features of heritage importance not detected during this Phase 1 assessment (e.g. uncovered during the construction process).

NOTATIONS AND TERMS/TERMINOLOGY

Absolute dating: Absolute dating provides specific dates or range of dates expressed in years.

Archaeological record: The archaeological record minimally includes all the material remains documented by archaeologists. More comprehensive definitions also include the record of culture history and everything written about the past by archaeologists.

Artefact: Entities whose characteristics result or partially result from human activity. The shape and other characteristics of the artefact are not altered by removal of the surroundings in which they are discovered. In the Southern African context examples of artefacts include potsherds, iron objects, stone tools, beads and hut remains.

Assemblage: A group of artefacts recurring together at a particular time and place, and representing the sum of human activities.

Context: An artefact's context usually consists of its immediate *matrix*, its *provenience* and its *association* with other artefacts. When found in *primary context*, the original artefact or structure was undisturbed by natural or human factors until excavation and if in *secondary context,* disturbance or displacement by later ecological action or human activities occurred.

Cultural Heritage Resource: The broad generic term *Cultural Heritage Resources* refers to any physical and spiritual property associated with past and present human use or occupation of the environment, cultural activities and history. The term includes sites, structures, places, natural features and material of palaeontological, archaeological, historical, aesthetic, scientific, architectural, religious, symbolic or traditional importance to specific individuals or groups, traditional systems of cultural practice, belief or social interaction.

Cultural landscape: A cultural landscape refers to a distinctive geographic area with cultural significance.

Cultural Resource Management (CRM): A system of measures for safeguarding the archaeological heritage of a given area, generally applied within the framework of legislation designed to safeguard the past.

Feature: Non-portable artefacts, in other words artefacts that cannot be removed from their surroundings without destroying or altering their original form. Hearths, roads, and storage pits are examples of archaeological features

Lithic: Stone tools or waste from stone tool manufacturing found on archaeological sites.

Matrix: The material in which an artefact is situated (sediments such as sand, ashy soil, mud, water, etcetera). The matrix may be of natural origin or human-made.

Midden: Refuse that accumulates in a concentrated heap.

Microlith: A small stone tool, typically knapped of flint or chert, usually about three centimetres long or less.

Monolith: A geological feature such as a large rock, consisting of a single massive stone or rock, or a single piece of rock placed as, or within, a monument or site.

Phase 1 CRM Assessment: An Impact Assessment which identifies archaeological and heritage sites, assesses their significance and comments on the impact of a given development on the sites. Recommendations for site mitigation or conservation are also made during this phase.

Phase 2 CRM Study: In-depth studies which could include major archaeological excavations, detailed site surveys and mapping / plans of sites, including historical / architectural structures and features. Alternatively, the sampling of sites by collecting material, small test pit excavations or auger sampling is required. Mitigation / Rescue involves planning the protection of significant sites or sampling through excavation or collection (in terms of a permit) at sites that may be lost as a result of a given development.

Phase 3 CRM Measure: A Heritage Site Management Plan (for heritage conservation), is required in rare cases where the site is so important that development will not be allowed and sometimes developers are encouraged to enhance the value of the sites retained on their properties with appropriate interpretive material or displays.

Provenience: Provenience is the three-dimensional (horizontal and vertical) position in which artefacts are found. Fundamental to ascertaining the provenience of an artefact is *association,* the co-occurrence of an artefact with other archaeological remains; and *superposition,* the principle whereby artefacts in lower levels of a matrix were deposited before the artefacts found in the layers above them, and are therefore older.

Random Sampling: A probabilistic sampling strategy whereby randomly selected sample blocks in an area are surveyed. These are fixed by drawing coordinates of the sample blocks from a table of random numbers.

Site (Archaeological): A distinct spatial clustering of artefacts, features, structures, and organic and environmental remains, as the residue of human activity. These include surface sites, caves and rock shelters, larger open-air sites, sealed sites (deposits) and river deposits. Common functions of archaeological sites include living or habitation sites, kill sites, ceremonial sites, burial sites, trading, quarry, and art sites,

Stratigraphy: This principle examines and describes the observable layers of sediments and the arrangement of strata in deposits

Systematic Sampling: A probabilistic sampling strategy whereby a grid of sample blocks is set up over the survey area and each of these blocks is equally spaced and searched.

LIST OF ABBREVIATIONS

Abbreviation	Description
ASAPA	Association for South African Professional Archaeologists
AIA	Archaeological Impact Assessment
BP	Before Present
BCE	Before Common Era
BGG	Burial Grounds and Graves
CRM	Culture Resources Management
ECO	Enviromental Control Officer
EIA	Early Iron Age (also Early Farmer Period)
EIA	Environmental Impact Assessment
EFP	Early Farmer Period (also Early Iron Age)
ESA	Earlier Stone Age
GIS	Geographic Information Systems
HIA	Heritage Impact Assessment
ICOMOS	International Council on Monuments and Sites
K2/Map	K2/Mapungubwe Period
LFP	Later Farmer Period (also Later Iron Age)
LIA	Later Iron Age (also Later Farmer Period)
LSA	Later Stone Age
MIA	Middle Iron Age (also Early later Farmer Period)
MSA	Middle Stone Age
NHRA	National Heritage Resources Act No.25 of 1999, Section 35
PFS	Pre-Feasibility Study
PHRA	Provincial Heritage Resources Authority
SAHRA	South African Heritage Resources Association
YCE	Years before Common Era (Present)

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1 BACKGROUND

1.1 Scope and Motivation

Exigo Sustainability was commissioned by SMEC South Africa for an Archaeological Impact Assessment (AIA) study subject to an Environmental Impact Assessment (EIA) process for the SANRAL N1 Zandkraal - Winburg Material Sources Project in the Lejweleputswa District Municipality, Free State Province. The rationale of this AIA is to determine the presence of heritage resources such as archaeological and historical sites and features, graves and places of religious and cultural significance in previously unstudied areas; to consider the impact of the proposed project on such heritage resources, and to submit appropriate recommendations with regard to the cultural resources management measures that may be required at affected sites / features.

1.2 Project Direction

Exigo Sustainability's expertise ensures that all projects be conducted to the highest international ethical and professional standards. As archaeological specialist for Exigo Sustainability, Mr Nelius Kruger acted as field director for the project; responsible for the assimilation of all information, the compilation of the final consolidated AIA report and recommendations in terms of heritage resources on the demarcated project areas. Mr Kruger is an accredited archaeologist and Culture Resources Management (CRM) practitioner with the Association of South African Professional Archaeologists (ASAPA), a member of the Society for Africanist Archaeologists (SAFA) and the Pan African Archaeological Association (PAA) as well as a Master's Degree candidate in archaeology at the University of Pretoria.

1.3 Project Brief

SANRAL has appointed SMEC South Africa as project managers for the abovementioned project and EOH Coastal and Environmental Services (EOH CES) has been appointed as the Environmental Assessment Practitioner (EAP) for the proposed quarries and borrow pits. The above material sources will be utilised for natural/crushed gravel for earthworks, layer works, asphalt and concrete layers, and thus require environmental authorisation. Dependant on the quantities and quality of each, it may be cost effective to source some, or all, materials from commercial sources. Asphalt and concrete aggregate may be sourced from the quarries, while gravel materials will be sourced from the borrow pits. The following material sources and locations are proposed for authorisation:

ID	Source	Area (ha)	Property Description	Type
1	BP 39.6	7.29	Kleinfontein 859	Borrow Pit
2	BP 42.7	13.86	Die Pan 1034	Borrow Pit
3	BP 44.6	6.83	Graspan 553	Borrow Pit
4	Q 50.6 (Q2)	19.01	Brandkop 1594	Quarry
5	BP 51.0	19.46	Tweefontein 66	Borrow Pit
6	BP 52.8	22.8	Helpman 1438	Borrow Pit
7	BP 56.3	10.27	Welgevondon 64	Borrow Pit
8	BP 57.3	9.5	Kraal 62	Borrow Pit
9	BP 64.2	12.78	Welkom 55	Borrow Pit
10	BP 67.3	5.76	Pleasant View 1356	Borrow Pit
11	BP 72.7	6.23	Kruidbaden 1245	Borrow Pit
12	BP 73.8	8.04	Kruidbaden 1245	Borrow Pit
13	Q 77.5 (Q1B)	18.64	Rietfontein 18	Quarry
14	BP 77.7	10.81	Hartplaats 17	Borrow Pit

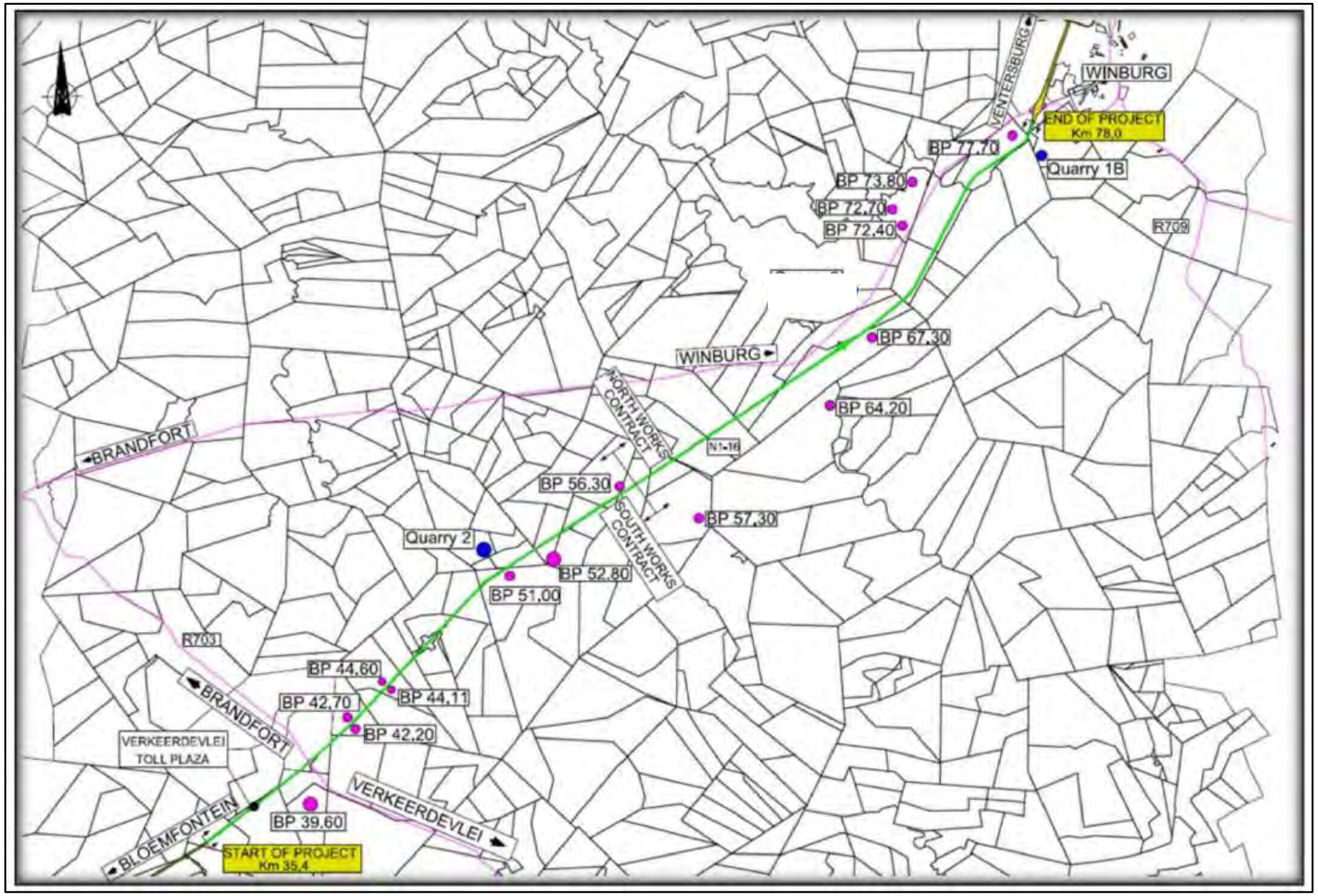

Figure 1-1: Project map indicating the locations of burrow pits and quarries proposed for the SANRAL N1 Zandkraal - Winburg Material Sources Project.

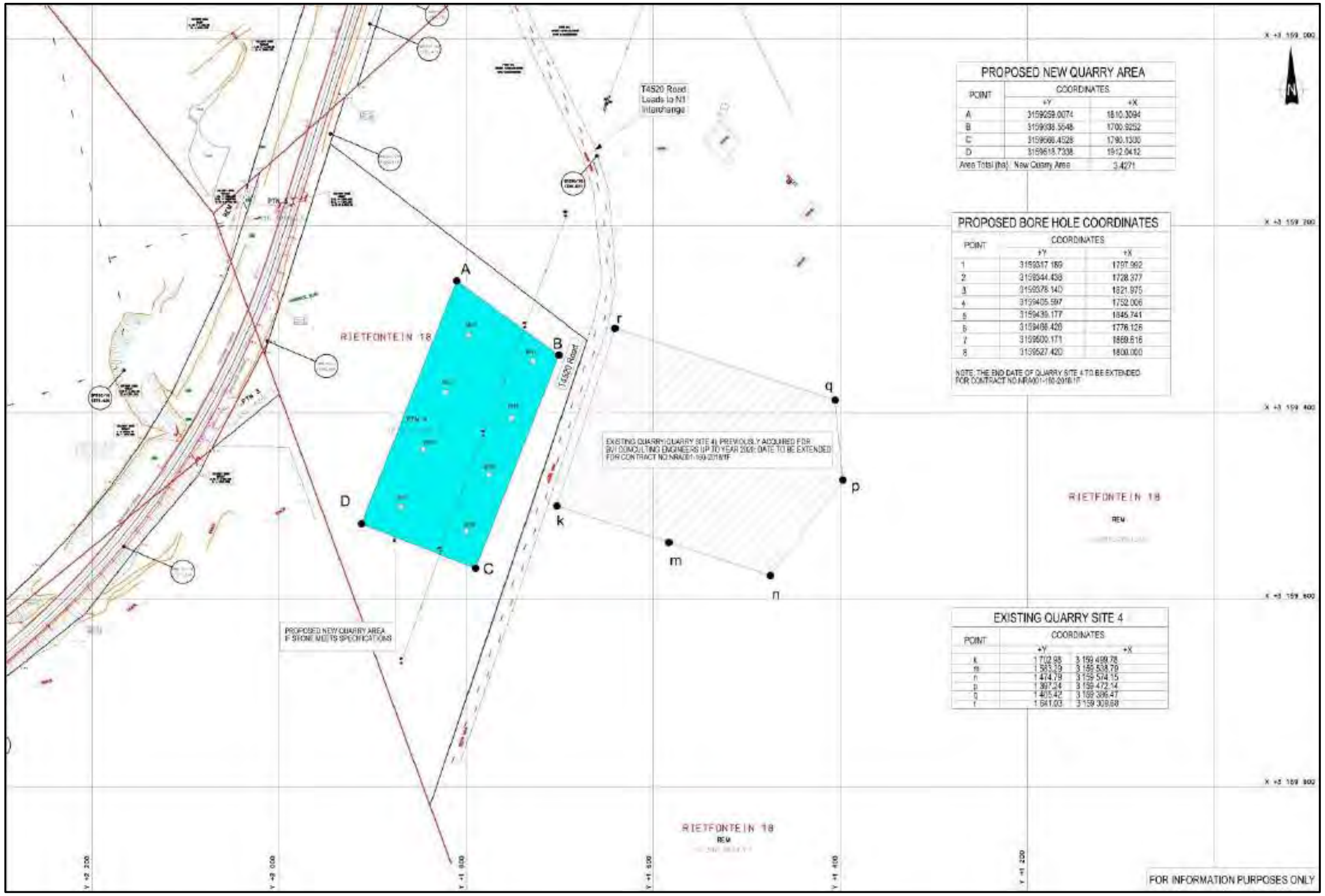

Figure 1-2: Site map of the proposed quarry at Q1 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project.

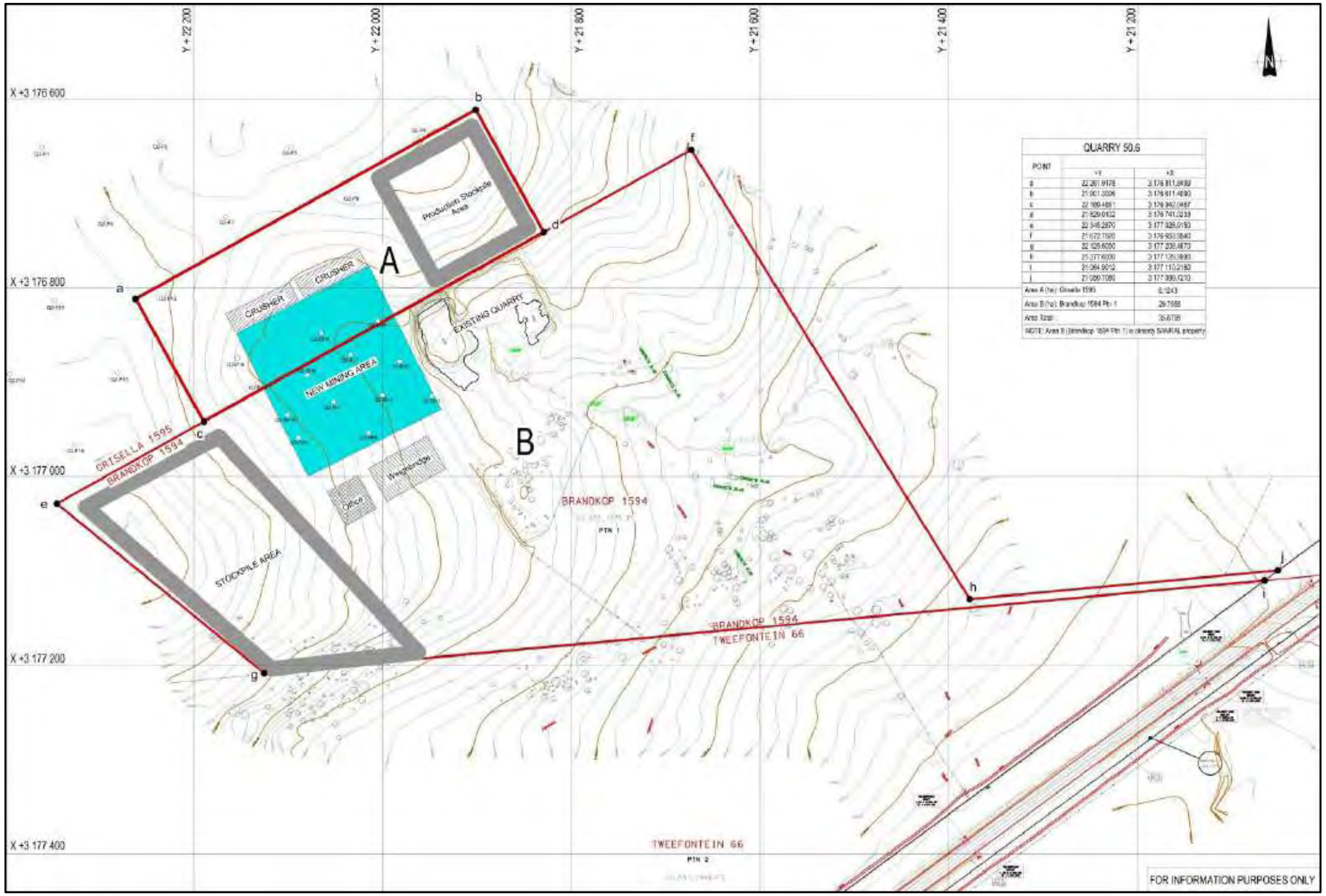

Figure 1-3: Site map of the proposed quarry at Q2 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project.

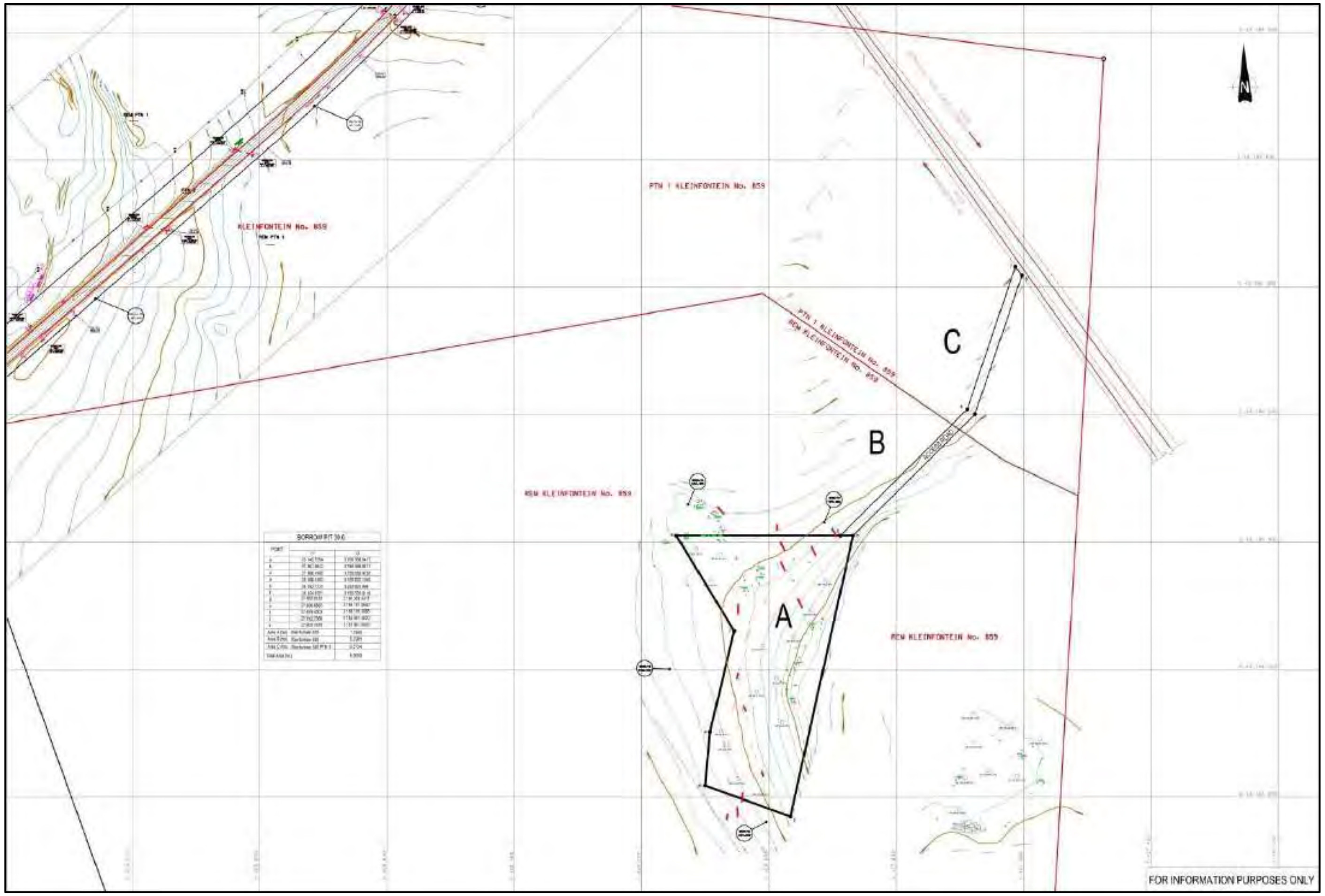

Figure 1-4: Site map of the proposed burrow pit at BP39.6 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project.

Figure 1-5: Site map of the proposed burrow pit at B42.2 and BP42.7 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project.

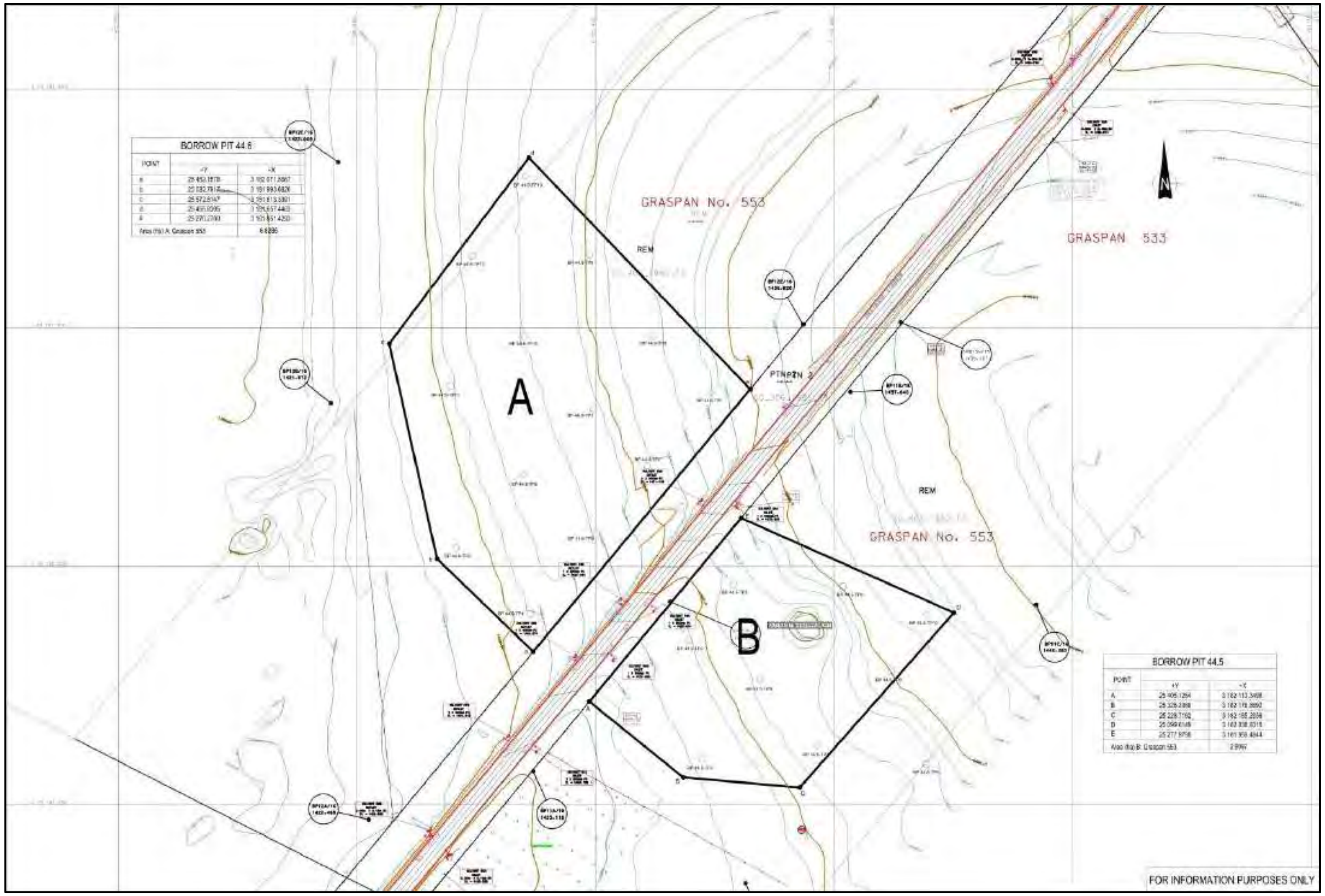

Figure 1-6: Site map of the proposed burrow pit at BP44.5 and BP44.6 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project.

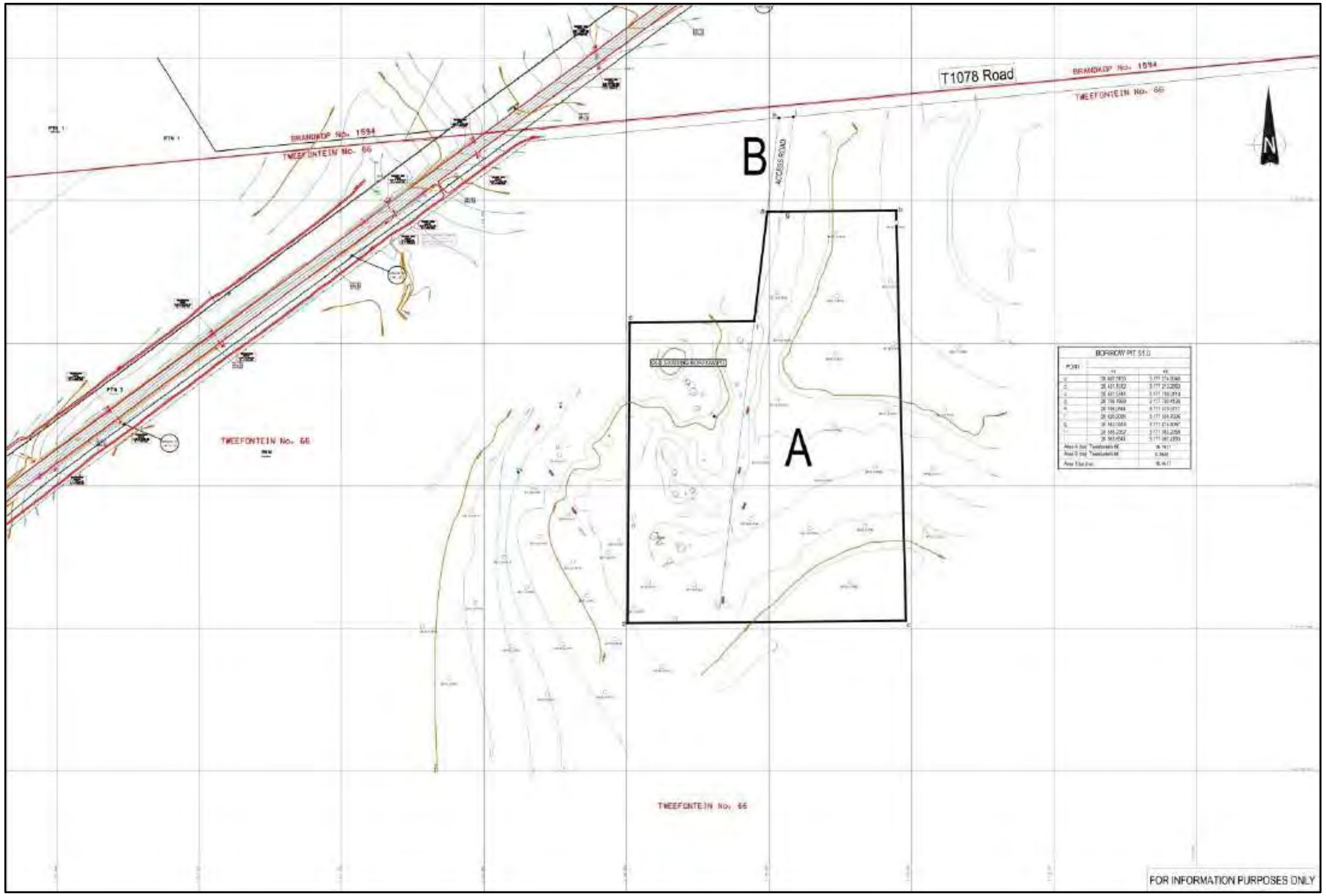

Figure 1-7: Site map of the proposed burrow pit at BP51.0 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project

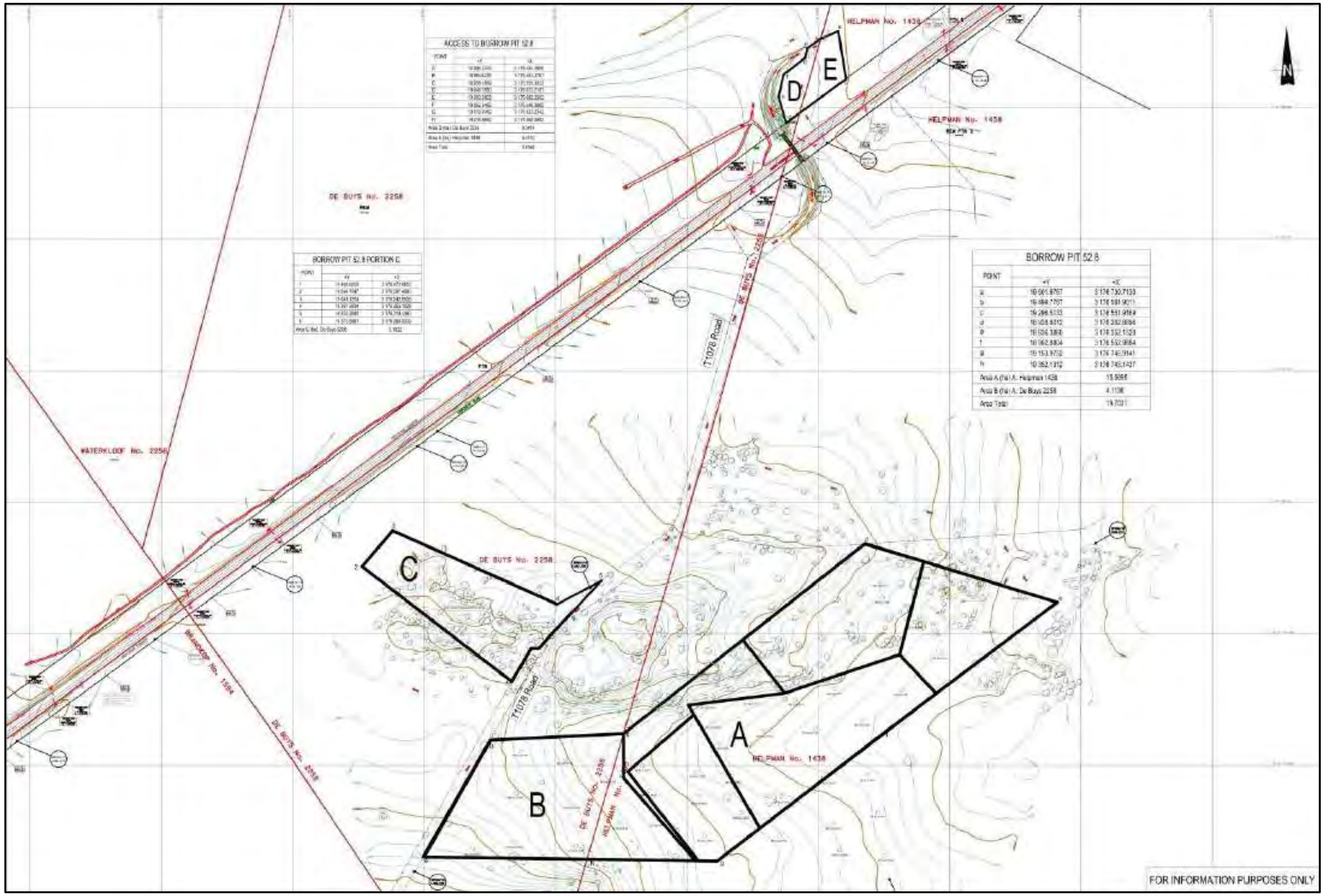

Figure 1-8: Site map of the proposed burrow pit at BP52.8 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project

Figure 1-9: Site map of the proposed burrow pit at BP56.3 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project.

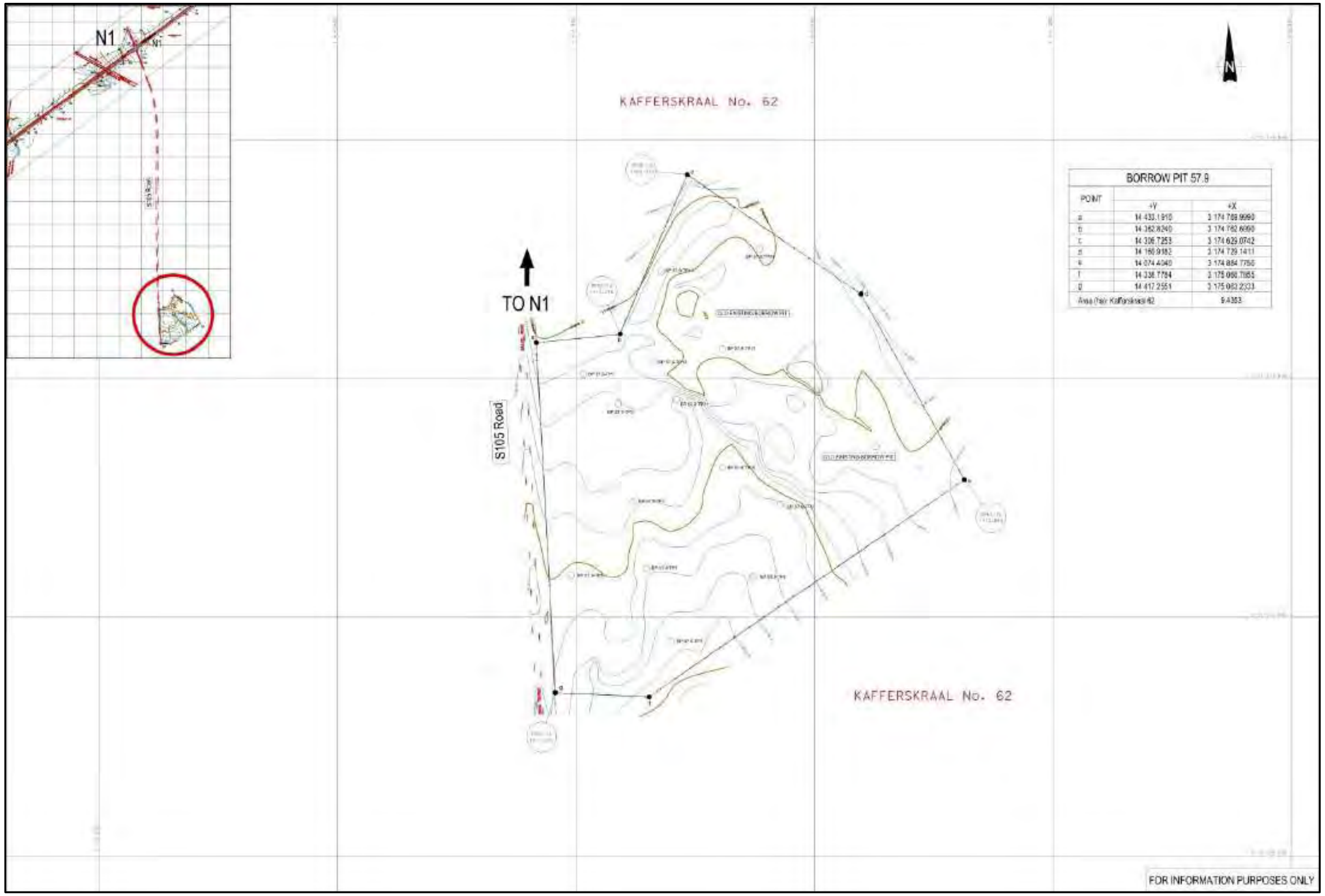

Figure 1-10: Site map of the proposed burrow pit at BP57.9 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project

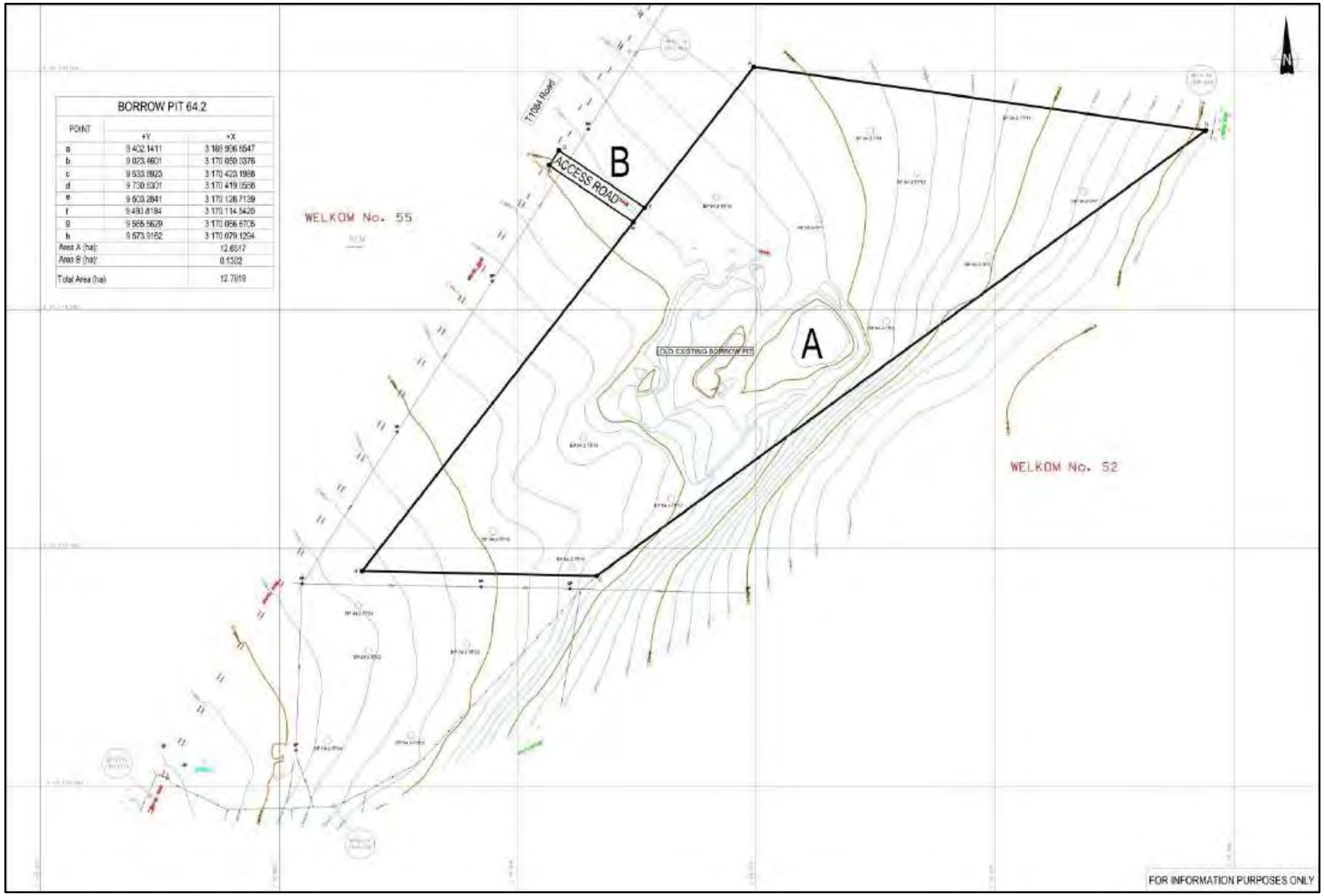

Figure 1-11: Site map of the proposed burrow pit at BP64.2 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project

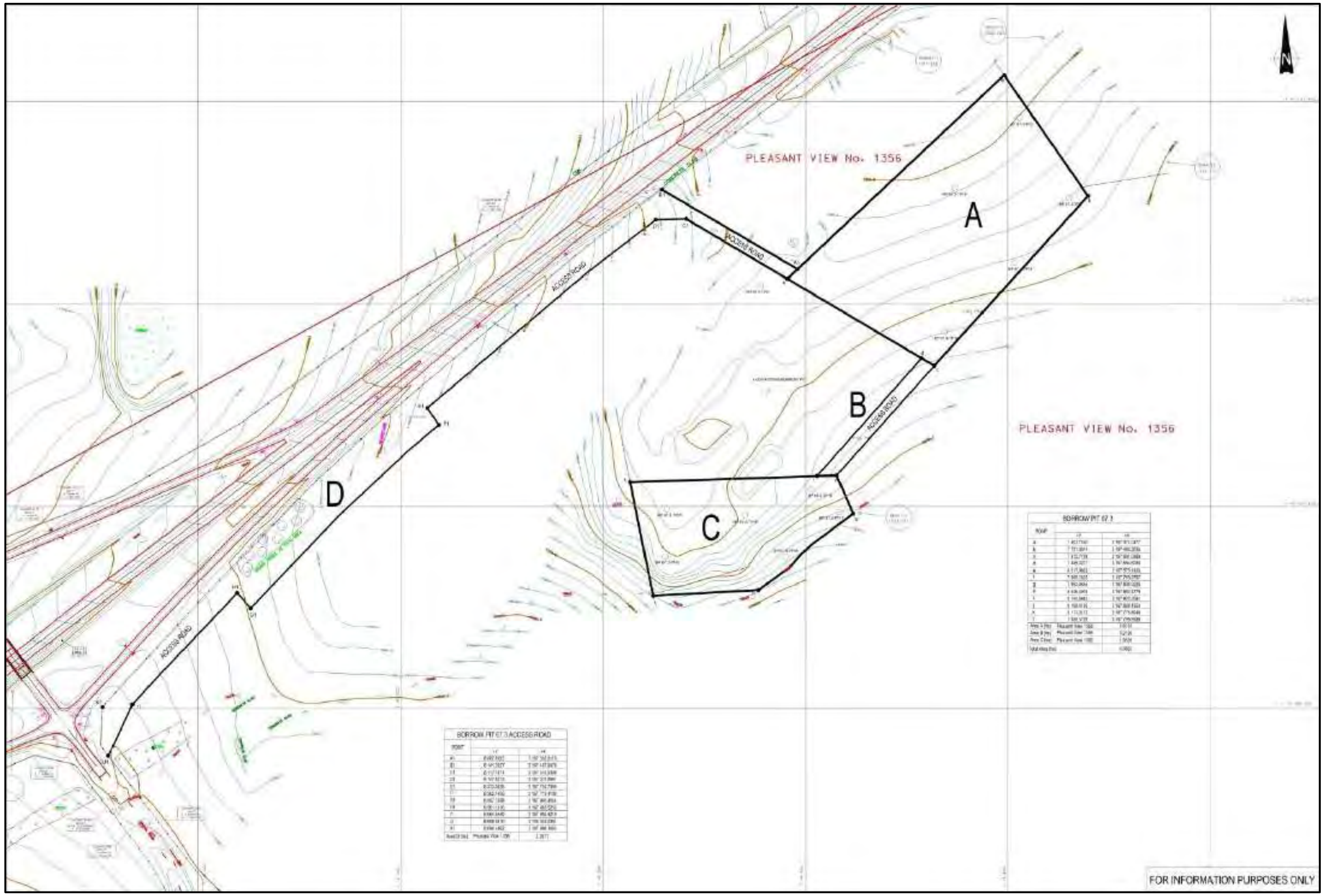

Figure 1-12: Site map of the proposed burrow pit at BP67.3 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project

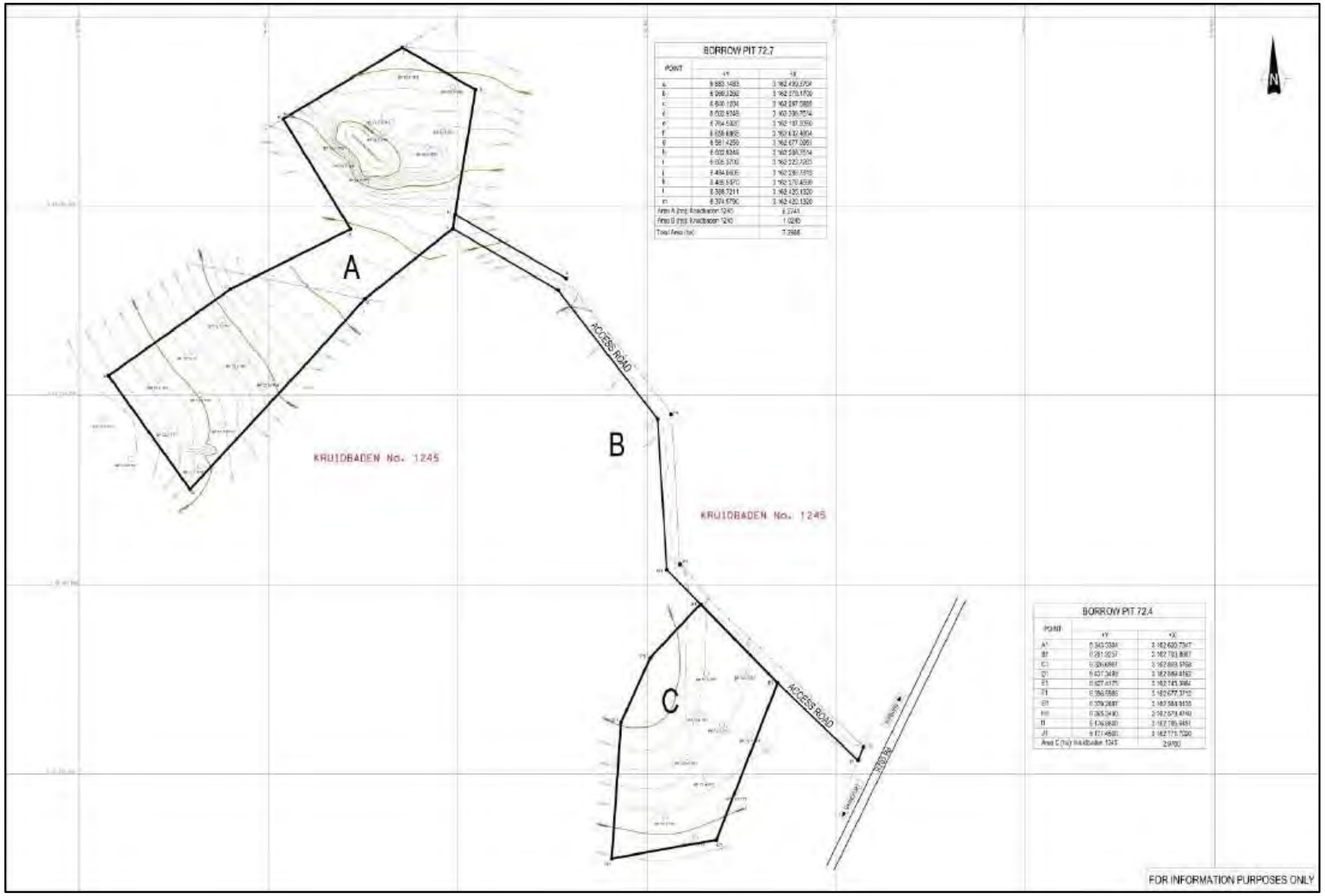

Figure 1-13: Site map of the proposed burrow pit at BP72.4 and BP72.7 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project

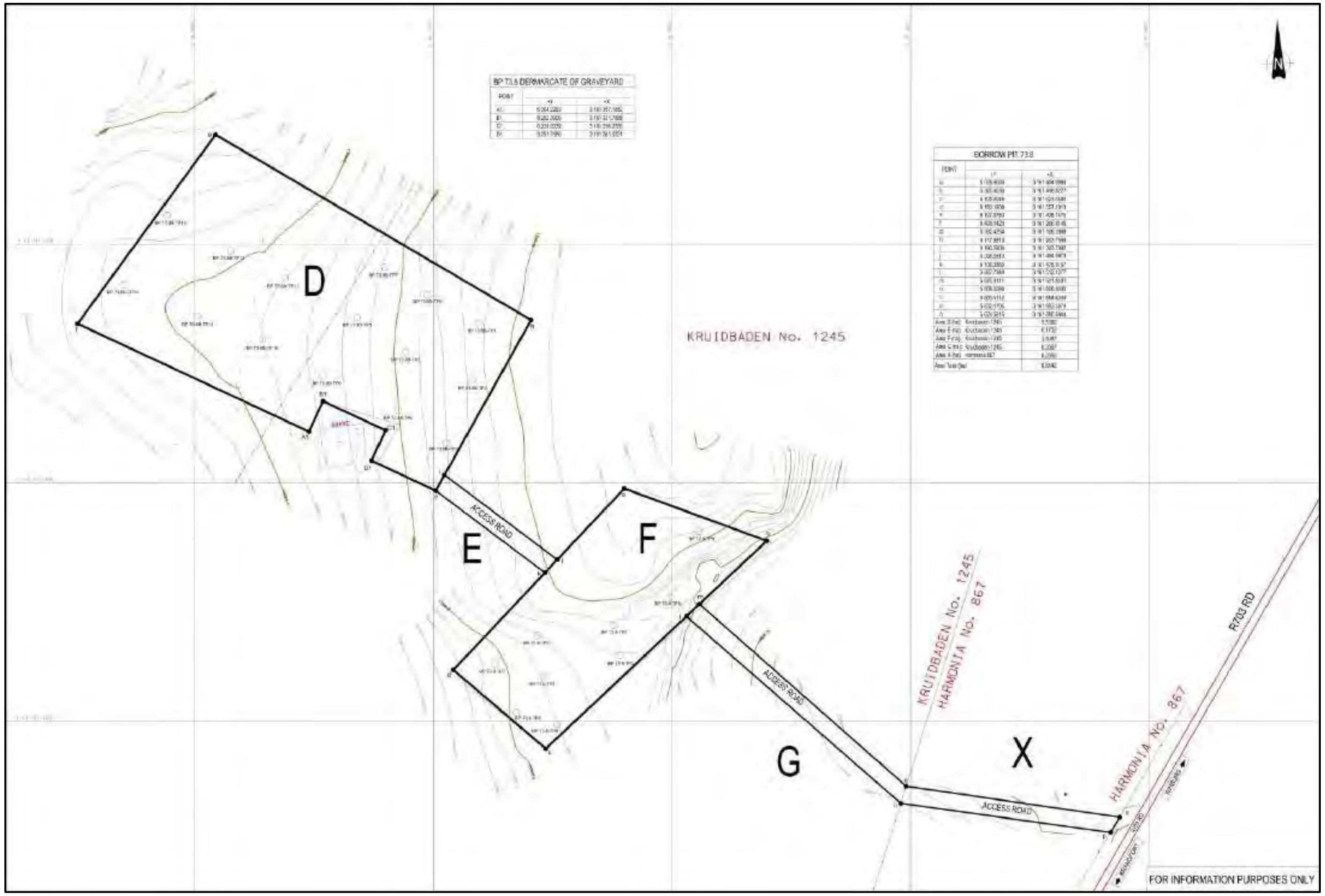

Figure 1-14: Site map of the proposed burrow pit at BP73.8 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project

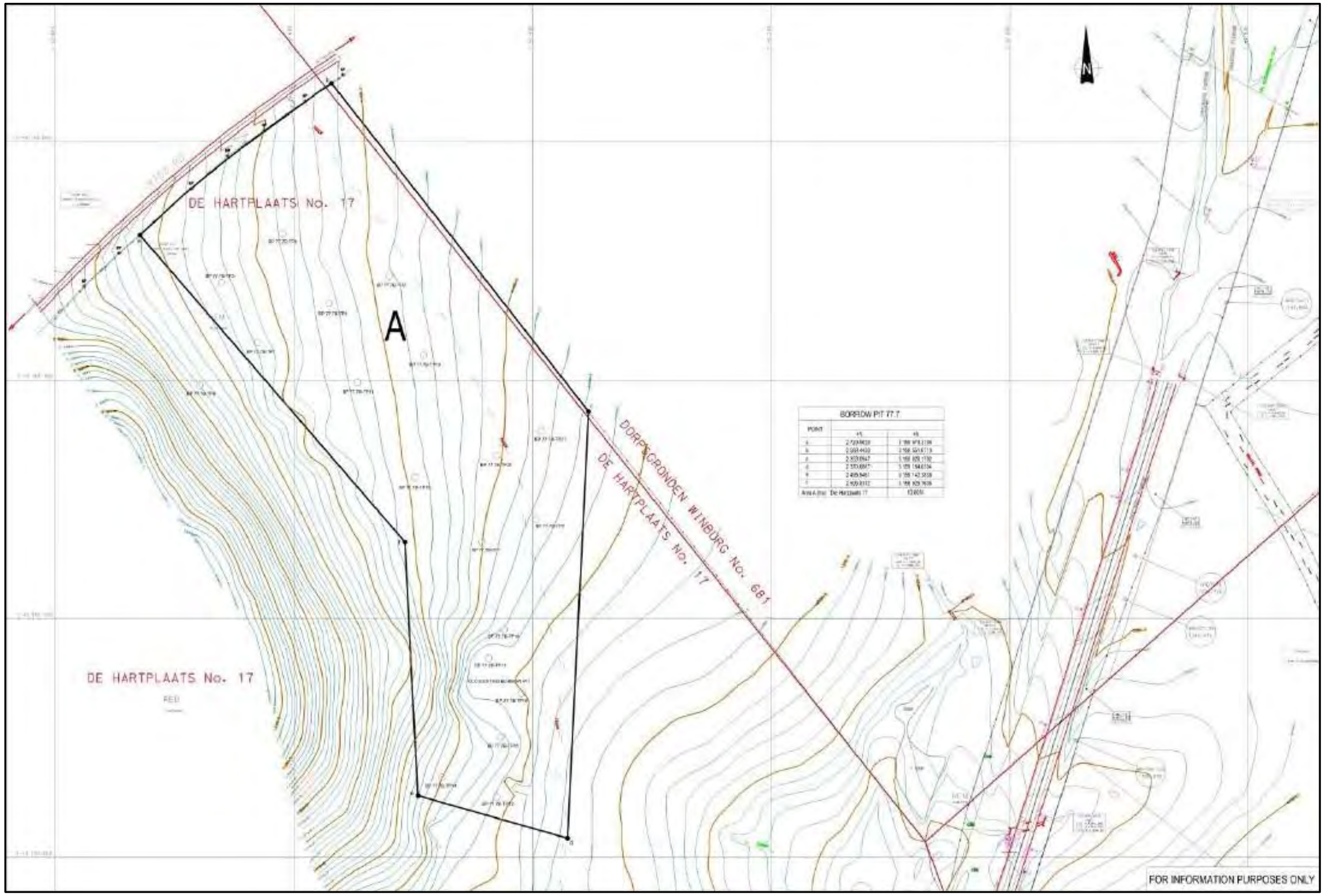

Figure 1-15: Site map of the proposed burrow pit at BP77.7 subject to the SANRAL N1 Zandkraal - Winburg Material Sources Project

1.4 Terms of Reference

Heritage specialist input into the Environmental Impact Assessment (EIA) process is essential to ensure that, through the management of change, developments still conserve our heritage resources. Heritage specialist input in EIA processes can play a positive role in the development process by enriching an understanding of the past and its contribution to the present. It is also a legal requirement for certain development categories which may have an impact on heritage resources (Refer to Section 2.5.2).

Thus, EIAs should always include an assessment of heritage resources. The heritage component of the EIA is provided for in the **National Environmental Management Act, (Act 107 of 1998)** and endorsed by section 38 of the **National Heritage Resources Act (NHRA - Act 25 of 1999)**. In addition, the NHRA protects all structures and features older than 60 years, archaeological sites and material and graves as well as burial sites. The objective of this legislation is to ensure that developers implement measures to limit the potentially negative effects that the development could have on heritage resources. Based hereon, this project functioned according to the following **terms of reference for** heritage specialist input**:**

- *Provide a detailed description of all archaeological artefacts, structures (including graves) and settlements which may be affected, if any.*
- *Assess the nature and degree of significance of such resources within the area.*
- *Establish heritage informants/constraints to guide the development process through establishing thresholds of impact significance;*
- *Assess and rate any possible impact on the archaeological and historical remains within the area emanating from the proposed development activities.*
- *Propose possible heritage management measures provided that such action is necessitated by the development.*
- *Liaise and consult with the South African Heritage Resources Agency (SAHRA)*

1.5 CRM: Legislation, Conservation and Heritage Management

The broad generic term *Cultural Heritage Resources* refers to any physical and spiritual property associated with past and present human use or occupation of the environment, cultural activities and history. The term includes sites, structures, places, natural features and material of palaeontological, archaeological, historical, aesthetic, scientific, architectural, religious, symbolic or traditional importance to specific individuals or groups, traditional systems of cultural practice, belief or social interaction.

1.5.1 Legislation regarding archaeology and heritage sites

The South African Heritage Resources Agency (SAHRA) and its provincial offices aim to conserve and control the management, research, alteration and destruction of cultural resources of South Africa. It is therefore vitally important to adhere to heritage resource legislation at all times.

a. National Heritage Resources Act No 25 of 1999, section 35

According to the National Heritage Resources Act No 25 of 1999 (section 35) the following features are protected as cultural heritage resources:

a. Archaeological artifacts, structures and sites older than 100 years

b. Ethnographic art objects (e.g. prehistoric rock art) and ethnography

c. Objects of decorative and visual arts

d. Military objects, structures and sites older than 75 years

e. Historical objects, structures and sites older than 60 years

f. Proclaimed heritage sites

g. Grave yards and graves older than 60 years

h. Meteorites and fossils

i. Objects, structures and sites of scientific or technological value.

In addition, the national estate includes the following:

a. Places, buildings, structures and equipment of cultural significance

b. Places to which oral traditions are attached or which are associated with living heritage

c. Historical settlements and townscapes

d. Landscapes and features of cultural significance

e. Geological sites of scientific or cultural importance

f. Archaeological and paleontological importance

g. Graves and burial grounds

h. Sites of significance relating to the history of slavery

i. Movable objects (e.g. archaeological, paleontological, meteorites, geological specimens, military, ethnographic, books etc.)

With regards to activities and work on archaeological and heritage sites this Act states that:

"No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit by the relevant provincial heritage resources authority." (34. [1] 1999:58)

and

"No person may, without a permit issued by the responsible heritage resources authority-

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites. (35. [4] 1999:58)."

and

"No person may, without a permit issued by SAHRA or a provincial heritage resources agency-

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority;

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) and excavation equipment, or any equipment which assists in the detection or recovery of metals (36. [3] 1999:60)."

b. Human Tissue Act of 1983 and Ordinance on the Removal of Graves and Dead Bodies of 1925

Graves and burial grounds are commonly divided into the following subsets:

a. ancestral graves
b. royal graves and graves of traditional leaders
c. graves of victims of conflict
d. graves designated by the Minister
e. historical graves and cemeteries
f. human remains

Graves 60 years or older are heritage resources and fall under the jurisdiction of both the National Heritage Resources Act and the Human Tissues Act of 1983. However, graves younger than 60 years are specifically protected by the Human Tissues Act (Act 65 of 1983) and Ordinance on Excavations (Ordinance no. 12 of 1980) as well as any local and regional provisions, laws and by-laws. Such burial places also fall under the jurisdiction of the National Department of Health and the Provincial Health Departments. Approval for the exhumation and re-burial must be obtained from the relevant Provincial MEC as well as the relevant local authorities.

c. National Heritage Resources Act No 25 of 1999, section 35

This act (Act 107 of 1998) states that a survey and evaluation of cultural resources must be done in areas where development projects, that will change the face of the environment, will be undertaken. The impact of the development on these resources should be determined and proposals for the mitigation thereof are made. Environmental management should also take the cultural and social needs of people into account. Any disturbance of landscapes and sites that constitute the nation's cultural heritage should be avoided as far as possible and where this is not possible the disturbance should be minimized and remedied.

1.5.2 Background to HIA and AIA Studies

South Africa's unique and non-renewable archaeological and palaeontological heritage sites are 'generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority. Heritage sites are frequently threatened by development projects and both the environmental and heritage legislation require impact assessments (HIAs & AIAs) that identify all heritage resources in areas to be developed. Particularly, these assessments are required to make recommendations for protection or mitigation of the impact of the sites.

HIAs and AIAs should be done by qualified professionals with adequate knowledge to (a) identify all heritage resources including archaeological and palaeontological sites that might occur in areas of developed and (b) make recommendations for protection or mitigation of the impact on the sites.

A detailed guideline of statutory terms and requirements is supplied in Addendum 1.

2 REGIONAL CONTEXT

2.1 Area Location

The project is located on National Road 1 section 16, between Zandkraal (km 33.8) and Winburg (km 78.0), in a southern direction from Winburg in the Free State Province. The town of Bloemfontein is situated more or less 70km to the southwest of Winburg. The respective footprints for quarries and burrow pits appear on 1:50 000 map sheets **2826DA, 2826DB, 2826DC, 2826DD** (see Figure 2-1), more or less at the following geographical point:

- **Q1 Rietfontein 18: S28.55052° E26.98156°**
- **Q2 Grisella 1595: S28.70848° E26.77684°**
- **BP 39.6 Kleinfontein 859: S28.79368° E26.71288°**
- **BP 42.2 Die Pan 1034: S28.77164° E26.72531°**
- **BP 42.7 Die Pan 1034: S28.76487° E26.72511°**
- **BP 44.5 Graspan 553: S28.75420° E26.74192°**
- **BP 44.6 Graspan 553: S28.75177° E26.73942°**
- **BP 51.0 Tweefontein 66: S28.71340° E26.78915°**
- **BP 52.8 Helpman 1438: S28.70479° E26.80484°**
- **BP 56.3 Welgevonden 64: S28.67876° E26.82581°**
- **BP 57.9 Kraal 62: S28.68983° E26.85395°**
- **BP 64.2 Welkom 55: S28.64807° E26.90309°**
- **BP 67.3 Pleasant View 1356: S28.62418° E26.91878°**
- **BP 72.4 Kruidbaden 1245: S28.58016° E26.93490°**
- **BP 72.7 Kruidbaden 1245: S28.57540° E26.93172°**
- **BP 73.8 Kruidbaden 1245: S28.56758° E26.93687°**
- **BP 77.7 Hartplaats 77: S28.54342° E26.97301°**

2.2 Area Description: Receiving Environment

The development site lies within the Savanna biome which is the largest biome in Southern Africa. The original vegetation of the landscape around the subject farms is made up of Dry Sandy Highveld Grassland, but in many places has been replaced due to farming activities (ploughing). The geology of the area is made up of mudstone. The topography is describes as moderately undulating plains and pans. The Groot Vet River bisects the landscape to flow into the Erfenis Dam south-west of Winburg. Large portions of the project properties have been converted to agricultural fields in past decades and other farms are being used for livestock grazing, farming and tourism.

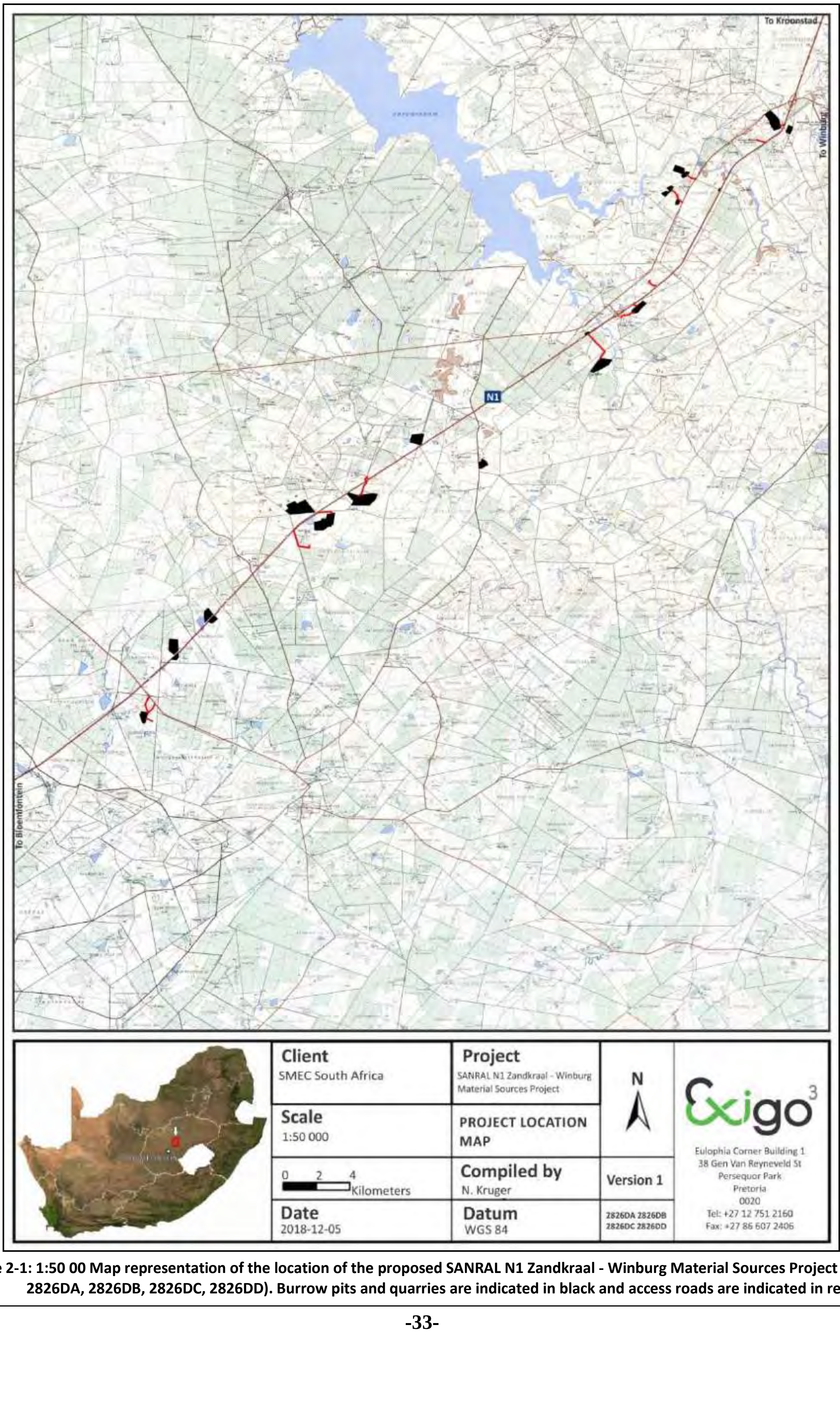

Figure 2-1: 1:50 00 Map representation of the location of the proposed SANRAL N1 Zandkraal - Winburg Material Sources Project (sheet 2826DA, 2826DB, 2826DC, 2826DD). Burrow pits and quarries are indicated in black and access roads are indicated in red.

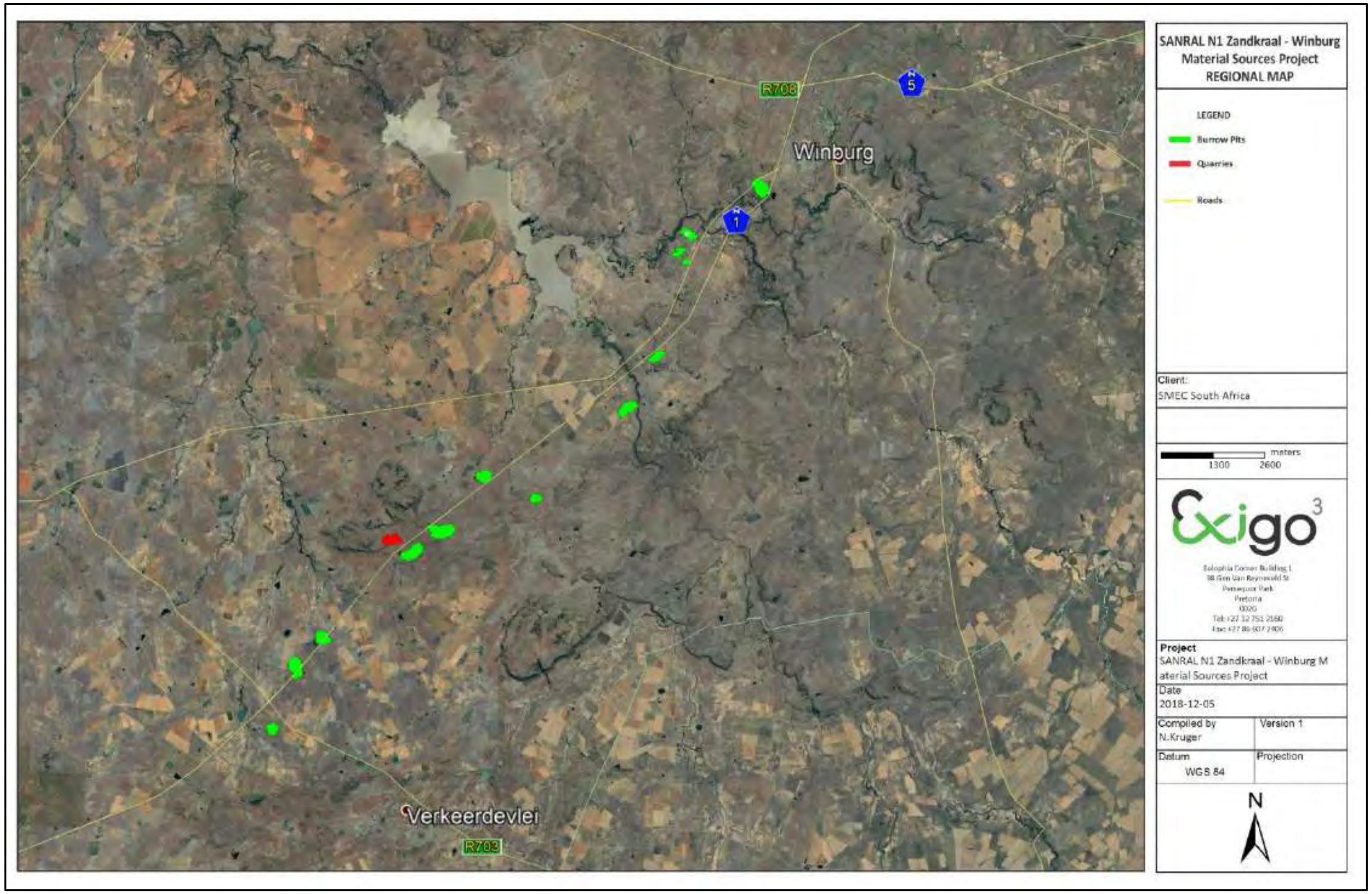

Figure 2-2: Aerial map providing a regional setting for the SANRAL N1 Zandkraal - Winburg Material Sources Project locality. Burrow pits are indicated in green and quarries are indicated in red.

2.3 Site Descriptions

2.3.1 Quarries

- **Q1 Rietfontein 18 7.29ha**

The farm is situated just south of the Winburg/Brandfort interchange approximately 200m east of km 77.7. The farm is situated east of the R703 and approximately 1.9 km perpendicular from km 72.6 of the N1-16. An existing quarry was un-rehabilitated and left approximately 3m deep. The area is sparsely grassed and can be described as typical Free State grasslands with regular outcrops of. Shrubs and bushes and scattered trees are also visible. The quarry was previously used for a previous road construction project.

Figure 2-1: View of general surroundings at Q1 on the farm Rietfontein.

Figure 2-2: View of general surroundings at Q1 on the farm Rietfontein.

Figure 2-3: View of an existing quarry at Q1 on the farm Rietfontein.

- **Q2 Grisella 1595 7.29ha**

The farm is located north of the Monte Video/Kromdraai intersection. The proposed quarry is approximately 500m west of the N1. A large quarry area was partially rehabilitated and a vast and deep digging site had been fenced off previously. The area inclines to the west where rock surfaces and faces occur along the area pf the proposed quarry. To the east the area is grassed and can be described as typical Free State grasslands with regular outcrops of dolerite on the ridge side of the borrow pit. Shrubs and bushes and scattered trees are also visible. The quarry was previously used for a previous road construction project.

Figure 2-4: View of general surroundings at Q2 on the farm Grisella.

Figure 2-5: View of a large rock bank at Q2 on the farm Grisella.

Figure 2-6: View of an existing quarry at Q2 on the farm Grisella.

2.3.2 Burrow Pits

- **BP 39.6 Kleinfontein 859: 7.29ha**

The farm is located west of Verkeerdevlei, on the south side of the R703 with the entrance gate to the borrow pit next to the R703 and approximately 1km from the N1-16. The portion of the farm is currently used as a grazing camp for cattle. There is no established or previously used borrow pit on the portion of the farm. The portion of the farm is untouched and lies in its natural state. The proposed borrow pit is grassed and can be described as typical Free State grasslands used for cattle grazing. At the border of the proposed borrow pit in the eastern side there is coarse outcrops of dolerite.

Figure 2-7: View of general surroundings at BP 39.6 on the farm Kleinfontein. Note dolerite outcrops.

Figure 2-8: View of general surroundings at BP 39.6 on the farm Kleinfontein.

- **BP 42.2 Die Pan 1034: 3.49ha**

The farm is located just north of the Verkeerdevlei/Brandfort intersection. The borrow pit borders the N1 road reserve on the western side. The portion of the farm is untouched and lies in its natural state. The area is grassed and can be described as typical Free State grasslands. The portion of the farm is currently used as a grazing camp for cattle. There is no established or previously used borrow pit on the portion of the farm.

Figure 2-9: View of general surroundings at BP 42.2 on the farm Die Pan.

Figure 2-10: Ashy soil visible from the subsurface of BP 42.2 on the farm Die Pan.

- **BP 42.7 Die Pan 1034: 13.86ha**

The farm is located just north of the Verkeerdevlei/Brandfort intersection. The borrow pit borders the N1 road reserve on the eastern side. The portion of the farm is untouched and lies in its natural state. The area is grassed and can be described as typical Free State grasslands.The portion of the farm is currently used as a grazing camp for cattle with a concrete dam present. There is no established or previously used borrow pit on the portion of the farm.

Figure 2-11: View of general surroundings at BP 42.7 on the farm Die Pan.

Figure 2-12: View of a concrete dam at BP 42.7 on the farm Die Pan.

- **BP 44.5 Graspan 553: 3.91ha**

The farm is located north of the Verkeerdevlei/Brandfort intersection. The proposed borrow pit borders the N1 road reserve on the western side. The portion of the farm is currently used as a grazing camp for cattle. A small overgrown borrow pit is present on this part of the farm. The existing borrow pit was last utilized in the 1970's and have been fully rehabilitated. The area is grassed and can be described as typical Free State grasslands.

Figure 2-13: View of general surroundings at BP 44.5 on the farm Graspan.

Figure 2-14: View of an existing burrow pit at BP 44.5 on Graspan.

- **BP 44.6 Graspan 553: 6.83ha**

The farm is located north of Verkeerdevlei/Brandfort intersection. The borrow pit borders the N1 road reserve on the eastern side. The portion of the farm is currently used as a grazing camp for cattle. The portion of the farm is untouched and lies in its natural state. The area is grassed and can be described as typical Free State grasslands. There is no established or previously used borrow pit on the portion of the farm.

Figure 2-15: View of general surroundings at BP 44.6 on the farm Graspan.

Figure 2-16: View of general surroundings at BP 44.6 on the farm Graspan. Note the large embankment dam in the distance.

- **BP 51.0 Tweefontein 66: 19.46ha**

The farm is located north of the Monte Video/Kromdraai intersection. The proposed borrow pit is approximately 1 km south-east from the N1. The portion of the farm is currently used as a grazing camp for cattle. A previously used borrow pit is visible on the south-western side of the area. The majority of the area is untouched and lies in its natural state. Previous excavations were visible on the western side of the source. The area is grassed and can be described as typical Free State grasslands with regular outcrops of dolerite on the ridge side of the borrow pit.

Figure 2-17: View of general surroundings at BP 51.0 on the farm Tweefontein.

Figure 2-18: View of an old burrow pit on Tweefontein.

- **BP 52.8 Helpman 1438: 22.8ha**

The farm is located south of the Candy/Jossephinesdal intersection. The existing borrow pit borders the N1 on the western side. The portion of land is not currently utilised by the owner. A large portion is presently covered densely with typical Free State red grass. A large area of the proposed borrow pit still remains untouched and in its natural state. The existing borrow pit was not rehabilitated and construction waste like concrete and old pipes were spoiled in the borrow pit. The western portion of the borrow pit is moderately covered with Karee trees and the remaining area can be described as typical Free State grasslands.

Figure 2-19: View of an old burrow pit at BP 52.8 on the farm Helpman.

Figure 2-20: View of general surroundings at BP 52.8 on the farm Helpman.

Figure 2-21: View of general surroundings at BP 52.8 on the farm Helpman.

- **BP 56.3 Welgevonden 64: 10.27ha**

The farm is located south of the Candy/Jossephinesdal intersection. The proposed borrow pit borders the N1 on the western side. The portions of the farms are currently used as a grazing camp for cattle and sheep. An existing borrow pit was not rehabilitated. The grassed area were used as a grazing camp for sheep but after the use of the borrow pit the area was not sufficient anymore. The entire borrow pit is located on a "koppie" with regular outcrops of dolerite and the area in general can be described as typical Free State grasslands.

Figure 2-22: View of general surroundings at BP 56.3 on the farm Welgevonden.

Figure 2-23: View of an old burrow pit at BP 56.3 on the farm Welgevonden.

- **BP 57.9 Kraal 62: 9.5ha**

The borrow pit area is situated 2.4 km south-east on the S105 from the N1. The portion of land is not currently utilized due to the small area of the existing borrow pit that is still surrounded by the initial fence. The existing borrow pit was rehabilitated and the old fence surrounding the borrow pit still remained in place. The area is grassed and can be described as typical Free State grasslands.

Figure 2-24: View of old quarries at BP 57.9 on the farm Kraal.

Figure 2-25: View of old quarries at BP 57.9 on the farm Kraal.

- **BP 64.2 Welkom 55: 12.78ha**

The borrow pit is located just south of the Groot Vet river, approximately 1.2 km east of the N1. The portion of the farm is currently used as a grazing camp for cattle and antelopes. The grass has not completely been established on the un-rehabilitated borrow pit. The existing borrow pit was not rehabilitated. Water gathered in some parts of the borrow pit due to no rehabilitation. The area is grassed and can be described as typical Free State grasslands. Scattered scrubs and trees are evident closer to the river.

Figure 2-26: View of general surroundings at BP 64.2 on the farm Welkom.

Figure 2-27: View of old quarries at BP 64.2 on the farm Welkom.

- **BP 67.3 Pleasant View 1356: 5.76ha**

The borrow pit is located just north of the Kareedam/Ceylonia interchange, approximately 150 m east from the road reserve. The portion of the farm is currently used as a grazing camp for cattle. The existing borrow pit has been rehabilitated and well worked off. The existing borrow pit was rehabilitated and grass have been established in the borrow pit area. Vegetation consists of typical Free State grass, smallish shrubs and bushes and scattered trees.

Figure 2-28: View of general surroundings at BP 67.3 on the farm Pleasant View.

Figure 2-29: View of an old burrow pit at BP 67.3 on the farm Pleasant View.

- **BP 72.4 Kruidbaden 1245: 2.98ha**

The farm is situated west of the R703 and approximately 1.3 km perpendicular from km 72.4 of the N1-16. The portion of the farm is currently used as a grazing camp for cattle and antelopes. There is no established or previously used borrow pit on the portion of the farm. The portion of the farm is untouched and lies in its natural state. The area is grassed and can be described as typical Free State grasslands with regular outcrops of dolerite on the ridge side of the borrow pit.

Figure 2-30: View of general surroundings at BP 72.4 on the farm Kruidbaden.

Figure 2-31: View of general surroundings at BP 72.4 on the farm Kruidbaden.

- **BP 72.7 Kruidbaden 1245: 6.23ha**

The farm is situated west of the R703 and approximately 1.9 km perpendicular from km 72.6 of the N1-16. The existing borrow pit was un-rehabilitated and left approximately 9 m deep. The faces were also left steep. This causes a threat for cattle that can possibly fall into the borrow pit. The area is grassed and can be described as typical Free State grasslands with regular outcrops of dolerite on the ridge side of the borrow pit. Shrubs and bushes and scattered trees are also visible. The borrow pit was previously used for a previous road construction project.

Figure 2-32: View of general surroundings at BP 72.7 on the farm Kruidbaden.

Figure 2-33: View of a large burrow pit at BP 72.7 on the farm Kruidbaden.

- **BP 73.8 Kruidbaden 1245: 8.04ha**

The farm is situated west of the R703 and approximately 1.5 km perpendicular from km 73.8 of the N1-16. The portion of the farm is currently used as a grazing camp for cattle. There is no established or previously used borrow pit on the portion of the farm. The portion of the farm is untouched and lies in its natural state. The area is grassed and can be described as typical Free State grasslands with regular outcrops of dolerite on the ridge side of the borrow pit. Shrubs and bushes and scattered trees are also visible.

Figure 2-34: View of general surroundings at BP 73.8 on the farm Kruidbaden.

Figure 2-35: Signs of digging visible at BP 73.8 on the farm Kruidbaden.

- **BP 77.7 Hartplaats 77: 10.81ha**

The farm is situated just south of the Winburg/Brandfort interchange approximately 180 m west of km 77.7. The greater part of the area is untouched and lies in its natural state. There is a small existing borrow pit where the grass is re-established. The area is grassed and can be described as typical Free State grazing grass. Dolerite outcrops is visible at the foot of the "koppie". Shrubs and bushes and scattered trees are also visible. The portion of the farm is currently used as a grazing camp for horses. The part of the existing borrow pit has not been used for a long time and the grass has been re-established.

Figure 2-36: View of general surroundings at BP 77.7 on the farm Hartplaats.

Figure 2-37: View of old burrow pits at BP 77.7 on the farm Hartplaats.

3 METHOD OF ENQUIRY

3.1 Sources of Information

Data from detailed desktop, aerial and field studies were employed in order to sample surface areas systematically and to ensure a high probability of heritage sites recording.

3.1.1 Desktop Study

A desktop study was prepared in order to contextualize the proposed project within a larger historical milieu. As such, the study functioned to provide a historical context for the proposed project and archival sources, aerial photographs, historical maps and local histories were used to create a baseline of the landscape's heritage. This desktop study also relied on commercially driven Heritage Assessments as well as academic papers and research articles that have been conducted in the region around the project area.

3.1.2 Aerial Representations and Survey

Aerial photography is employed to locate and study archaeological sites, particularly where larger scale area surveys are performed. This method was applied to assist the foot site survey where depressions, variation in vegetation, soil marks and landmarks were examined. Specific attention was given to shadow sites (shadows of walls or earthworks which are visible early or late in the day), crop mark sites (crop mark sites are visible because disturbances beneath crops cause variations in their height, vigour and type) and soil marks (e.g. differently coloured or textured soil (soil marks) might indicate ploughed-out burial mounds). Attention was also given to moisture differences, as prolonged dampening of soil as a result of precipitation frequently occurs over walls or embankments. By superimposing high frequency aerial photographs with images generated with Google Earth, potential sensitive areas were subsequently identified, geo-referenced and transferred to a handheld GPS device. These areas served as referenced points from where further vehicular and pedestrian surveys were carried out. The aerial survey suggested a landscape that has been transformed over the last century by human activity relating to agriculture and settlement (see Figure 3-1 - Figure 3-10).

3.1.3 Mapping of sites

Historical and current maps of the project area were examined. By merging data obtained from the desktop study and the aerial survey, sites and areas of possible heritage potential were plotted on these maps of the larger Winburg area using GIS software. These maps were then superimposed on high definition aerial representations in order to graphically demonstrate the geographical locations and distribution of potentially sensitive landscapes. Historical maps of the project areas indicate the general absence of man-made features such as farmsteads and buildings (see Figure 3-1 - Figure 3-10).

3.1.4 Field Survey

Archaeological survey implies the systematic procedure of the identification of archaeological sites. An archaeological survey of each of the respective quarry and burrow pit sites was conducted over a 3 day period in December 2018. The survey process encompassed field surveys in accordance with standard archaeological practice by which heritage resources are observed and documented. In order to sample surface areas systematically and to ensure a high probability of site recording, each quarry and burrow pit site was carefully inspected on foot by means of a transect survey. GPS reference points identified during the aerial and mapping surveys were also visited and random spot checks were made (see detail in previous section). Using a Garmin E-trex Montana GPS, the site was geo-referenced and photographed with a Samsung Digital camera. Real time aerial mapping and positioning by means of a hand-held tablet-based Google Earth application was also employed on site to investigate possible disturbed areas during the survey.

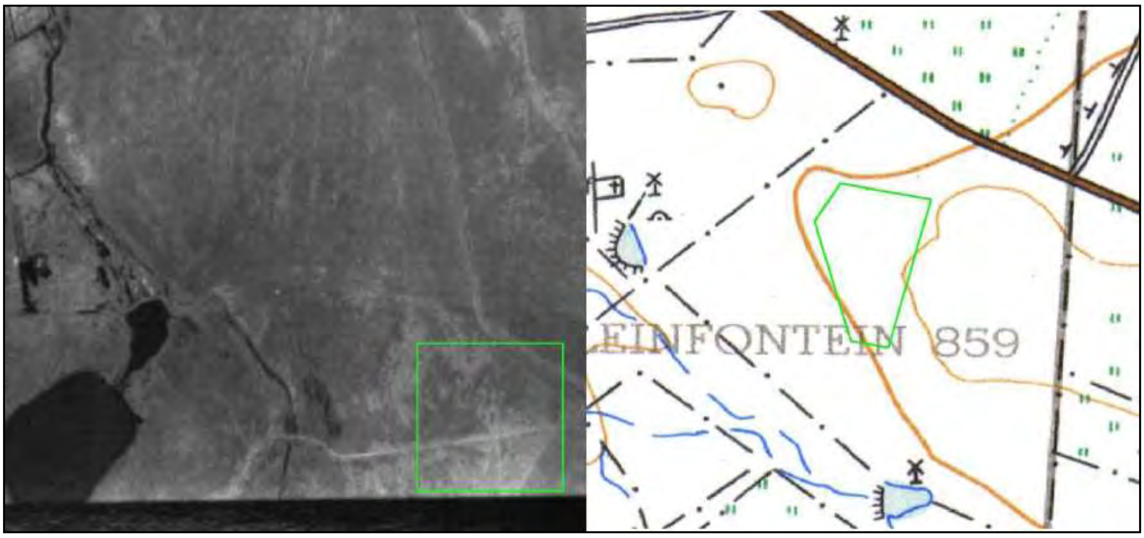

Figure 3-1: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farm Kleinfontein within the historical landscape. The relative location of BP 39.6 is indicated in green outline.

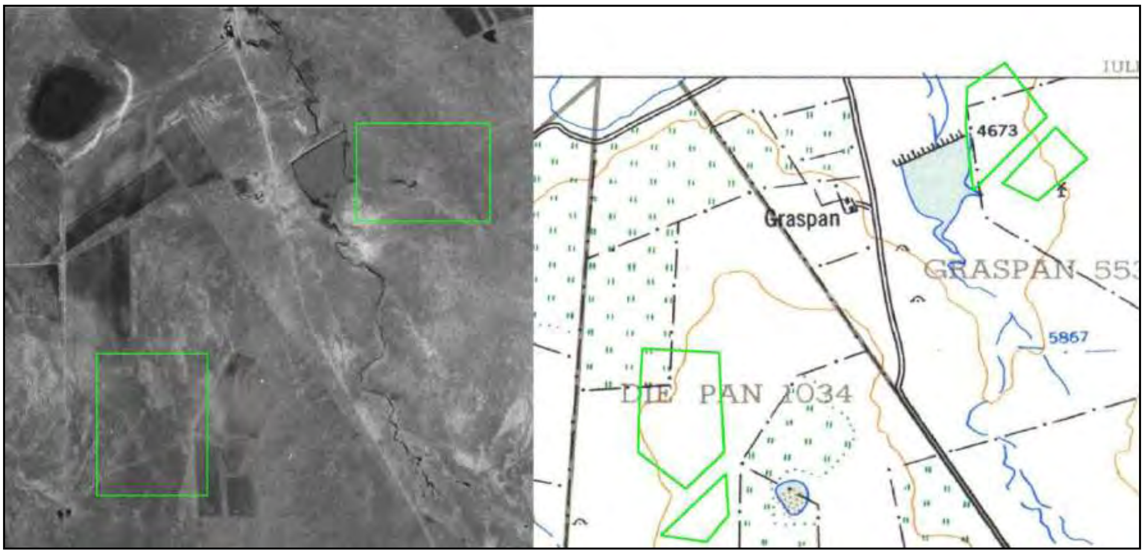

Figure 3-2: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farms Graspan and Die Pan within the historical landscape. The relative locations of BP 42.2, BP 42.7, BP 44.5 and BP 44.6 are indicated in green outline.

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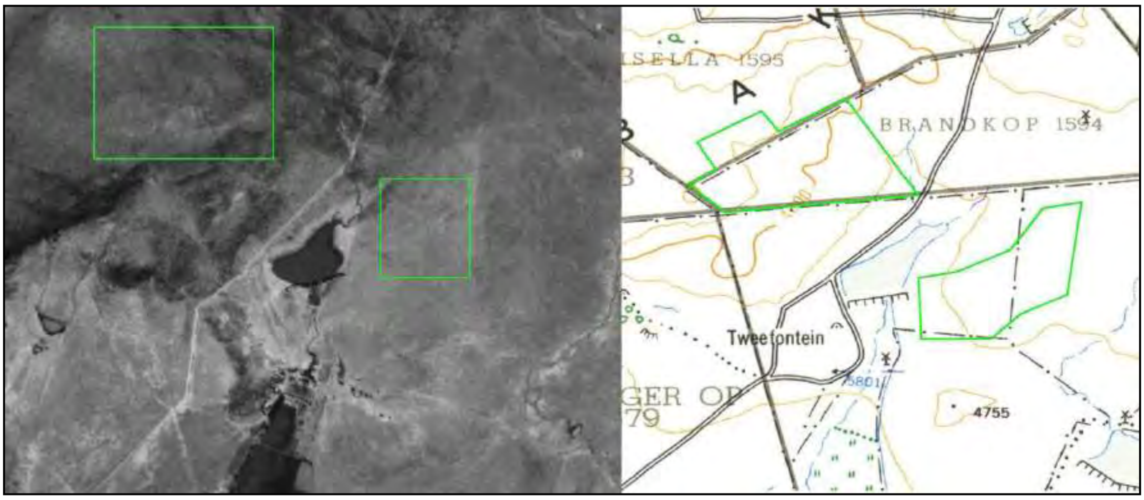

Figure 3-3: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farms Grisella and Tweefontein within the historical landscape. The relative locations of Q2 and BP 51.0 area indicated in green outline.

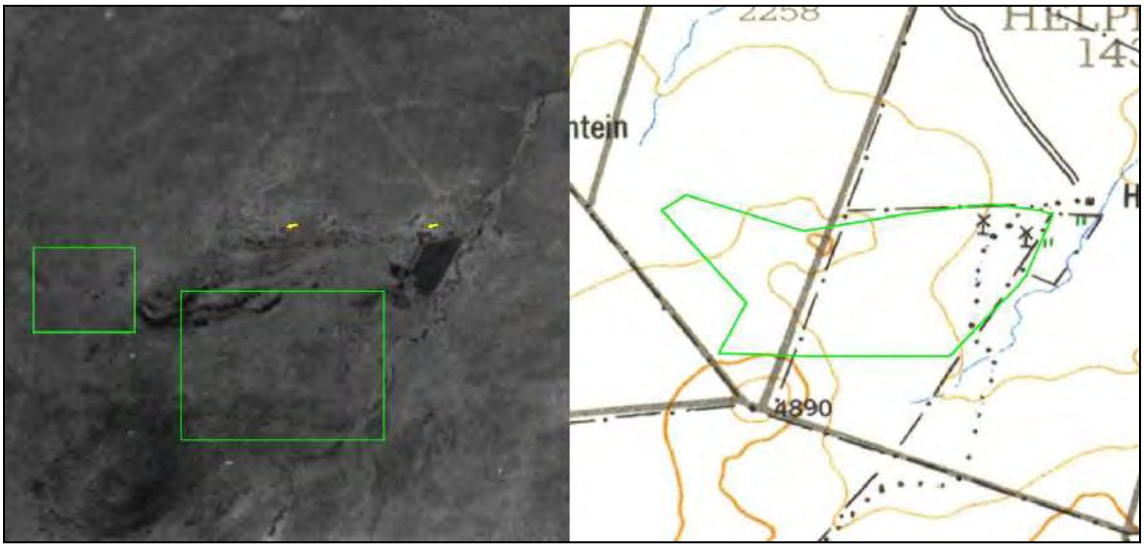

Figure 3-4: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farm Helpman within the historical landscape. The relative location of BP 52.8 is indicated in green outline. Note the absence of the later farmstead along the northern border (yellow arrows).

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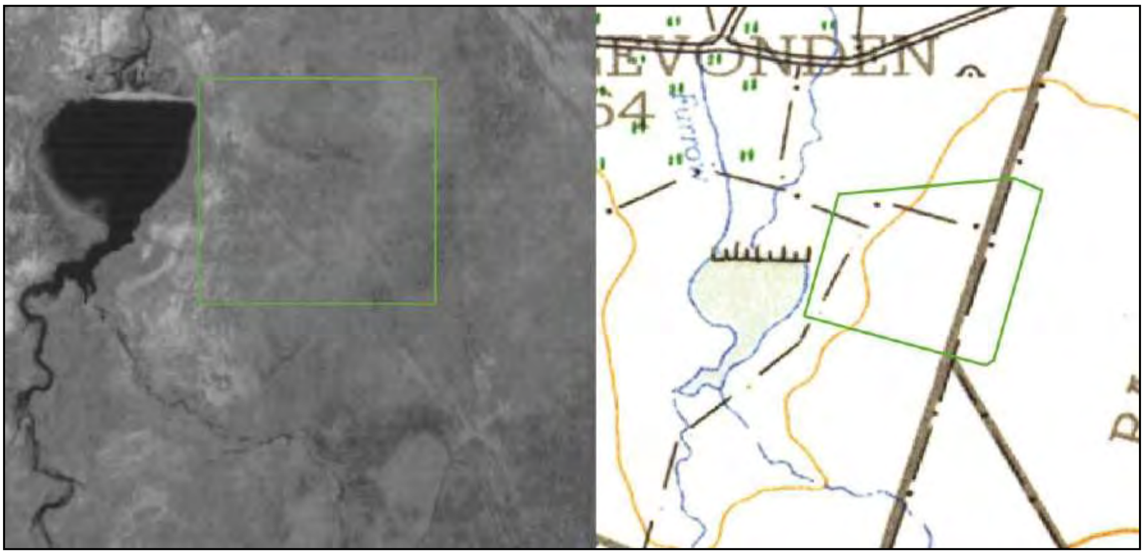

Figure 3-5: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farm Welgevonden within the historical landscape. The relative location of BP 56.3 is indicated in green outline.

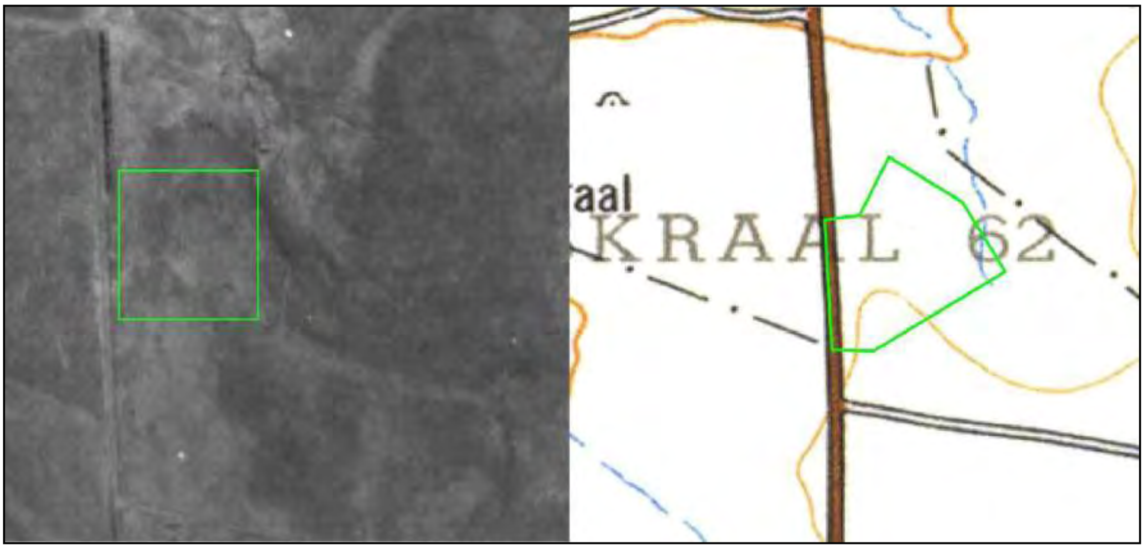

Figure 3-6: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farm Kraal within the historical landscape. The relative location of BP 57.9 is indicated in green outline.

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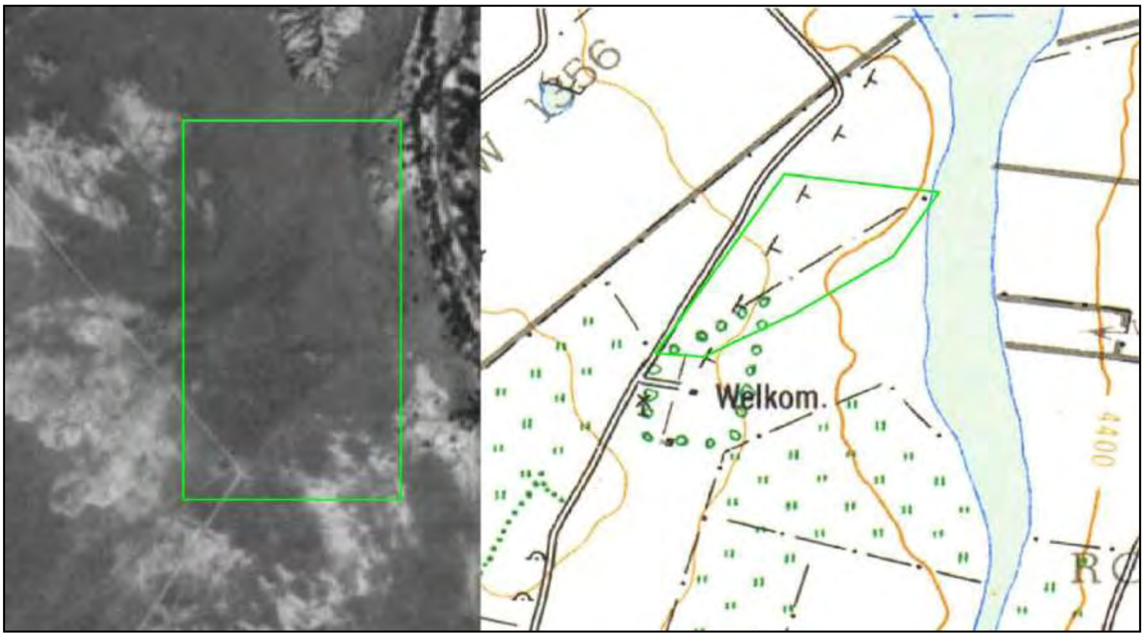

Figure 3-7: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farm Welkom within the historical landscape. The relative location of BP 64.2 is indicated in green outline.

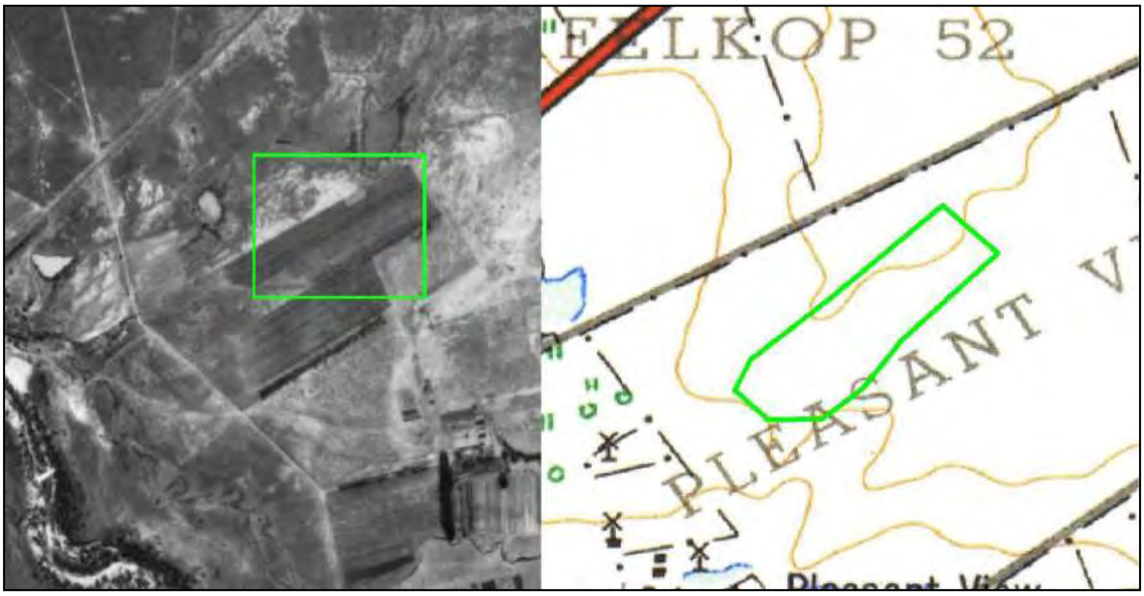

Figure 3-8: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farm Pleasant View within the historical landscape. The relative location of BP 67.3 is indicated in green outline.

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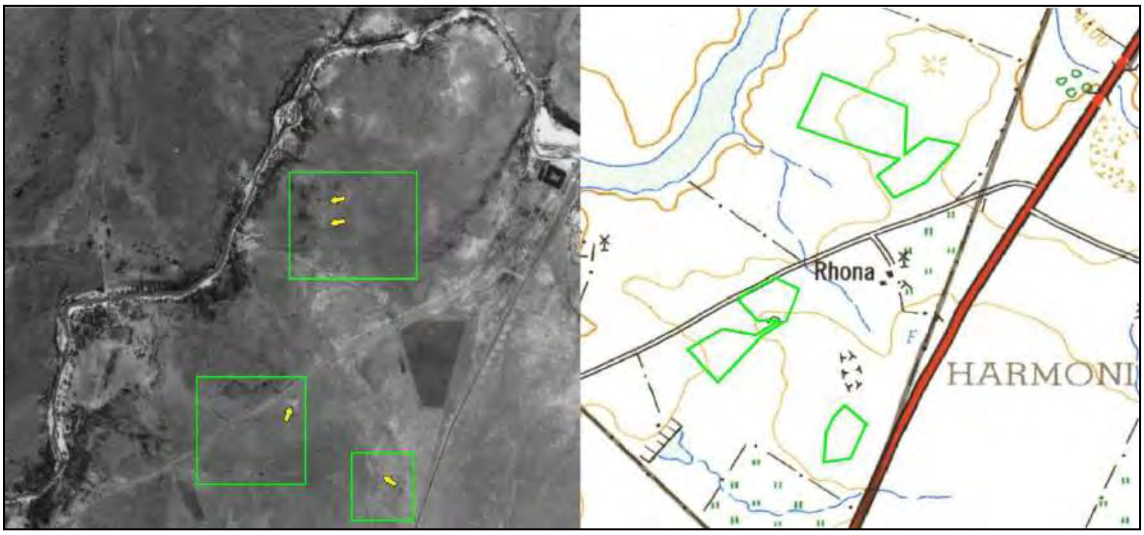


Figure 3-9: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farm Kruidbaden within the historical landscape. The relative locations of BP 72.4, BP 72.7 and BP 73.8 are indicated in green outline. Note the presence of sogn of human occupation on the property (yellow arrows).

Figure 3-10: Historical aerial image dating to 1945 (left) and a historical topographic map dating to 1964 (right) indicating the farm Hartplaats within the historical landscape. The relative location of BP 77.7 is indicated in green outline.

3.1.5 General Public Liaison

In a number of cases, correspondence with property owners provided information on the possible locations of heritage resources and brief commentaries on the recent history of the farms subject to this assessment.

3.2 Limitations

3.2.1 Access

For the largest part, properties subject to this assessment are accessed directly from the N1 and the R703 road. In most cases, access control is applied to the survey areas but no restrictions were encountered during the site visits in terms of access as the author was granted access in all instances.

3.2.2 Visibility

The surrounding vegetation in the project area is mostly comprised out of mixed grassland, trees and scrubs. The general visibility at the time of the AIA survey (December 2018) ranged from low in densely vegetated areas to high in transformed regions (refer to Section 2.3). In single cases during the survey sub-surface inspection was possible. Where applied, this revealed no archaeological deposits.

3.2.3 Limitations and Constraints Summary

The foot and vehicular site survey for the project primarily focused around areas of potential heritage sensitivity as well as areas of high human settlement catchment probability (for example, in association with vegetation changes or around soil disturbances).

- **Visibility** proved to be a constraint where denser surface cover obscured surface occurrences.

Even though it might be assumed that survey findings are representative of the heritage landscape of the project areas for the SANRAL N1 Zandkraal - Winburg Material Sources Project, it should be stated that the possibility exists that individual sites could be missed due to the localised nature of some heritage remains as well as the possible presence of sub-surface archaeology. Therefore, maintaining due cognisance of the integrity and accuracy of the archaeological survey, it should be stated that the heritage resources identified during the study do not necessarily represent all the heritage resources present in the project area. The subterranean nature of some archaeological sites, dense vegetation cover and visibility constraints sometimes distort heritage representations and any additional heritage resources located during consequent development phases must be reported to the Heritage Resources Authority or an archaeological specialist.

3.3 Impact Assessment

For consistency among specialists, impact assessment ratings by Exigo Specialists are generally done using the Plomp[1] impact assessment matrix scale supplied by Exigo. According to this matrix scale, each heritage receptor in the project area is given an impact assessment. An assessment of potential heritage impacts for the proposed project is included in this report (see Section 6).

4 ARCHAEO-HISTORICAL CONTEXT

4.1 The archaeology of Southern Africa

Archaeology in Southern Africa is typically divided into two main fields of study, the **Stone Age** and the **Iron Age** or **Farmer Period**. The following table provides a concise outline of the chronological sequence of periods, events, cultural groups and material expressions in Southern African pre-history and history.

Table 1 Chronological Periods across Southern Africa

Period	Epoch	Associated cultural groups	Typical Material Expressions
Early Stone Age 2.5m – 250 000 YCE	Pleistocene	Early Hominins: *Australopithecines* *Homo habilis* *Homo erectus*	Typically large stone tools such as hand axes, choppers and cleavers.
Middle Stone Age 250 000 – 25 000 YCE	Pleistocene	First *Homo sapiens* species	Typically smaller stone tools such as scrapers, blades and points.
Late Stone Age 20 000 BC – present	Pleistocene / Holocene	*Homo sapiens sapiens* including San people	Typically small to minute stone tools such as arrow heads, points and bladelets.
Early Iron Age / Early Farmer Period 300 – 900 AD	Holocene	First Bantu-speaking groups	Typically distinct ceramics, bead ware, iron objects, grinding stones.
Middle Iron Age (Mapungubwe / K2) / early Later Farmer Period 900 – 1350 AD	Holocene	Bantu-speaking groups, ancestors of present-day groups	Typically distinct ceramics, bead ware and iron / gold / copper objects, trade goods and grinding stones.
Late Iron Age / Later Farmer Period 1400 AD -1850 AD	Holocene	Various Bantu-speaking groups including Venda, Thonga, Sotho-Tswana and Zulu	Distinct ceramics, grinding stones, iron objects, trade objects, remains of iron smelting activities including iron smelting furnace, iron slag and residue as well as iron ore.
Historical / Colonial Period ±1850 AD – present	Holocene	Various Bantu-speaking groups as well as European farmers, settlers and explorers	Remains of historical structures e.g. homesteads, missionary schools etc. as well as, glass, porcelain, metal and ceramics.

[1] Plomp, H.,2004

4.2 The Free State and Landscape: Specific Themes.

The history of the Northern Free State is reflected in a rich archaeological landscape. Sites, documenting Stone Age habitation occur in places, mostly in open air locales or in sediments alongside rivers or pans. Bantu-speaking groups moved into this area during the last millennia and these presumably Sotho groups occupied the landscape during the Late Iron Age times at around AD 1500-1800. Settlement by Iron Age communities occurred near rivers and close to rocky outcrops. European farmers, settling in the area since the middle of the 19th century, divided up the landscape into a number of farms. In recent years an urban element developed, expanding at a rapid rate, largely as a result of mining development in the region.

4.2.1 Early History and the The Stone Ages

The Earlier Stone Age, from between 1.5 million and 250 000 years ago, refers to the earliest that *Homo sapiens sapiens'* predecessors began making stone tools. The earliest stone tool industry was referred to as the Olduwan Industry, originating from stone artefacts recorded at Olduvai Gorge, Tanzania. The Acheulian Industry, the predominant Southern African Early Stone Age Industry, which replaced the Olduwan Industry approximately 1.5 million years ago, is attested to in diverse environments and over wide geographical areas. The hallmark of the Acheulian Industry is its large cutting tools (LCTs or bifaces), primarily handaxes and cleavers. The most well-known Early Stone Age site in Southern Africa is Amanzi Springs, situated about 10km north-east of Uitenhage, near Port Elizabeth (Deacon 1970). In a series of spring deposits a large number of stone tools were found in situ to a depth of 3-4m. Wood and seed material preserved remarkably very well within the spring deposits, and possibly date to between 800 000 to 250 000 years old. Large stone ESA tools are often found associated with the gravels in the area, and were later replaced by smaller stone tools called the Middle Stone Age (MSA) flake and blades industries.

The Middle Stone Age (MSA) spans a period from 250 000-30 000 years ago and focuses on the emergence of modern humans through the change in technology, behaviour, physical appearance, art and symbolism. The large handaxes and cleavers were replaced by smaller stone artefacts called the MSA flake and blade industries. Surface scatters of these flake and blade industries occur widespread across Southern Africa. The majority of MSA sites occur on flood plains and sometimes in caves and rock shelters. Sites usually consist of large concentrations of knapped stone flakes such as scrapers, points and blades and associated manufacturing debris.

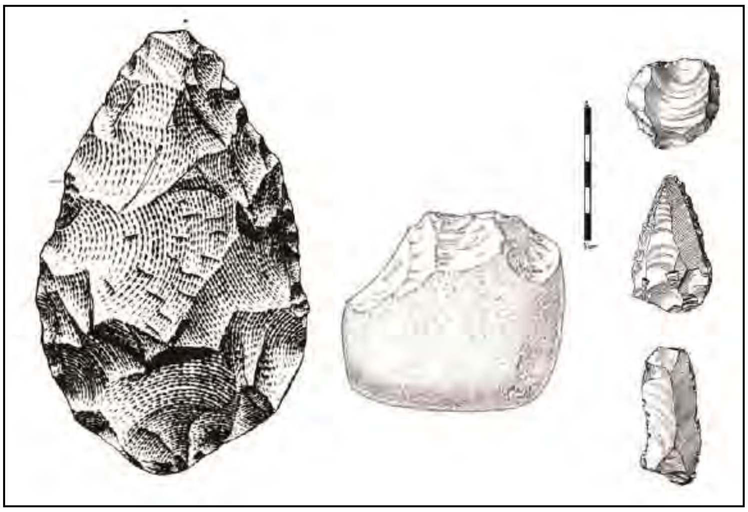


Figure 4-1: Typical ESA handaxe (left) and cleaver (center). To the right is a MSA scraper (right, top), point (right, middle) and blade (right, bottom).

The Later Stone Age (LSA) spans the period from about 20 000 years ago until the colonial era, although some communities continue making stone tools today. The period between 30 000 and 20 000 years ago is referred to as the transition from the MSA to LSA; although there is a lack of crucial sites and evidence that represent this change. The LSA is marked by a series of technological innovations, new tools and artefacts, the development of economic, political and social systems, and core symbolic beliefs and rituals. The stone toolkits changed over time according to time-specific needs and raw material availability, from smaller microlithic Robberg, Wilton Industries and in between, the larger Albany/Oakhurst and the Kabeljous Industries. Bored stones used as part of digging sticks, grooved stones for sharpening and grinding and stone tools fixed to handles with mastic also become more common. Fishing equipment such as hooks, gorges and sinkers also appear within archaeological excavations. Most importantly bows and arrows revolutionized the hunting economy. It was only within the last 2000 years that earthenware pottery was introduced. Before then tortoiseshell bowls were used for cooking and ostrich eggshell (OES) flasks were used for storing water. Sites dating to the LSA are better preserved in rock shelters, although open sites with scatters of mainly stone tools can occur. Well-protected deposits in shelters allow for stable conditions that result in the preservation of organic materials such as wood, bone, hearths, ostrich eggshell beads and even bedding material.

The earliest ancestors of modern man may therefore have roamed the Vaal valley at the same time that their contemporaries occupied some of the dolomite caves near Krugersdorp. Middle Stone Age sites dating from as early as two hundred thousand years ago have been found all over South Africa. Middle Stone Age hunter-gatherer bands also lived and hunted in the Orange and Vaal River valleys. These people, who probably looked like modern humans, occupied campsites near water but also used caves as dwellings. They manufactured a wide range of stone tools, including blades and point s that may have had long wooden sticks as hafts and were used as spears. The Late Stone Age commenced twenty thousand years ago or somewhat earlier. The various types of Stone Age industries scattered across the country are associated with the historical San and Khoi-Khoi people. The San were renowned as formidable hunter-gatherers, while the Khoi-Khoi herded cattle and small stock during the last two thousand years. Late Stone Age people manufactured tools that were small but highly effective, such as arrow heads and knives. Habitation of the larger geographical area took place since Early Stone Age times. This is confirmed by the occurrence of stone tools dating to the Early, Middle and Late Stone Age found in a number of places. However, these are mostly located in the vicinity of rivers, such as the Doring Spruit north of Kroonstad and the Groot Vet River as well as the Sand River to the south of Ventersburg.

4.2.2 The Iron Age Farmer Period

The beginnings of the Iron Age (Farmer Period) in southern Africa are associated with the arrival of a new Bantu speaking population group at around the third century AD. These newcomers introduced a new way of life into areas that were occupied by Later Stone Age hunter-gatherers and Khoekhoe herders. Distinctive features of the Iron Age are a settled village life, food production (agriculture and animal husbandry), metallurgy (the mining, smelting and working of iron, copper and gold) and the manufacture of pottery. Iron Age farming communities generally preferred to occupy river valleys within the eastern half of southern Africa owing to the summer-rainfall climate that was conducive for growing millet and sorghum. Even though much research has been conducted on the Iron Age (IA) across southern Africa, only a small portion has focused on the Free State. Complex stone wall clusters are scattered across the landscapes of the Southern Highveld and the Free State.

The Iron Age archaeology of the Free State is characterised by a wide distribution of stone-walled sites along the flat-topped ridges and hills. Studies have revealed detail and consistency in the arrangement and design of the structures. People's expression of culture has left its imprint on the material environment.

Thus, recognised settlement patterns display human perceptions with regard to social clustering, economic system and political organisation. Patterns are indicated by the arrangement of huts, byres and ash heaps in a particular order and in relation to one another. Spatial organisation in general is characterised by the central position of stock byres and the placing of the main dwelling area on the perimeter of the settlement. During the Later Iron Age, emphasis was not only on stone building, for additional structures of perishable materials, supplementing living space, have also been revealed. All the characteristics of settlement patterns allow the immediate recognition of specific cultural groups of people populating the landscape. A classification of settlement patterns produced a standardised archaeological framework for the ordering of structures and sites characterised by connecting walls, surrounding walls and huts with bilobial courtyards respectively. Furthermore, the research indicated that the division of sites based on layout is confirmed by associated pottery assemblages with different decoration styles. Different settlement patterns also produced huts of different materials in different styles. The classification of sites is based on the assumption that settlement layout is bound and prescribed by cultural perceptions. The identification of different ethnic groups is thus possible from the way in which these traditional peoples have organised their different living places in terms of space and time. The final result was directed by cultural preference (choice) and function. The importance of livestock, personal status, kinship, social organisation and the diverse roles of men, women and offspring have always been important in the understanding of settlement patterns. Pottery decorations associated with this settlement type are characterised by shallow line incisions in bands and triangles below the rim and on the shoulder, combined with straight or curved lines and areas of red ochre burnish on the body of clay vessels (Maggs 1976). The occupation of the sites with bilobial dwellings is ascribes to Batswana (Thlaping and Rolong) groups. It is also possible to link Kubung people to every known site of this kind (Maggs 1976). According to radiocarbon dating and oral history, these sites were occupied from the 16th and 17th to early 19th century at Ventersburg, and 18th to early 19th century at Bothaville. A single bone sample from Jansfontein in the Doringberg, Ventersburg, produced a calibrated date of 1670, which is slightly later than the Ventersburg date (Dreyer 1992).

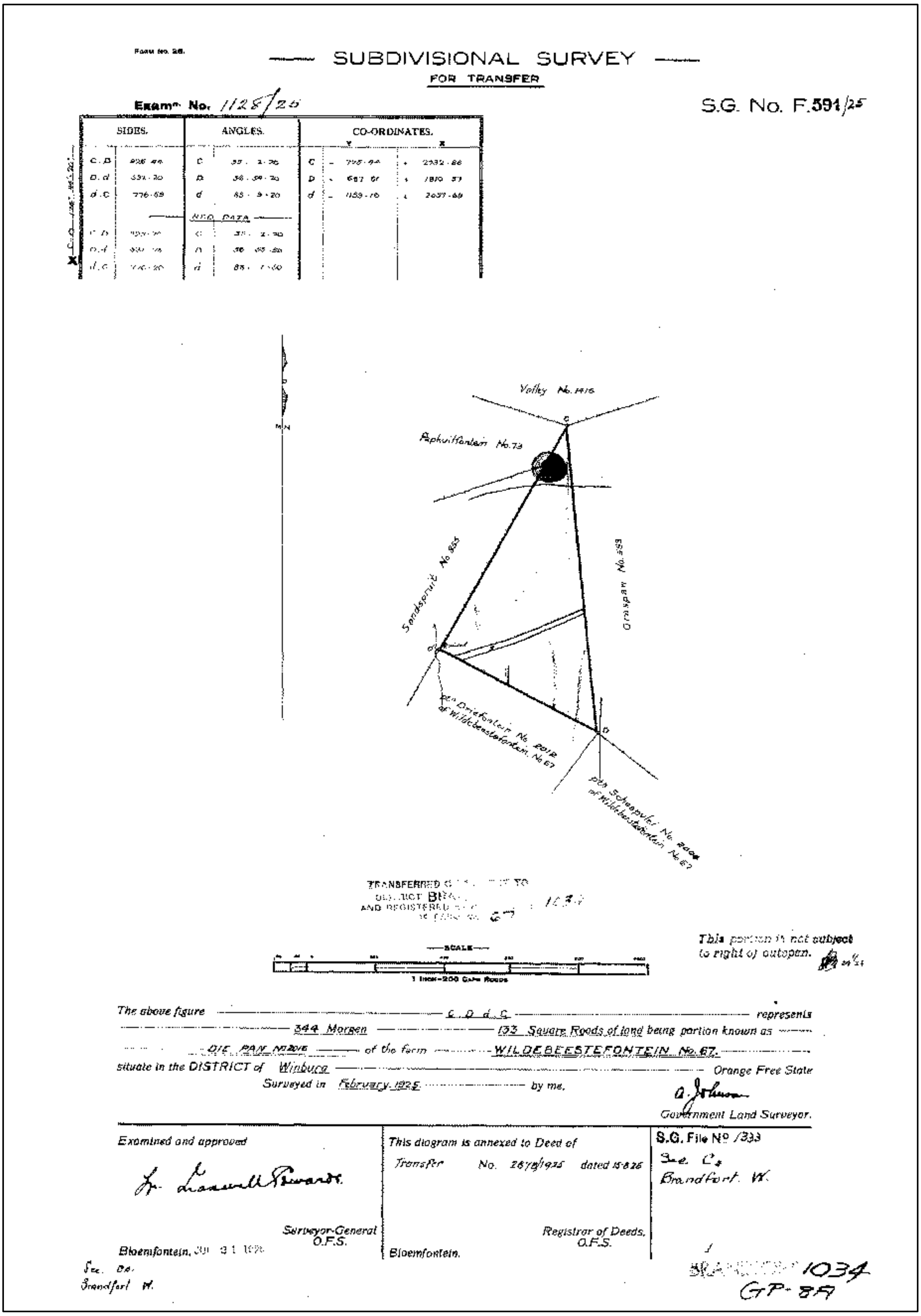
Figure 4-2: View of preserved Iron Age stone walling on the farm Middenspruit south of Kroonstad.

Figure 4-3: Undecorated potsherd and an upper grindstone documented by Dreyer on Middenspruit

4.2.3 Historical and Colonial Times and Recent History

The town of Winburg, a small mixed farming town, is the oldest proclaimed town (1837) in the Orange Free State, South Africa and thus along with Griquatown, one of the oldest settlements in South Africa located north of the Orange River. When the Voortrekkers reached the area of Winburg, there were no other tribes or inhabitants. The nearest community was that of a Tswana tribe under Chief Makwana at Thaba Nchu, 60 km south east of the town and the Basotho tribes in the mountains of the current Lesotho, 100 km east of the town. The trade of cattle for land between the Vaal and Vet Rivers, undertaken by Andries Pretorius and the Bataung Chief Makwana in 1836, led to the settlement of a dispute between the African tribes. The Voortrekkers offered protection for Chief Makwana from the Tswana tribes, against the Basotho tribes habouring in the mountains of the current Lesotho and stealing the cattle of the Bataung tribe. In exchange for continued protection, the Voortrekkers were offered the land between the Vet and Vaal Rivers. The Voortrekker leaders had a small disagreement as to where to establish a town. A vote was held under the Burgers and Andries Pretorius's group won and elected to establish the town in its current position and to call it Winburg, after the Dutch word winnen (to win). Winburg acted as a settlement and religious centre for Voortrekkers. Winburg was originally selected as the site for the main Voortrekker Monument, but Pretoria won favour and a five-tiered secondary Voortrekker monument was built on the outskirts of Winburg instead in the 1950s. It carries the names of the Voortrekker leaders: Piet Uys, Andries Hendrik Potgieter, Andries Pretorius, Piet Retief and Gerrit Maritz. The lengths of the five tiers are proportional to the distances travelled by the respective settler groups. The monument is built near the site of the birth-house of Martinus Theunis Steyn, who was president of the Boer Republic of the Orange Free State. The town was the site of a concentration camp for women and children captured by the British Army during their scorched earth campaign during the Second Boer War. 355 children and 132 adults died in this camp due to malnutrition and contagious diseases, while kept in tents without any infrastructure or protection during the bitter cold winters of 1899 – 1901. The famous Boer General Koos de la Rey was born in the district of Winburg on the farm Doornfontein.[5] General De La Rey was the leading Boer General of the Western Transvaal in 1899 – 1901. Winburg had a black armed commando supporting the British soldiers during the war of 1899 – 1901.

The farms subject to this assessment were proclaimed between 1853 and 1919 with rezoning of some of the properties done in later years.


Form No. 26.

SUBDIVISIONAL SURVEY

FOR TRANSFER

Examn. No. 1128/25

S.G. No. F.591/25

SIDES.		ANGLES.		CO-ORDINATES.	Y	X
C.D	926.44	C	35. 2.26	C	− 775.94	+ 2332.86
D.d	531.20	D	56. 59.20	D	+ 681.61	+ 1810.57
d.C	776.69	d	88. 9.20	d	− 1153.76	+ 2037.69
		NEO DATA				
C.D	[illegible]	C	35. 2.30			
D.d	[illegible]	D	56. 55.50			
d.C	[illegible]	d	88. 1.50			

TRANSFERRED ... TO DISTRICT BRA... AND REGISTERED ... 67 ... 1034

This portion is not subject to right of outspan.

The above figure C.D.d.C. represents 344 Morgen 133 Square Roods of land being portion known as DIE PAN No. 2015 of the farm WILDEBEESTEFONTEIN No. 67. situate in the DISTRICT of Winburg Orange Free State

Surveyed in February 1925 by me.

A. Johnson
Government Land Surveyor.

Examined and approved	This diagram is annexed to Deed of Transfer No. 2678/1925 dated 15-8-25	S.G. File No. /333
Surveyor-General O.F.S. Bloemfontein, 30 3 1925	Registrar of Deeds, O.F.S. Bloemfontein.	Sec. C4 Brandfort W.

Sec. D4. Brandfort W.

1034
GP-89

Figure 4-4: Original title deed of the farm Die Pan dating to 1925.

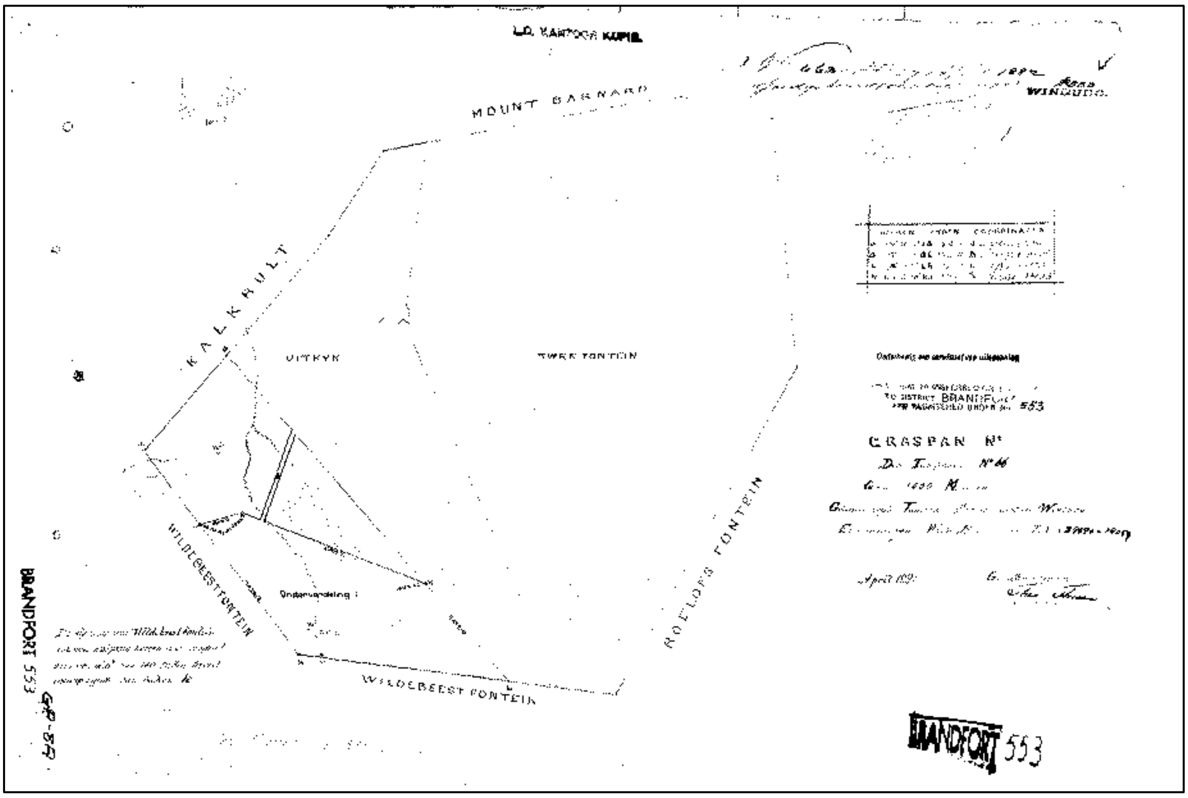


Figure 4-5: Original title deed of the farm Graspan.

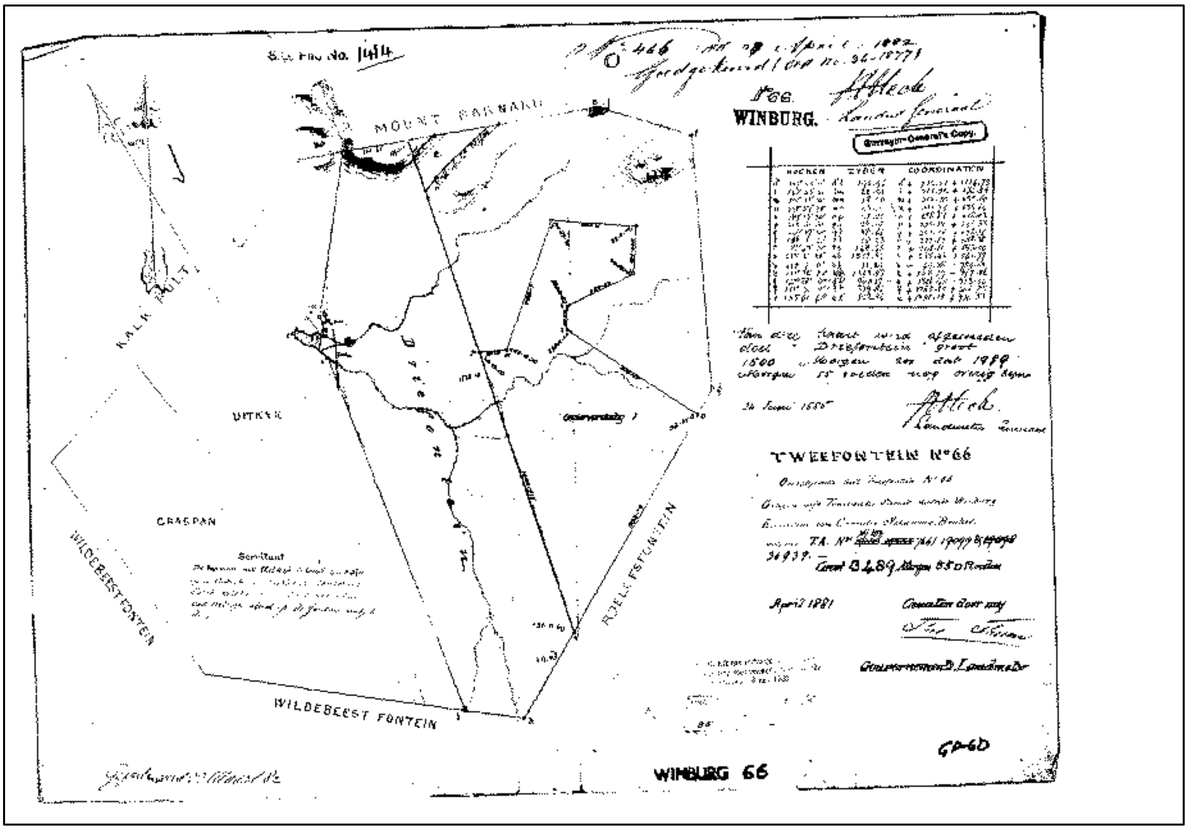
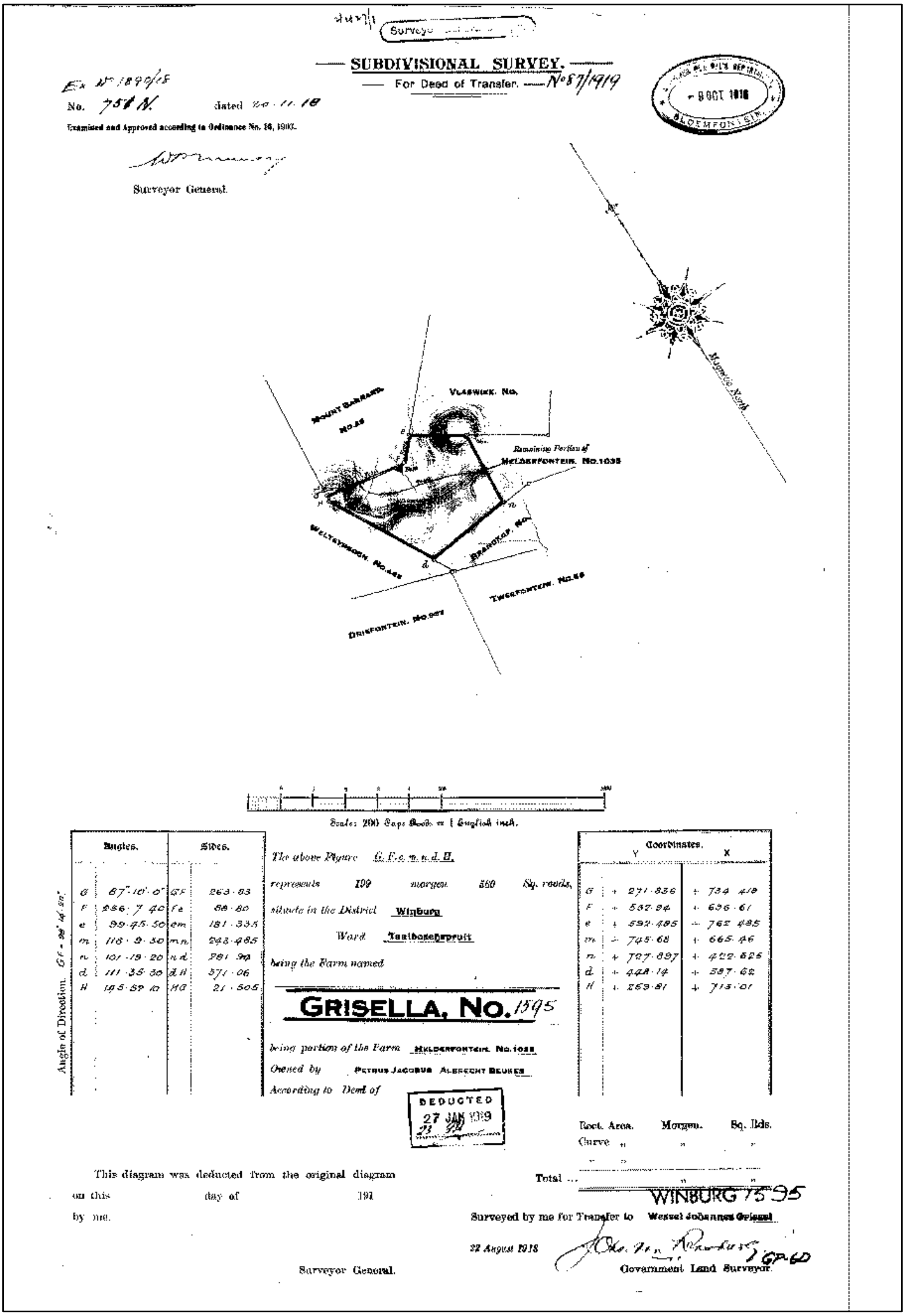


Figure 4-6: Original title deed of the farm Tweefontein dating to 1881.



SUBDIVISIONAL SURVEY.

For Deed of Transfer. N°87/1919

Ex N° 1890/18

No. 751 N. dated 20 . 11 . 18

Examined and Approved according to Ordinance No. 16, 1903.

Surveyor General.

Angle of Direction. GF = 98° 14' 50"

	Angles.		Sides.
G	87° 10' 0"	GF	263 · 83
F	256 · 7 40	Fe	68 · 80
e	99 · 45 · 50	em	181 · 335
m	116 · 9 · 30	mn	243 · 485
n	101 · 19 · 20	nd	281 · 90
d	111 · 35 · 30	dH	571 · 06
H	195 · 59 10	HG	21 · 505

The above Figure G. F. e. m. n. d. H.

represents 199 morgen 560 Sq. roods,

situate in the District Winburg

Ward Taaibosch Spruit

being the Farm named

GRISELLA, No. 1595

being portion of the Farm MELDERFONTEIN. No. 1035

Owned by PETRUS JACOBUS ALBRECHT BEUKES

According to Deed of

DEDUCTED 27 JAN 1919

	Coordinates. Y	X
G	+ 271 · 836	+ 734 418
F	+ 537 · 94	+ 696 · 61
e	+ 592 · 485	+ 762 485
m	+ 745 · 68	+ 665 · 46
n	+ 727 · 897	+ 422 · 625
d	+ 448 · 14	+ 387 · 62
H	+ 263 · 81	+ 713 · 01

Rect. Area. Morgen. Sq. Rds.

Curve

Total

WINBURG 1595

This diagram was deducted from the original diagram on this day of 191 by me.

Surveyor General.

Surveyed by me for Transfer to Wessel Johannes Grissel

22 August 1918

Government Land Surveyor.

Figure 4-7: Original title deed of the farm Grisella dating to 1919.

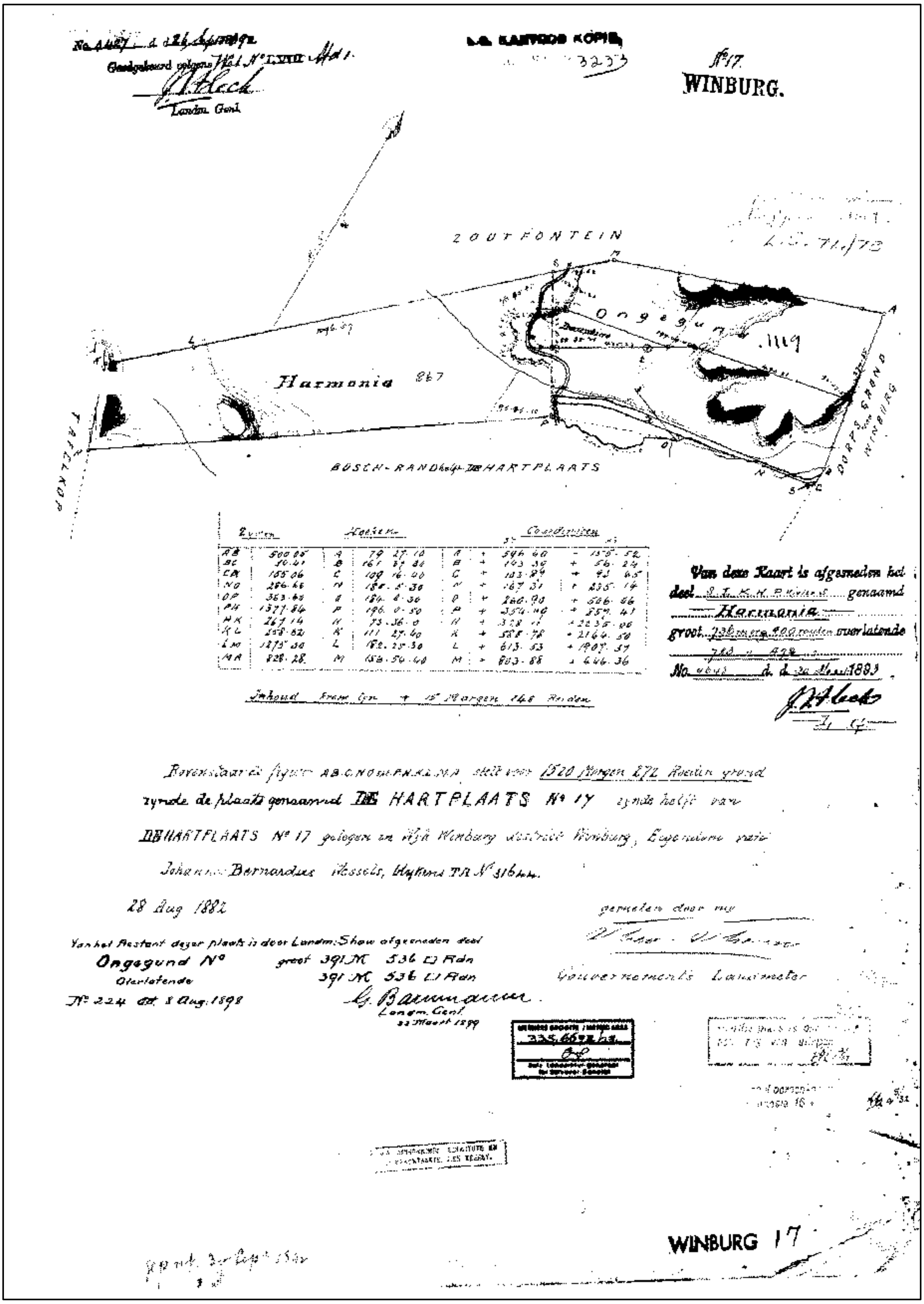


Figure 4-8: Original title deed of the farm Hartplaats dating to 1898.

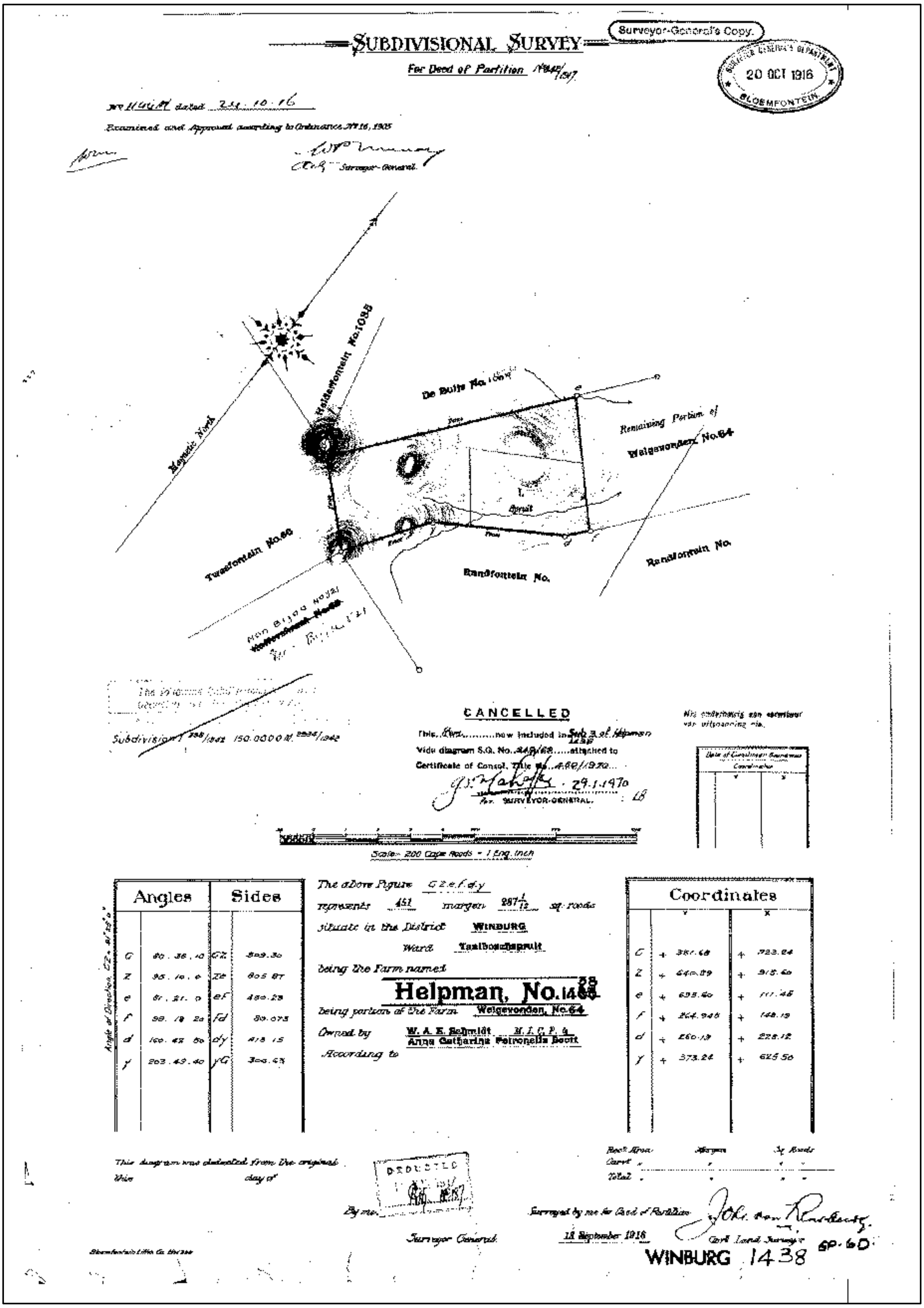


Figure 4-9: Original title deed of the farm Helpman dating to 1916.

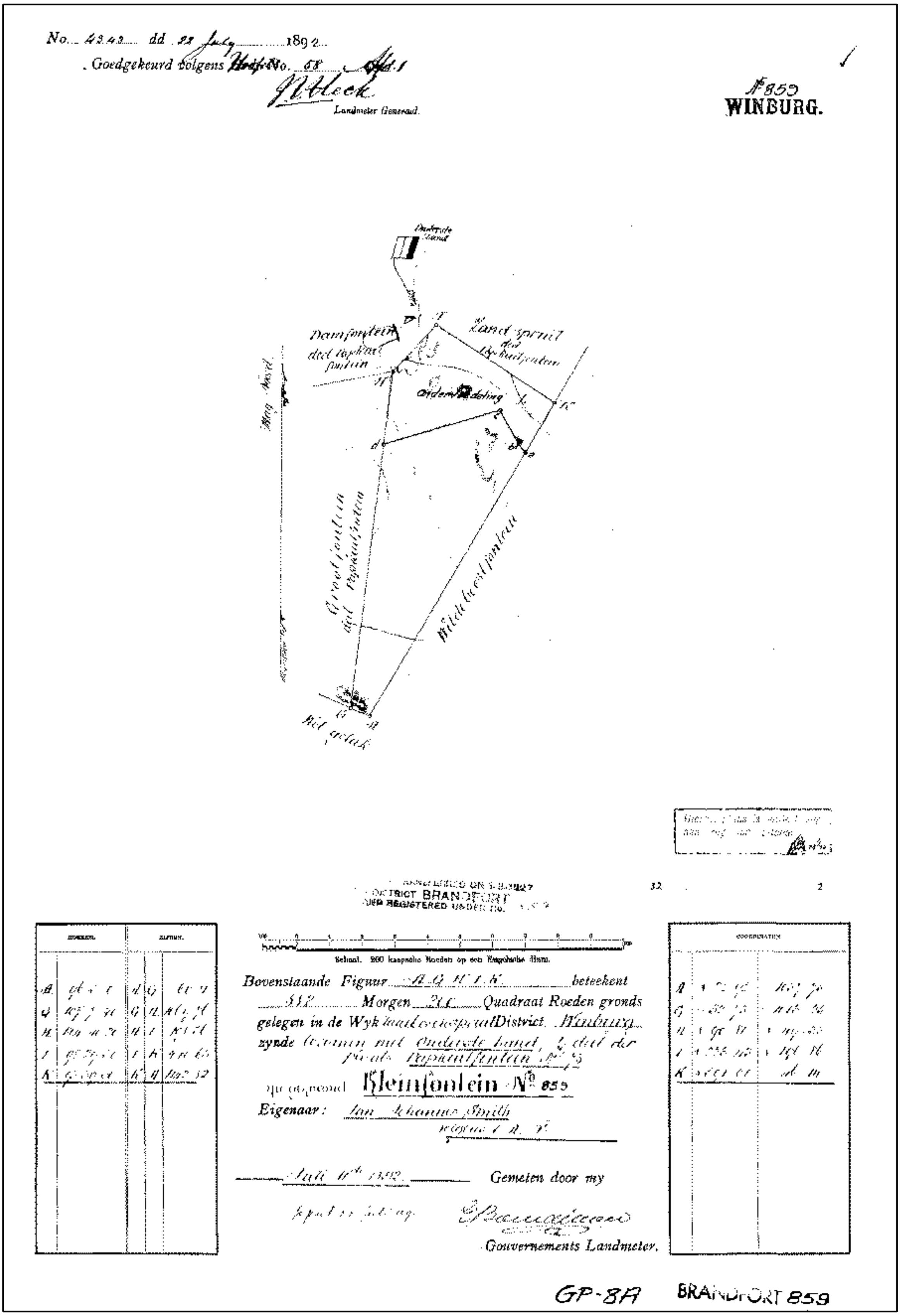


Figure 4-10: Original title deed of the farm Kleinfontein dating to 1892.

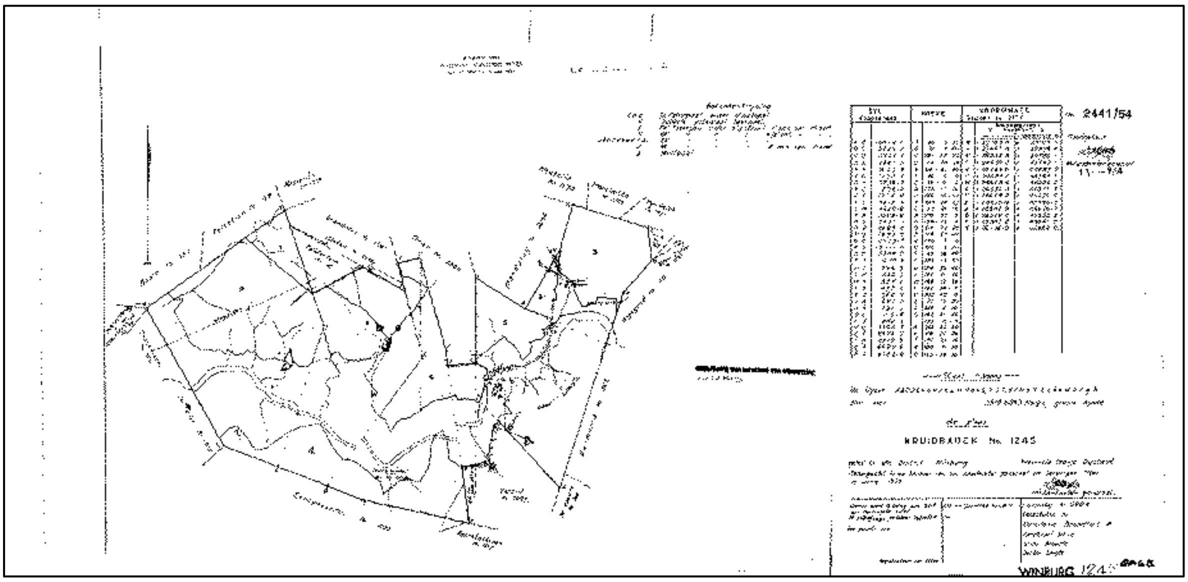


Figure 4-11: Original title deed of the farm Kruidbaden.

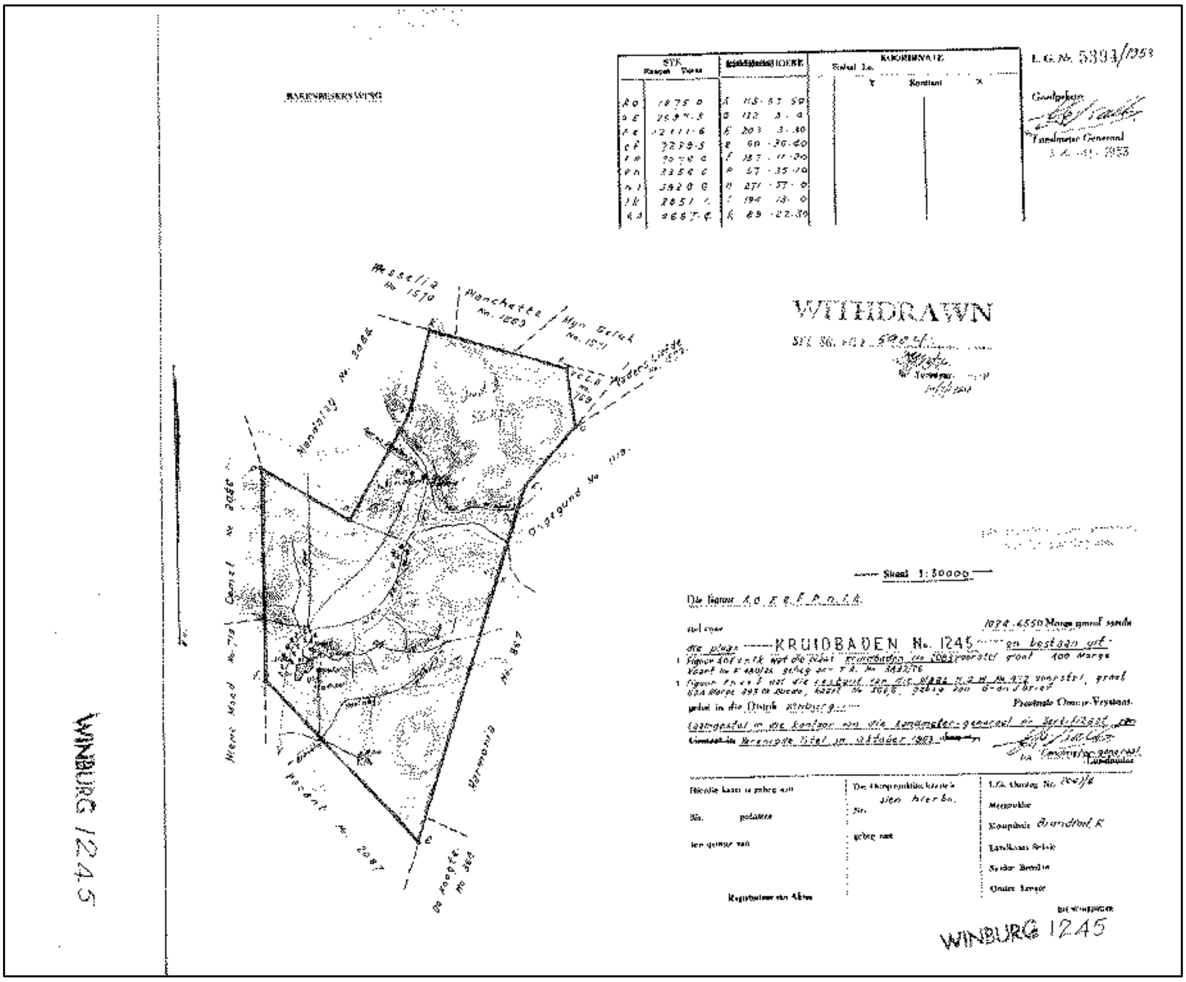


Figure 4-12: Original title deed of the farm Kruidbaden dating to 1853.

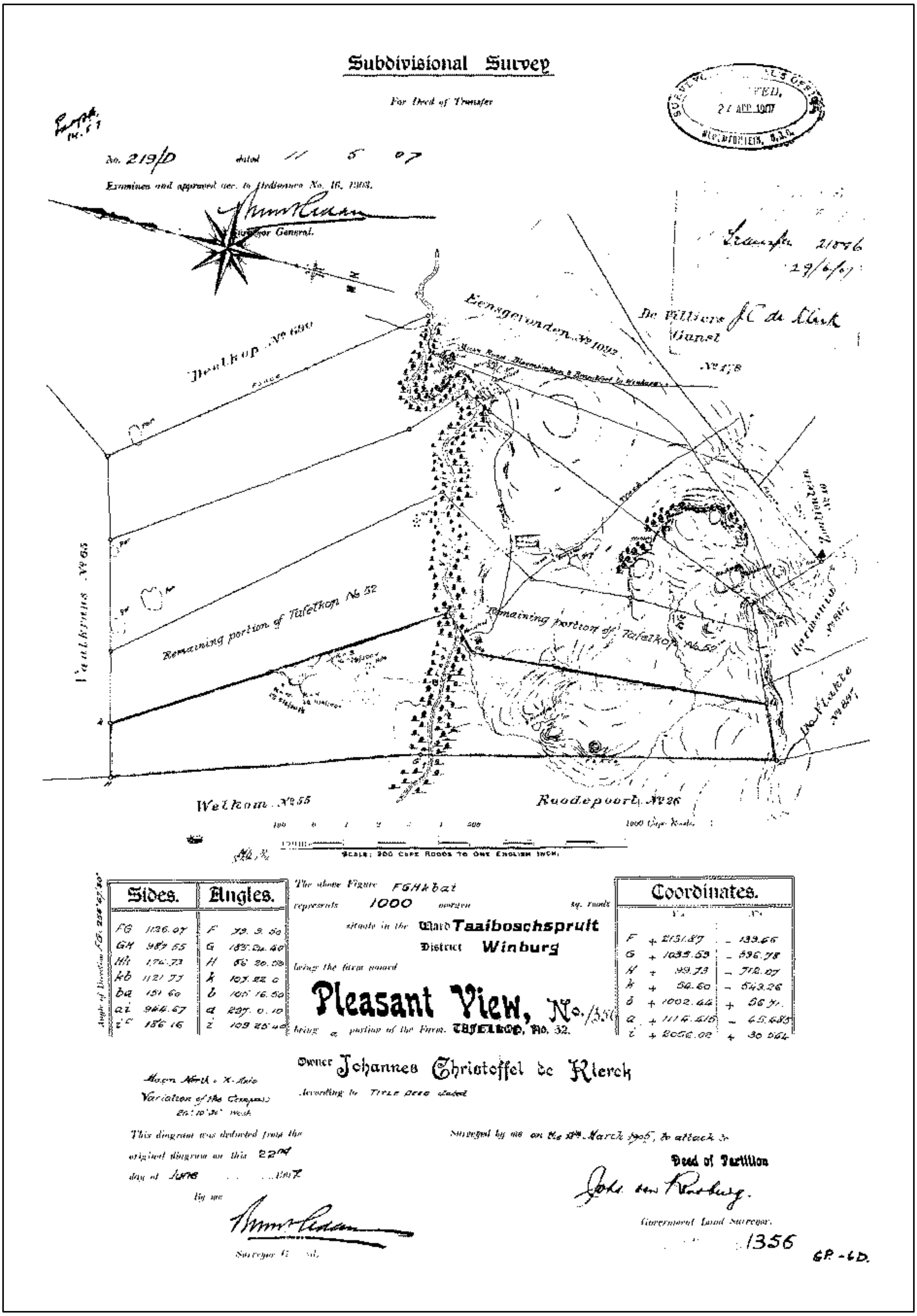


Figure 4-13: Original title deed of the farm Pleasant View dating to 1907.

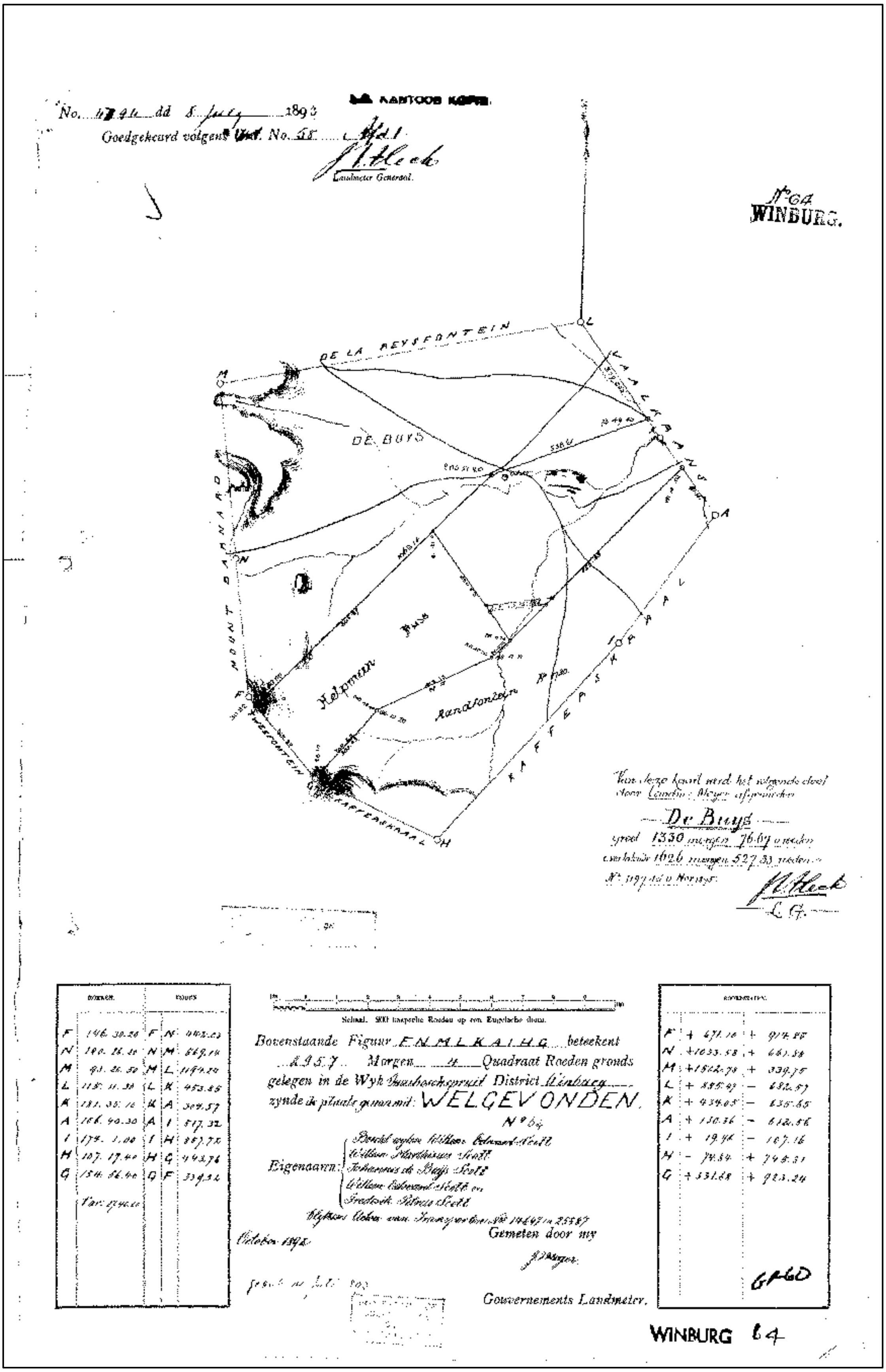


Figure 4-14: Original title deed of the farm Welgevonden dating to 1892.

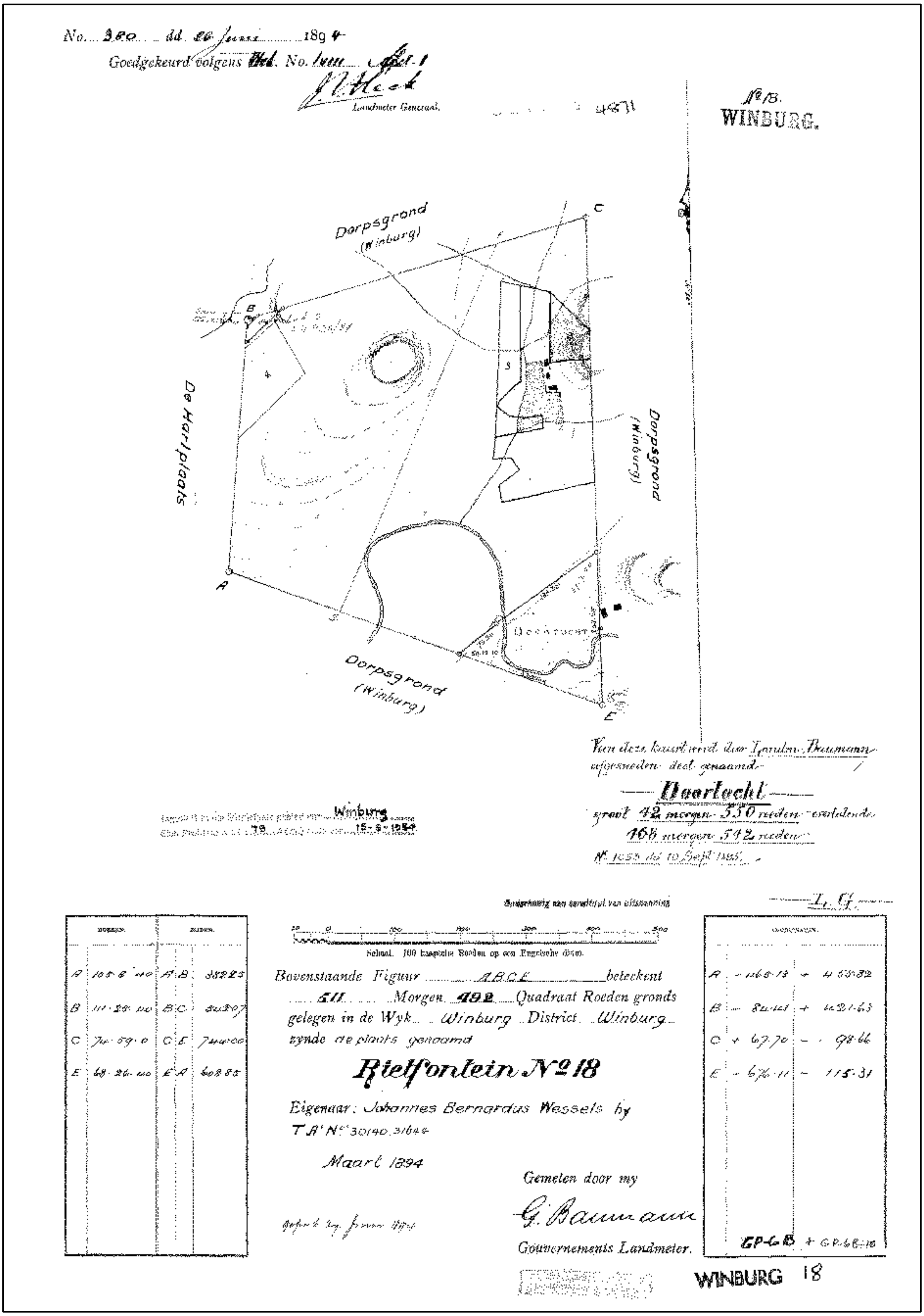


Figure 4-15: Original title deed of the farm Rietfontein dating to 1894.

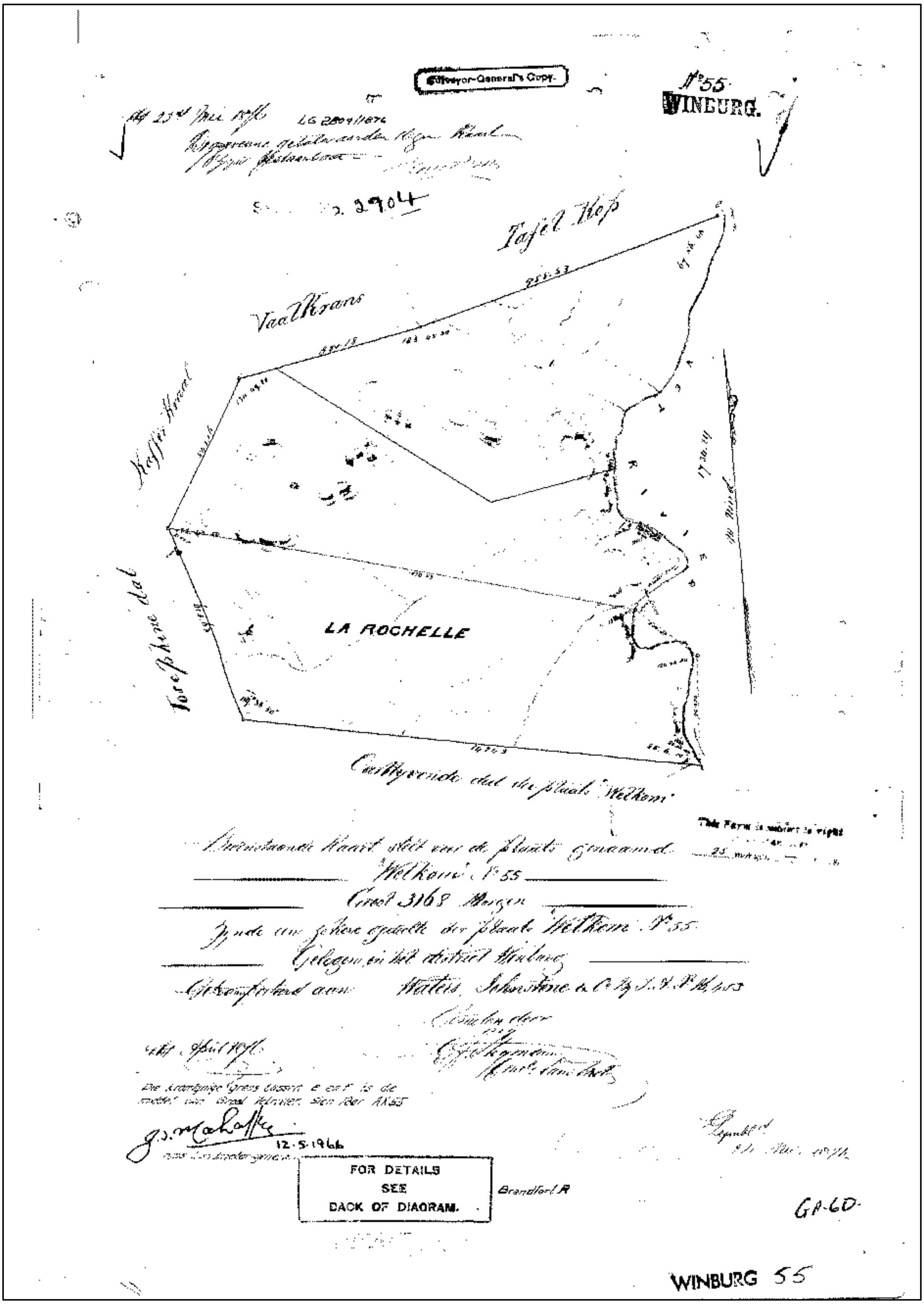


Figure 4-16: Original title deed of the farm Welkom dating to 1867.

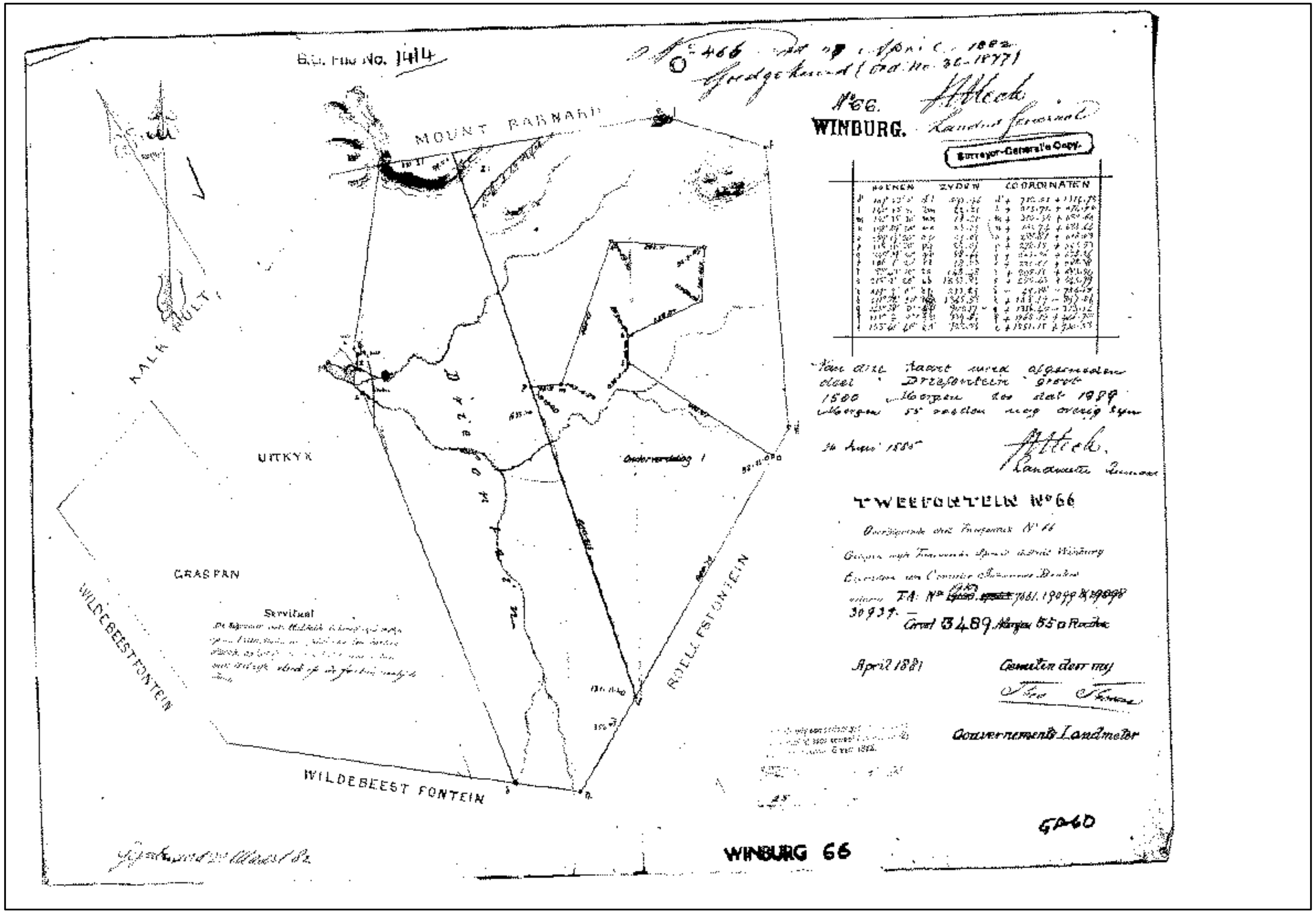


Figure 4-17: Original title deed of the farm Tweefontein dating to 1881.

5 RESULTS: ARCHAEOLOGICAL SURVEY

In terms of heritage resources, the landscape around the project area and Winburg is primarily well known for the occurrence of Historical Period sites. The landscape around the proposed SANRAL N1 Zandkraal - Winburg Material Sources Project remains pristine in places with the regular occurrence of transformed zones as a result of agriculture but a number of occurrences of heritage potential were identified in certain project areas. These were coded according to the following abbreviations: **HP: Historical Period, CE: Cemetery and FT: Feature**.

5.1.1 Burrow Pits

- **BP 39.6 Kleinfontein 859**
  Site Exigo-BP39.6-FT01 (S28.79169° E26.71608°)

An elongated stone heaps was documented along the proposed BP39.6 access road on the farm Kleinfontein. No associated material culture was observed near the structure. The function and context of the feature is not known but the stones might have been removed from the nearby cultivated fields. In addition, the possibility of the feature indicating an informal human burial should not be excluded and the feature should be closely monitored during development phases. Since the age of the structures is not known and related contextual heritage artefacts or features are absent from the site, the occurrence is probably of low heritage significance since it does not implicitly display any social or cultural meaning.

Figure 5-1: View of a stone feature at Exigo-BP39.6-FT01.

- **BP 42.2 Die Pan 1034**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 42.7 Die Pan 1034**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 44.5 Graspan 553**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 44.6 Graspan 553**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 51.0 Tweefontein 66**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 52.8 Helpman 1438**

Site Exigo-BP52.8-CP01 (S28.70326° E26.80724°)

During the survey, the dilapidated remains of a farmstead were documented along the north-eastern periphery of BP 52.8 on the farm Helpman 1438. The farm is located south of the Candy/Jossephinesdal intersection. Here, the poorly preserved wall remains of a brick house and livestock stables constructed out of stone and cement as well as material culture in the form of artefact remains (glass, metal, plastic) were noted. Even though an absolute age for the structures could not be ascertained, a relative recent temporal context is provided by an analysis of historical aerial photographs and topographic maps, which suggest that the farmstead was not present in the landscape at around 1950 (see Figure 5-2). It is therefore highly likely that the structures at the farmstead are younger than 60 years - and not protected under the National Heritage Resource Act (NHRA 1999).

Figure 5-2: View of farmhouse remains at Exigo-BP52.8-CP01.

Figure 5-3: View of stone structure remains of livestock enclosures at Exigo-BP52.8-CP01.

Site Exigo-BP52.8-FT01 (S28.70259° E26.80041°)

The remains of a rough and irregular stone wall foundation were noted north of a deep excavated pit north-western periphery of BP 52.8 on the farm Helpman 1438. No material culture was noted in association with the poorly preserved structure and a temporal and cultural context for the feature is not known. The site, which is located within areas demarcated for the proposed development is rated as of low heritage significance

Figure 5-4: View of a stone wall foudation at Exigo-BP52.8-FT01.

Site Exigo-BP52.8-FT02 (S28.70326° E26.80724°)

An elongated stone heap was documented near the farmstead remains along the north-eastern periphery of BP 52.8 on the farm Helpman 1438. No associated material culture was observed near the structure and no function or context for the feature could be ascertained but the possibility of the stones indicating an informal human burial should not be excluded. As such, the feature should be closely monitored during development phases. The occurrences are probably of low heritage significance since it does not hold known social or cultural meaning.

Figure 5-5: View of a stone feature at Exigo-BP52.8-FT02.

- **BP 56.3 Welgevonden 64**
  Site Exigo-BP56.3-FT01 (S28.67986° E26.82775°)

A small, circular stone enclosure approximately 3m in diameter was documented at the proposed BP 56.3 site along a border fence on the farm Welgevonden 64. The stone structure, which is poorly preserved, occurs approximately 100m east of exiting diggings and burrow pits and its function is not known. An analysis of historical topographical maps and aerial photographs does not indicate the presence of the feature and no material culture were observed in association of the enclosure remains. As the site is poorly preserved and generally devoid of material culture it carries limited heritage significance.

Figure 5-6: View of a rough stone enclosure at Exigo-BP56.3-FT01.

- **BP 57.9 Kraal 62**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 64.2 Welkom 55**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 67.3 Pleasant View 1356**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 72.4 Kruidbaden 1245**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 72.7 Kruidbaden 1245**

No sites of heritage potential were documented in the proposed burrow pit footprint on this property.

- **BP 73.8 Kruidbaden 1245**
  Site Exigo-BP73.8-CE01 (S28.56765° E26.93578°)

A small informal cemetery holding an unknown number of graves was documented in close proximity if the proposed BP 73.8 site on the farm Kruidbaden 1245. Most of the burials are indicated by elongate stone heaps but some graves bear marble dressings and headstones. Others have metal grave markers which is not legible. One of the marble headstones notes the following:

OUR FATHER
PULE ISAAC
POTSANE

BORN 1917-12-8
DIES 1976-12-30
ROBALA KA KGOTSO

A number of graves are enclosed in wire fencing and material culture such as glass bottles, enamel containers and metal objects were noted on and around graves at the site. An analysis of historical topographical maps and aerial photographs suggest that this area was occupied during the mid-20th century and these burials probably relate that the occupation phase. The burial site is of high heritage significance, it is situated in close proximity of the development footprint of the project and a conservation buffer should be observed. Alternatively, the burials should be relocated according to the applicable social and statutory requirements, should impact prove inevitable.

Figure 5-7: View of a small informal cemetery at Exigo-BP73.8-CE01.

Figure 5-8: A marked marble headstone at Exigo-BP73.8-CE01.

Site Exigo-BP73.8-FT01 (S28.56863° E26.93846°)

An excavation trench or horizontal shaft of approximately 10m was documented in the proposed BP 73.8 site on the farm Kruidbaden 1245. The trench is lined with round stones and the site is overgrown with trees. An analysis of historical topographical maps and aerial photographs does not indicate the presence of the feature and no material culture were observed in association of the enclosure remains. As the site is poorly preserved and generally devoid of material culture it carries limited heritage significance

Figure 5-9: View of a stone-lined trench at Exigo-BP73.8-FT01.

- **BP 77.7 Hartplaats 77**
  Site Exigo-BP77.7-HP01 (S28.54601° E26.97453°)

The remains of a multi-room stone and mud structure were noted along the western periphery of the proposed BP 77.7 site on the farm Hartplaats 77. Here, a number of rooms measuring approximately 2m x 2m were constructed in the dwelling, the walls of which are poorly preserved. No material culture were noted at the site but the area is densely overgrown with tall grasses and it is likely that artefacts, middens and associated structures could occur in association with the building remains. As farming communities settled in the Free State in this landscape during the Colonial Period in the last centuries, this structure might be remnants of an old farmhouse dwelling. In addition, aerial imagery dating to the first part of the 20^{th} century suggest the presence of the feature at that time and it is therefore highly likely that the structure is older than 60 years - and protected under the National Heritage Resource Act (NHRA 1999). The site might afford a better understanding of social, cultural and architectural developments of the Historical period landscape around Windburg and it is rated as of medium significance.

Figure 5-10: View of a Historical Period structure at Exigo-BP77.7-HP01.

Figure 5-11: A Square stone wall room at Exigo-BP77.7-HP01.

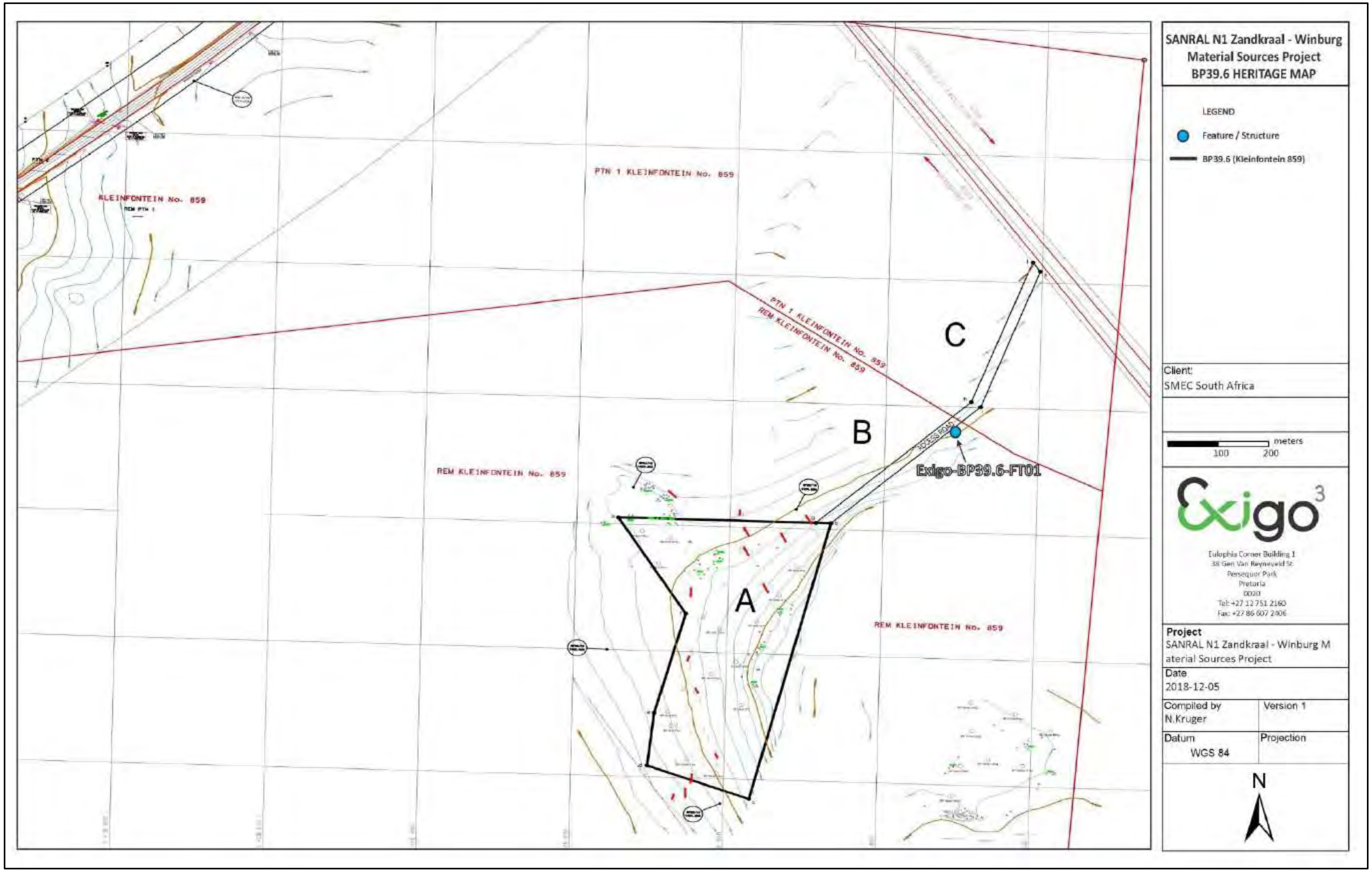


Figure 5-12: Geo-referenced project map of BP39.6 indicating the locations of occurrences of heritage potential, discussed in the text.

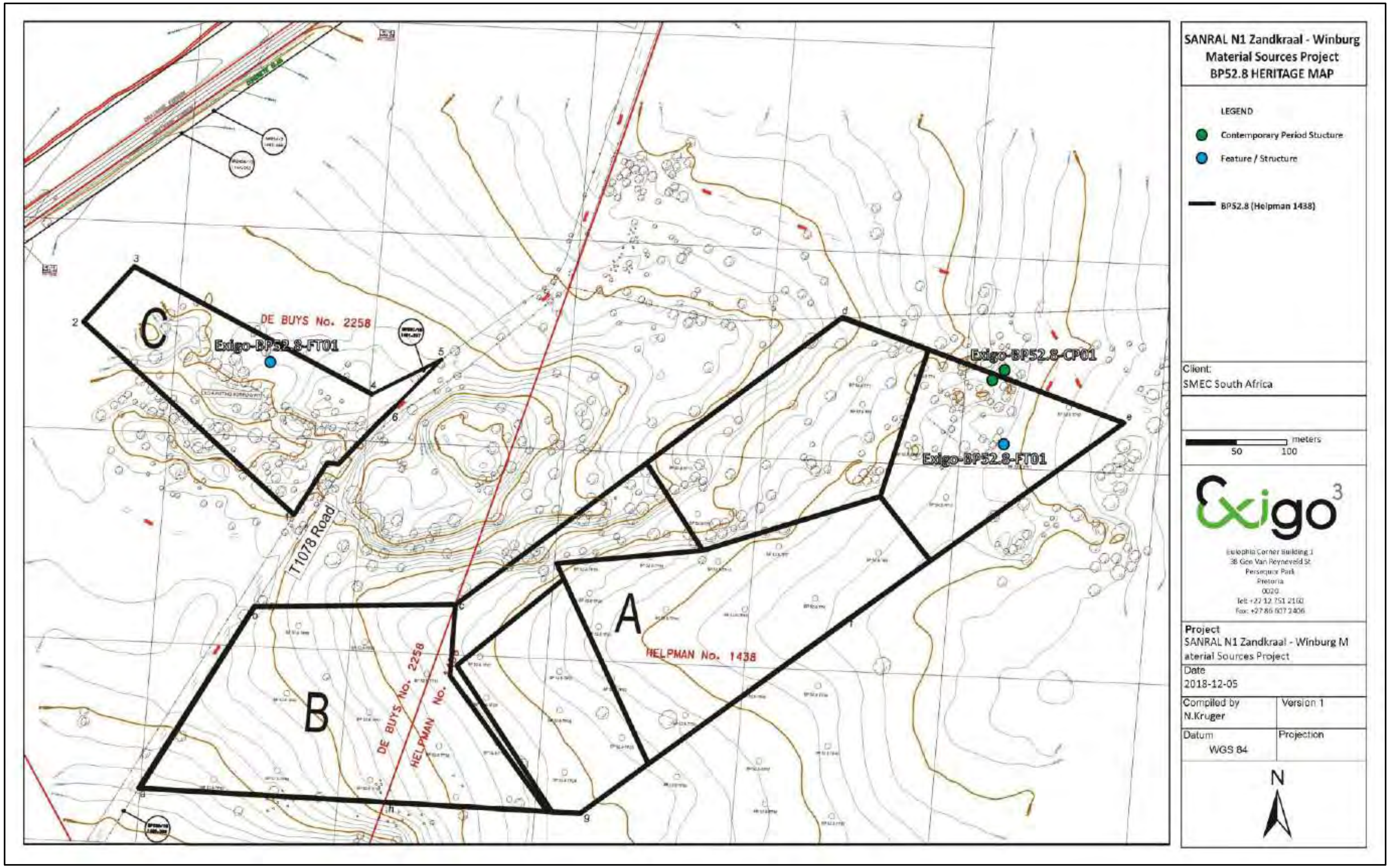


Figure 5-13: Geo-referenced project map of BP52.8 indicating the locations of occurrences of heritage potential, discussed in the text.

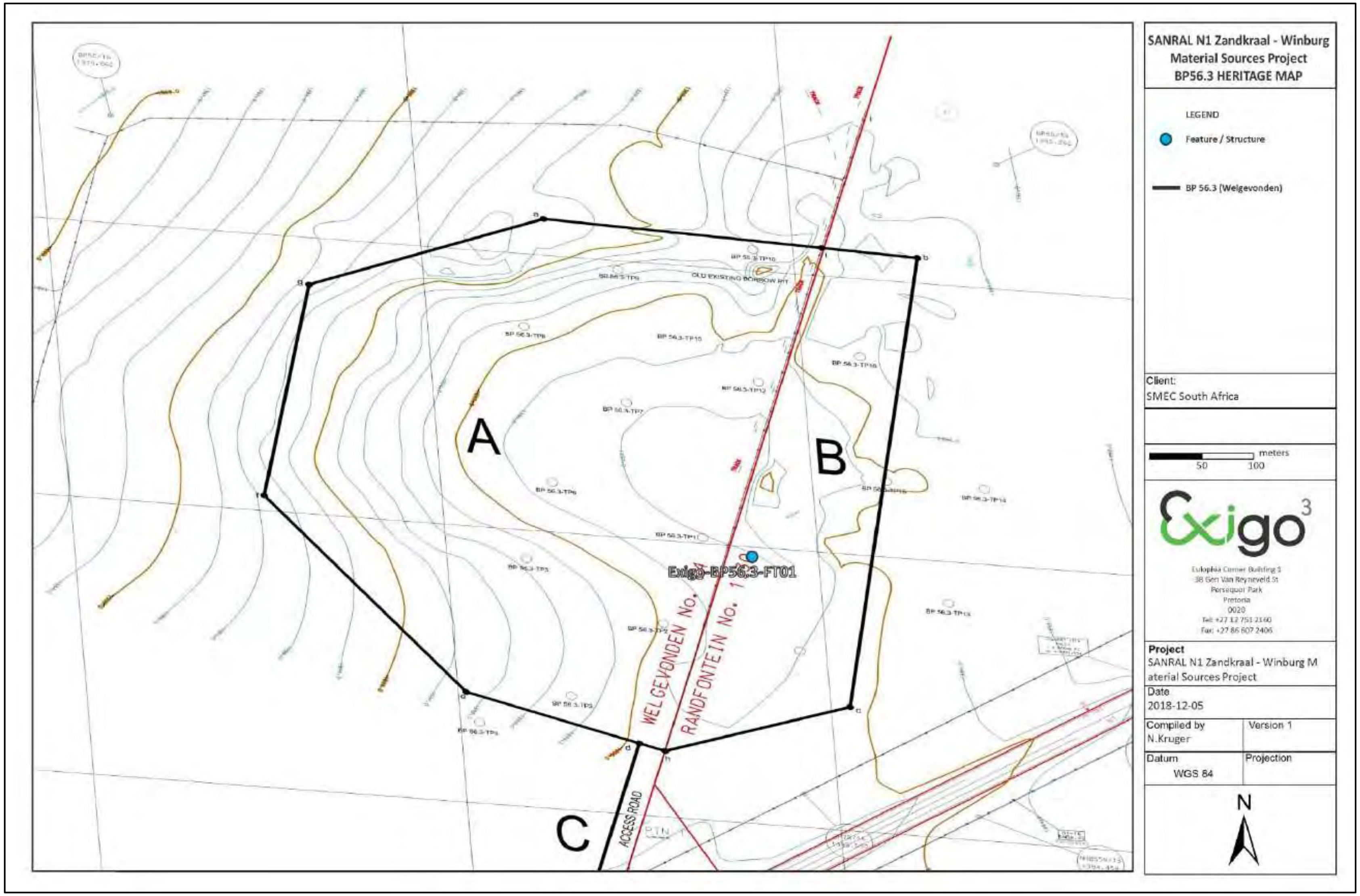


Figure 5-14: Geo-referenced project map of BP56.3 indicating the locations of occurrences of heritage potential, discussed in the text.

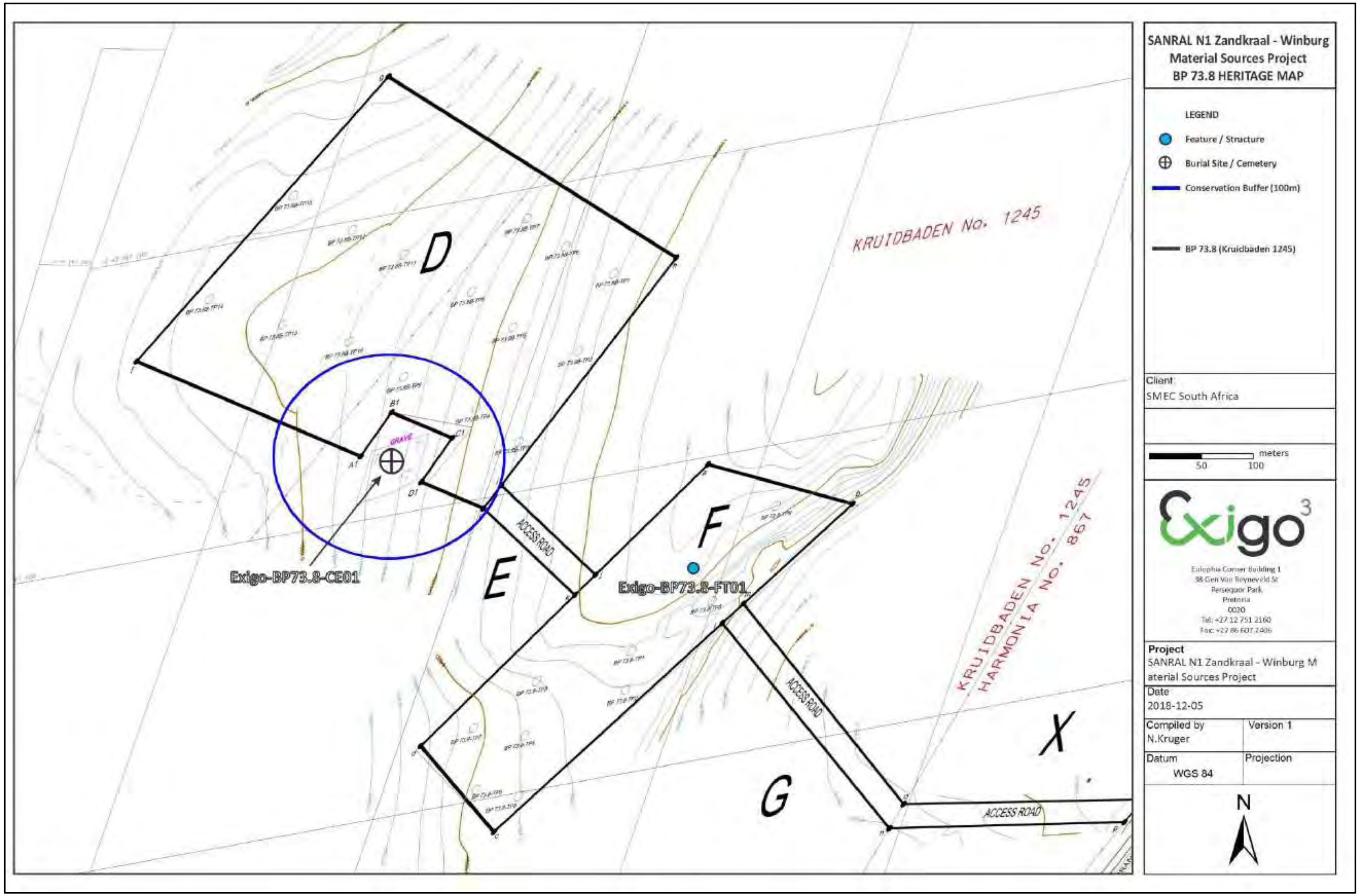


Figure 5-15: Geo-referenced project map of BP73.8 indicating the locations of occurrences of heritage potential, discussed in the text.

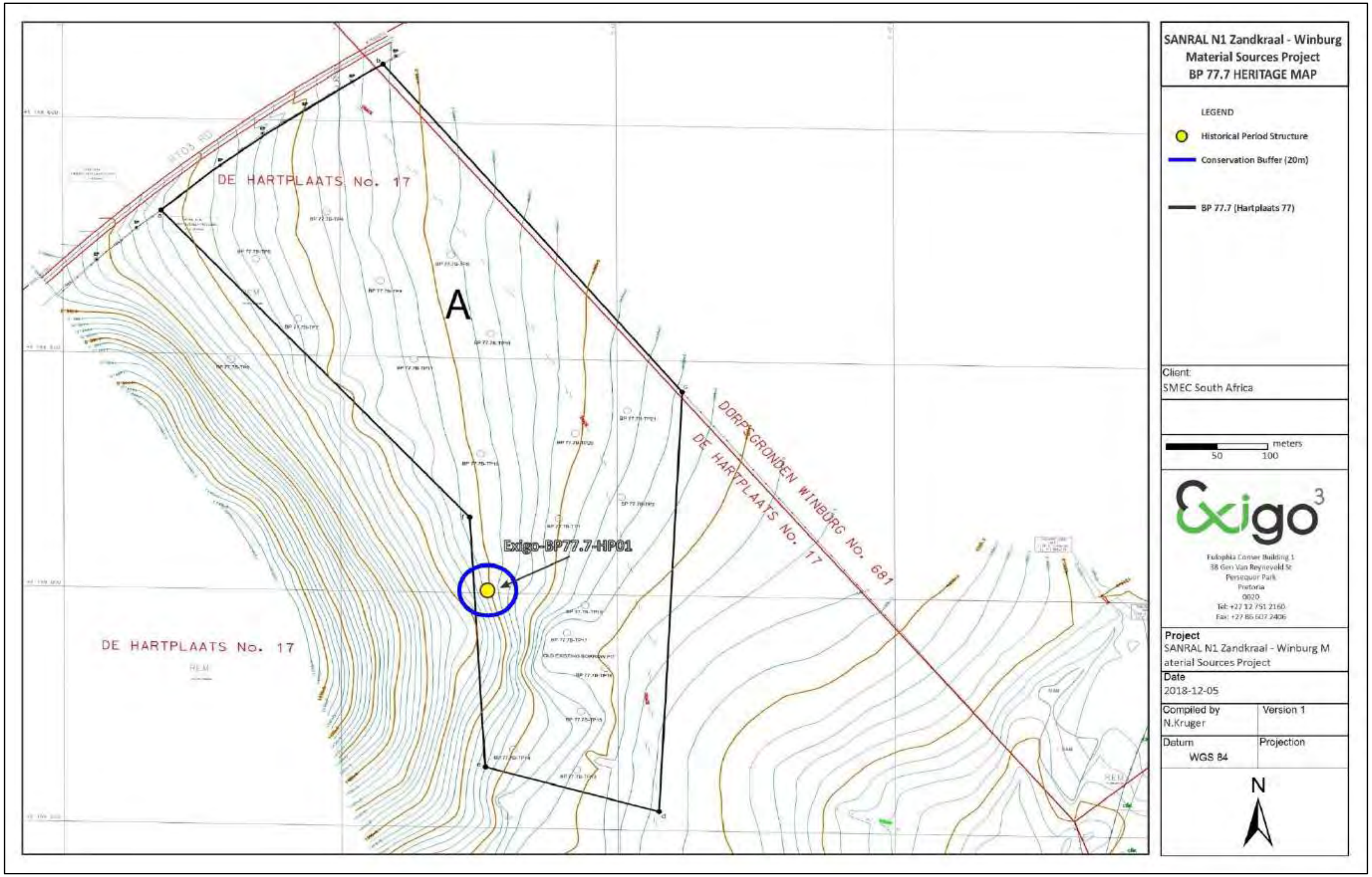


Figure 5-16: Geo-referenced project map of BP77.7 indicating the locations of occurrences of heritage potential, discussed in the text.

6 RESULTS: STATEMENT OF SIGNIFICANCE AND IMPACT RATING

6.1 Potential Impacts and Significance Ratings[2]

The following section provides a background to the identification and assessment of possible impacts and alternatives, as well as a range of risk situations and scenarios commonly associated with heritage resources management. A guideline for the rating of impacts and recommendation of management actions for areas of heritage potential within the project area is supplied in Section 10.2 of the Addendum.

6.1.1 General assessment of impacts on resources

Generally, the value and significance of archaeological and other heritage sites might be impacted on by any activity that would result immediately or in the future in the destruction, damage, excavation, alteration, removal or collection from its original position, any archaeological material or object (as indicated in the National Heritage Resources Act (No 25 of 1999)). Thus, the destructive impacts that are possible in terms of heritage resources would tend to be direct, once-off events occurring during the initial construction period. However, in the long run, the proximity of operations in any given area could result in secondary indirect impacts. The EIA process therefore specifies impact assessment criteria which can be utilised from the perspective of a heritage specialist study which elucidates the overall extent of impacts.

6.1.2 Direct impact rating

Direct or primary effects on heritage resources occur at the same time and in the same space as the activity, e.g. loss of historical fabric through demolition work. **Indirect effects or secondary effects** on heritage resources occur later in time or at a different place from the causal activity, or as a result of a complex pathway, e.g. restriction of access to a heritage resource resulting in the gradual erosion of its significance, which is dependent on ritual patterns of access (refer to Section 10.3 in the Addendum for an outline of the relationship between the significance of a heritage context, the intensity of development and the significance of heritage impacts to be expected). The significances of the impacts were determined through a synthesis of the criteria below:

Probability: This describes the likelihood of the impact actually occurring.	
Improbable:	The possibility of the impact occurring is very low, due to the circumstances, design or experience.
Probable:	There is a probability that the impact will occur to the extent that provision must be made therefore.
Highly Probable	It is most likely that the impact will occur at some stage of the development.
Definite:	The impact will take place regardless of any prevention plans, and there can only be relied on mitigatory actions or contingency plans to contain the effect.
Duration: The lifetime of the impact	
Short term:	The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
Medium term:	The impact will last up to the end of the phases, where after it will be negated.
Long term:	The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
Permanent:	Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

[2] Based on: Winter, S. & Baumann, N. 2005. *Guideline for involving heritage specialists in EIA processes: Edition 1.*

Scale: The physical and spatial size of the impact	
Local:	The impacted area extends only as far as the activity, e.g. footprint
Site:	The impact could affect the whole, or a measurable portion of the above mentioned properties.
Regional:	The impact could affect the area including the neighbouring residential areas.
Magnitude/ Severity: Does the impact destroy the environment, or alter its function.	
Low:	The impact alters the affected environment in such a way that natural processes are not affected.
Medium:	The affected environment is altered, but functions and processes continue in a modified way.
High:	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Significance: This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.	
Negligible:	The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
Low:	The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
Moderate:	The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
High:	The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights were assigned to each attribute:

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
Duration	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8
Significance	**Sum (Duration, Scale, Magnitude) x Probability**	
	Negligible	<20
	Low	<40
	Moderate	<60
	High	>60

The significance of each activity is rated without mitigation measures and with mitigation measures for both construction and operational phases of the development.

The following table summarizes impacts to the heritage receptors within and in close proximity of the project area:

Nr	Activity	Impact	Without or With Mitigation	Nature (Negative or Positive Impact)	Probability		Duration		Scale		Magnitude/ Severity		Significance		Mitigtion Measures
					Magnitude	Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	Score	Magnitude	
Planning Phase															
1	Exigo-BP77.7-HP01	Potential damage to Colonial Period structures	WOM	Negative	Probable	2	Short term	1	Site	2	Medium	6	18	Negligible	Site monitoring, avoidance, 20m conservation buffer.
			WM	Positive	Improbable	1	Short term	1	Site	2	Low	2	5	Negligible	Phase 2 Study and destruction permitting if impacted on.
1	Exigo-BP39.6-FT01, Exigo-BP52.8-FT01, Exigo-BP52.8-FT02, Exigo-BP56.3-FT01, Exigo-BP73.8-FT01	Potential damage to Colonial Period structures	WOM	Negative	Probable	2	Short term	1	Site	2	Low	2	10	Negligible	
			WM	Positive	Improbable	1	Short term	1	Site	2	Low	2	5	Negligible	Frequent site monitoring by heritage specialist / ECO.
2	Exigo-BP73.8-CE01	Potential damage to burial sites	WOM	Negative	Probable	2	Short term	1	Site	2	High	8	22	Low	
			WM	Positive	Improbable	1	Short term	1	Site	2	Low	2	5	Negligible	Frequent site monitoring by heritage specialist / ECO, heritage site management plan.
Construction Phase															
3	Exigo-BP77.7-HP01	Potential damage to Colonial Period structures	WOM	Negative	Probable	2	Long term	4	Site	2	Medium	6	24	Low	Site monitoring, avoidance, 20m conservation buffer.
			WM	Positive	Improbable	1	Short term	1	Site	2	Low	2	5	Negligible	Phase 2 Study and destruction permitting if impacted on.
1	Exigo-BP39.6-FT01, Exigo-BP52.8-FT01, Exigo-BP52.8-FT02, Exigo-BP56.3-FT01, Exigo-BP73.8-FT01	Potential damage to Colonial Period structures	WOM	Negative	Probable	2	Short term	1	Site	2	Low	2	10	Negligible	
			WM	Positive	Improbable	1	Short term	1	Site	2	Low	2	5	Negligible	Frequent site monitoring by heritage specialist / ECO.
4	Exigo-BP73.8-CE01	Potential damage to burial sites	WOM	Negative	Definite	5	Long term	4	Site	2	High	8	70	High	Site monitoring, avoidance, 100m conservation buffer, site management.
			WM	Positive	Improbable	1	Short term	1	Site	2	Low	2	5	Negligible	Grave relocation subject to authorisations and permitting if impacted on.

Operational / Decomissioning Phase															
5	Site Exigo-NIU-HP01, Site Exigo-NIU-HP02	Potential damage to Colonial Period structures	**WOM**	**Negative**	Improbable	1	Permanent	5	Local	1	Medium	6	12	Negligible	Site monitoring, avoidance, 20m conservation buffer.
			WM	**Positive**	Improbable	1	Short term	1	Site	2	Low	2	5	Negligible	Phase 2 Study and destruction permitting if impacted on.
1	Exigo-BP39.6-FT01, Exigo-BP52.8-FT01, Exigo-BP52.8-FT02, Exigo-BP56.3-FT01, Exigo-BP73.8-FT01	Potential damage to Colonial Period structures	**WOM**	**Negative**	Probable	2	Short term	1	Site	2	Low	2	10	Negligible	
			WM	**Positive**	Improbable	1	Short term	1	Site	2	Low	2	5	Negligible	Frequent site monitoring by heritage specialist / ECO.
6	Exigo-BP73.8-CE01	Potential damage to burial sites	**WOM**	**Negative**	Definite	5	Permanent	5	Site	2	High	8	75	High	Site monitoring, avoidance, 100m conservation buffer, site management.
			WM	**Positive**	Improbable	1	Short term	1	Site	2	Low	2	5	Negligible	Grave relocation subject to authorisations and permitting if impacted on.

6.2 Evaluation Impacts

Previous studies conducted in the larger Free State landscape around the project area suggest a rich and diverse archaeological landscape. The SANRAL N1 Zandkraal - Winburg Material Sources Project landscape has been inhabited continuously in prehistoric and historical times where large portions of land have been transformed for agriculture. Cognisance should be taken of archaeological material that might be present in surface and sub-surface deposits.

6.2.1 Archaeology

The study did not identify any archaeological receptors which will be directly impacted by the proposed project and no impact on archaeological sites or features is anticipated.

6.2.2 Built Environment

A Historical Period building as well as the remains of a Contemporary Period farmstead relating to rural settlement occur in the general landscape and more recently constructed buildings occur in the project footprint. However, no impact on the built environment is anticipated.

6.2.3 Cultural Landscape

The larger area comprises a rich cultural horizon and the natural landscape surrounding the proposed project encompasses open grasslands, typical of the southern Highveld and rural Free State. The cultural landscape holds Iron Age remains, Colonial Period farmsteads and Historical towns. The proposed project is unlikely to result in a significant impact on the cultural landscape of this area.

6.2.4 Graves / Human Burials Sites

A burial site containing an unknown number of graves was located in the project development footprint. These receptors are of high significance for their social and cultural value. The potential impact on the resources is anticipated to be high but this impact rating can be limited to a indelible impact by the implementation of mitigation measures (avoidance, site management, site monitoring / grave relocation) for the sites, if / when required.

In the rural areas of the Free State, graves and cemeteries sometimes occur within settlements or around homesteads but they are also randomly scattered around archaeological and historical settlements. The probability of additional and informal human burials encountered during development should thus not be excluded. In addition, human remains and burials are commonly found close to archaeological sites; they may be found in "lost" graveyards, or occur sporadically anywhere as a result of prehistoric activity, victims of conflict or crime. It is often difficult to detect the presence of archaeological human remains on the landscape as these burials, in most cases, are not marked at the surface. Human remains are usually observed when they are exposed through erosion. In some instances packed stones or rocks may indicate the presence of informal pre-colonial burials. If any human bones are found during the course of construction work then they should be reported to an archaeologist and work in the immediate vicinity should cease until the appropriate actions have been carried out by the archaeologist. Where human remains are part of a burial they would need to be exhumed under a permit from SAHRA (for pre-colonial burials as well as burials later than about AD 1500). Should any unmarked human burials/remains be found during the course of construction, work in the immediate vicinity should cease and the find must immediately be reported to the archaeologist, or the South African Heritage Resources Agency (SAHRA). Under no circumstances may burials be disturbed or removed until such time as necessary statutory procedures required for grave relocation have been met.

Heritage resources occur within the SANRAL N1 Zandkraal - Winburg Material Sources Project zones and potential direct impacts on these heritage receptors are foreseen. However, these impacts can be mitigated and in the opinion of the author of this AIA study the proposed SANRAL N1 Zandkraal - Winburg Material Sources Project may proceed from a culture resources management perspective on the condition that mitigation measures are implemented where applicable, and provided that no subsurface heritage remains are encountered during construction.

6.3 Management actions

Recommendations for relevant heritage resources management actions are vital to the conservation of heritage resources. A general guideline for recommended management actions is included in Section 10.4 of the Addendum. The following management measures should be considered during implementation of the proposed SANRAL N1 Zandkraal - Winburg Material Sources Project.

OBJECTIVE: prevent unnecessary disturbance and/or destruction of previously undetected heritage receptors.

- *No further action is required for the Contemporary Period remains of a farmstead (**Exigo-BP52.8-CP01)** in the project area but it should be noted that human burials might occur in association with the farmstead at precisely undated locations.*

- *For various features found across a number of properties in the project area rated as of low significance (**Exigo-BP39.6-FT01, Exigo-BP52.8-FT01, Exigo-BP52.8-FT02, Exigo-BP56.3-FT01, Exigo-BP73.8-FT01)** within the project area the following are required in terms of heritage management and mitigation:*

<table>
<tr><td>PROJECT COMPONENT/S</td><td colspan="2">All phases of construction and operation.</td></tr>
<tr><td>POTENTIAL IMPACT</td><td colspan="2">Damage/destruction of sites.</td></tr>
<tr><td>ACTIVITY RISK/SOURCE</td><td colspan="2">Digging foundations and trenches into sensitive deposits that are not visible at the surface.</td></tr>
<tr><td>MITIGATION: TARGET/OBJECTIVE</td><td colspan="2">To conserve the historical fabric of the sites and to locate undetected heritage remains as soon as possible after disturbance so as to maximize the chances of successful rescue/mitigation work.</td></tr>
<tr><td>MITIGATION: ACTION/CONTROL</td><td>RESPONSIBILITY</td><td>TIMEFRAME</td></tr>
<tr><td colspan="3">Fixed Mitigation Procedure (required)</td></tr>
<tr><td>Site Monitoring: Regular examination of trenches and excavations.</td><td>ECO, HERITAGE ASSESSMENT PRACTITIONER</td><td>Monitor as frequently as practically possible.</td></tr>
<tr><td>PERFORMANCE INDICATOR</td><td colspan="2">Archaeological sites are discovered and mitigated with the minimum amount of unnecessary disturbance.</td></tr>
<tr><td>MONITORING</td><td colspan="2">Successful location of sites by person/s monitoring.</td></tr>
</table>

- *For the remains of a Historical Period dwelling (***Exigo-BP77.7-HP01***) occurring in the project area the following are required in terms of heritage management and mitigation:*

PROJECT COMPONENT/S	All phases of construction and operation.		
POTENTIAL IMPACT	Damage/disturbance to sites and subsurface features and deposits.		
ACTIVITY RISK/SOURCE	Digging foundations and trenches into sensitive deposits that are not visible at the surface.		
MITIGATION: TARGET/OBJECTIVE	To the historical fabric and conserve existing, and locate undetected heritage remains as soon as possible after disturbance so as to maximize the chances of successful rescue/mitigation work.		
MITIGATION: ACTION/CONTROL		**RESPONSIBILITY**	**TIMEFRAME**
Preferred Mitigation Procedure			
Avoidance: Implement a heritage conservation buffer of at least 20m around the heritage receptor, where possible redesign infrastructure to avoid the heritage resource and the proposed conservation buffer.		DEVELOPER QUALIFIED HERITAGE SPECIALIST	Prior to the commencement of construction and earth-moving.
Alterative Mitigation Procedure (**if preferred mitigation procedure is not feasible**)			
Phase 2 Study and Sampling: Full Phase 2 Specialist Assessment of site including mapping, site sampling and possible conservation management and protection measures. Subject to authorisations and relevant permitting from heritage authorities and affected parties.		QUALIFIED HERITAGE SPECIALIST	Prior to the commencement of construction and earth-moving.
Fixed Mitigation Procedure (**required**)			
Site Monitoring: Regular examination of trenches and excavations.		ECO	Monitor as frequently as practically possible.
PERFORMANCE INDICATOR	Archaeological sites are discovered and mitigated with the minimum amount of unnecessary disturbance.		
MONITORING	Successful location of sites by person/s monitoring.		

- *For the highly significant cemetery (***Exigo-BP73.8-CE01***) occurring in close proximity of the project area the following are required in terms of heritage management and mitigation:*

PROJECT COMPONENT/S	All phases of construction and operation.		
POTENTIAL IMPACT	Damage/disturbance to subsurface burials and surface burial features.		
ACTIVITY RISK/SOURCE	Digging foundations and trenches into sensitive deposits that are not visible at the surface.		
MITIGATION: TARGET/OBJECTIVE	To locate human burials as soon as possible after disturbance so as to maximize the chances of successful rescue/mitigation work.		
MITIGATION: ACTION/CONTROL		**RESPONSIBILITY**	**TIMEFRAME**
Preferred Mitigation Procedure			
Avoidance: Implement a heritage conservation buffer of at least 100m around the grave / cemeteries, if necessary redesign the project infrastructure to avoid the heritage resource and the proposed conservation buffer. Fence all burial places and apply access control. Implement a site management plan detailing strict site management conservation measures.		DEVELOPER QUALIFIED HERITAGE SPECIALIST	Prior to the commencement of construction and earth-moving.

Alterative Mitigation Procedure (**if preferred mitigation procedure is not feasible**)		
Grave Relocation: Relocation of burials and documentation of site, full social consultation with affected parties, possible conservation management and protection measures. Subject to authorisations and relevant permitting from heritage authorities and affected parties.	QUALIFIED HERITAGE SPECIALIST	Prior to the commencement of construction and earth-moving.
Fixed Mitigation Procedure (**required**)		
Site Monitoring: Regular examination of trenches and excavations in this area in order to avoid the destruction of previously undetected burials or heritage remains.	ECO	Monitor as frequently as practically possible.
PERFORMANCE INDICATOR	Archaeological sites are discovered and mitigated with the minimum amount of unnecessary disturbance.	
MONITORING	Successful location of sites by person/s monitoring.	

7 RECOMMENDATIONS

In terms of heritage resources, the landscape around the project area is primarily well known for the occurrence of Iron Age farmer presence and a Colonial frontier denoting farmer expansion. The landscape that encompasses the SANRAL N1 Zandkraal - Winburg Material Sources Project footprints seems to have been inhabited continuously for centuries in prehistoric and historical times, the remnants of which are visible in transformed agriculture and rural settlement areas. The following general recommendations are made based on general observations in the proposed SANRAL N1 Zandkraal - Winburg Material Sources Project area pertaining to a number of identified occurrences of heritage potential:

- The remains of a Contemporary Period farmstead including the ruins of a farmhouse and livestock enclosures (**Exigo-BP52.8-CP01)** in the project area is not of heritage significance and no action in terms of heritage mitigation is required for these features. However, cognisance should taken of the fact that human burials might occur in association with the farmstead at precisely undated locations.
- A number of stone heaps, enclosures and unidentified features occur across properties subject to this assessment (**Exigo-BP39.6-FT01, Exigo-BP52.8-FT01, Exigo-BP52.8-FT02, Exigo-BP56.3-FT01, Exigo-BP73.8-FT01)** and they are rated as of of low significance due to their poor state of preservation and the general absence of associated material culture. However, the possibility of some of the features indicating informal human burial sites should not be excluded and it is therefore recommended that the area be monitored by an informed ECO in order to avoid the destruction of previously undetected heritage remains or burials.
- The remains of a Historical Period dwelling or farmstead (**Exigo-BP77.7-HP01**) might afford a better understanding of social, cultural and architectural developments of the Historical period landscape around Windburg and it is rated as of medium significance. The site is located along the western periphery of the proposed BP 77.7 site on the farm Hartplaats 77 and it is primarily recommended that the burrow pit be redesigned to avoid impact on the site where a heritage conservation buffer of at least 20m around the heritage receptor is implemented. If this measure proves unachievable it is recommended that the historical fabric of the site be conserved by means of a Phase 2 Specialist study (mapping, site sampling and possible conservation management and protection) and the necessary permits should be obtained from the relevant Heritage Resources Authorities
- A small informal cemetery holding an unknown number of graves was documented in close proximity if the proposed BP 73.8 site on the farm Kruidbaden 1245 (**Exigo-BP73.8-CE01).** The site is of high significance and as a primary measure, the Burial Grounds and Graves (BGG) Unit of SAHRA requires a 100m conservation buffer for all burials. It is therefore recommended that the burrow pit proposed for this area around the burial site be redesigned to avoid encroaching on the required 100m conservation buffer. In addition it is recommended that the burial site be fenced off with wire or palisade fencing placed no closer than 2m from the burials. An access gate should be erected and access control should be applied to the site. A heritage Site Management Plan (SMP) should be compiled for the burials to stipulate conservation measures, responsible persons and chance find procedures for further heritage mitigation. The developer should carefully liaise with the heritage specialist, SAHRA as well as local communities and possible affected parties with regards to the management and monitoring of any human grave or cemetery in order to detect and manage negative impact on the sites. **Should impact on the burial site prove inevitable, full grave relocations are recommended for these burial grounds. This measure should be undertaken by a qualified archaeologist, and in accordance with relevant legislation, permitting, statutory permissions and subject to any local and regional provisions and laws and**

by-laws pertaining to human remains. A full social consultation process with the Kamffer family and other affected parties should occur in conjunction with the mitigation of cemeteries and burials (see Addendum B).

- Considering the localised nature of heritage remains, the general monitoring of the development progress by an ECO is recommended for all stages of the project. Should any subsurface palaeontological, archaeological or historical material, or burials be exposed during construction activities, all activities should be suspended and the archaeological specialist should be notified immediately
- It is essential that cognisance be taken of the larger archaeological landscape of the area in order to avoid the destruction of previously undetected heritage sites. It should be stated that the possibility of undetected archaeological remains occurring elsewhere in the project area should not be excluded. Burials and historically significant structures dating to the Colonial Period occur on farms in the area and these resources should be avoided during all phases of construction and development, including the operational phases of the development.

In addition to these site-specific recommendations, careful cognizance should be taken of the following:

- As Palaeontological remains occur where bedrock has been exposed, all geological features should be regarded as sensitive.
- Water sources such as drainage lines, fountains and pans would often have attracted human activity in the past. As Stone Age material the larger landscape should be regarded as potentially sensitive in terms of possible subsurface deposits.

8 GENERAL COMMENTS AND CONDITIONS

This AIA report serves to confirm the extent and significance of the heritage landscape of the proposed SANRAL N1 Zandkraal - Winburg Material Sources Project area. The larger heritage horizon encompasses rich and diverse archaeological landscapes and cognisance should be taken of heritage resources and archaeological material that might be present in surface and sub-surface deposits. If, during construction, any possible archaeological material culture discoveries are made, the operations must be stopped and a qualified archaeologist be contacted for an assessment of the find. Such material culture might include:

- Formal Earlier Stone Age stone tools.
- Formal MSA stone tools.
- Formal LSA stone tools.
- Potsherds
- Iron objects.
- Beads made from ostrich eggshell and glass.
- Ash middens and cattle dung deposits and accumulations.
- Faunal remains.
- Human remains/graves.
- Stone walling or any sub-surface structures.
- Historical glass, tin or ceramics.
- Fossils.

If such sites were to be encountered or impacted by any proposed developments, recommendations contained in this report, as well as endorsement of mitigation measures as set out by Free State-PHRA, SAHRA, the National Resources Act and the CRM section of ASAPA will be required.

It must be emphasised that the conclusions and recommendations expressed in this archaeological heritage sensitivity investigation are based on the visibility of archaeological sites/features and may not therefore, represent the area's complete archaeological legacy. Many sites/features may be covered by soil and vegetation and might only be located during sub-surface investigations. If subsurface archaeological deposits, artefacts or skeletal material were to be recovered in the area during construction activities, all activities should be suspended and the archaeological specialist should be notified immediately **(*cf*. NHRA (Act No. 25 of 1999)**, Section 36 (6)). It must also be clear that Archaeological Specialist Reports will be assessed by the relevant heritage resources authority (SAHRA).

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10 ADDENDUM 1: HERITAGE LEGISLATION BACKGROUND

10.1 CRM: Legislation, Conservation and Heritage Management

The broad generic term Cultural Heritage Resources refers to any physical and spiritual property associated with past and present human use or occupation of the environment, cultural activities and history. The term includes sites, structures, places, natural features and material of palaeontological, archaeological, historical, aesthetic, scientific, architectural, religious, symbolic or traditional importance to specific individuals or groups, traditional systems of cultural practice, belief or social interaction.

10.1.1 Legislation regarding archaeology and heritage sites

The South African Heritage Resources Agency (SAHRA) and their provincial offices aim to conserve and control the management, research, alteration and destruction of cultural resources of South Africa. It is therefore vitally important to adhere to heritage resource legislation at all times.

d. National Heritage Resources Act No 25 of 1999, section 35

According to the National Heritage Resources Act of 1999 a historical site is any identifiable building or part thereof, marker, milestone, gravestone, landmark or tell older than 60 years. This clause is commonly known as the "60-years clause". Buildings are amongst the most enduring features of human occupation, and this definition therefore includes all buildings older than 60 years, modern architecture as well as ruins, fortifications and Iron Age settlements. "Tell" refers to the evidence of human existence which is no longer above ground level, such as building foundations and buried remains of settlements (including artefacts).

The Act identifies heritage objects as:

- objects recovered from the soil or waters of South Africa including archaeological and palaeontological objects, meteorites and rare geological specimens
- visual art objects
- military objects
- numismatic objects
- objects of cultural and historical significance
- objects to which oral traditions are attached and which are associated with living heritage
- objects of scientific or technological interest
- any other prescribed category

With regards to activities and work on archaeological and heritage sites this Act states that:

"No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit by the relevant provincial heritage resources authority." (34. [1] 1999:58)

and

"No person may, without a permit issued by the responsible heritage resources authority-

(d) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(e) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(f) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(g) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites. (35. [4] 1999:58)."

and

"No person may, without a permit issued by SAHRA or a provincial heritage resources agency-

(h) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(i) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority;

(j) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) and excavation equipment, or any equipment which assists in the detection or recovery of metals (36. [3] 1999:60)."

e. Human Tissue Act of 1983 and Ordinance on the Removal of Graves and Dead Bodies of 1925

Graves 60 years or older are heritage resources and fall under the jurisdiction of both the National Heritage Resources Act and the Human Tissues Act of 1983. However, graves younger than 60 years are specifically protected by the Human Tissues Act (Act 65 of 1983) and the Ordinance on the Removal of Graves and Dead Bodies (Ordinance 7 of 1925) as well as any local and regional provisions, laws and by-laws. Such burial places also fall under the jurisdiction of the National Department of Health and the Provincial Health Departments. Approval for the exhumation and re-burial must be obtained from the relevant Provincial MEC as well as the relevant Local Authorities.

10.1.2 Background to HIA and AIA Studies

South Africa's unique and non-renewable archaeological and palaeontological heritage sites are 'generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority. Heritage sites are frequently threatened by development projects and both the environmental and heritage legislation require impact assessments (HIAs & AIAs) that identify all heritage resources in areas to be developed. Particularly, these assessments are required to make recommendations for protection or mitigation of the impact of the sites. HIAs and AIAs should be done by qualified professionals with adequate knowledge to (a) identify all heritage resources including archaeological and palaeontological sites that might occur in areas of developed and (b) make recommendations for protection or mitigation of the impact on the sites.

The National Heritage Resources Act (Act No. 25 of 1999, section 38) provides guidelines for Cultural Resources Management and prospective developments:

"38. *(1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a* *development categorised as:*

(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site:

(i) exceeding 5 000 m^2 in extent; or

(ii) involving three or more existing erven or subdivisions thereof; or

(iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

(iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or a provincial heritage

resources authority,

must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development."

And:

"The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)(a): Provided that the following must be included:

(k) The identification and mapping of all heritage resources in the area affected;

(l) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;

(m) an assessment of the impact of the development on such heritage resources;

(n) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;

(o) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

(p) if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and

(q) plans for mitigation of any adverse effects during and after the completion of the proposed development (38. [3] 1999:64)."

Consequently, section 35 of the Act requires Heritage Impact Assessments (HIAs) or Archaeological Impact Assessments (AIAs) to be done for such developments in order for all heritage resources, that is, all places or objects of aesthetics, architectural, historic, scientific, social, spiritual, linguistic or technological value or significance to be protected. Thus any assessment should make provision for the protection of all these heritage components, including archaeology, shipwrecks, battlefields, graves, and structures older than 60 years, living heritage, historical settlements, landscapes, geological sites, palaeontological sites and objects.Heritage resources management and conservation.

10.2 Assessing the Significance of Heritage Resources

Archaeological sites, as previously defined in the National Heritage Resources Act (Act 25 of 1999) are places in the landscape where people have lived in the past – generally more than 60 years ago – and have left traces of their presence behind. In South Africa, archaeological sites include hominid fossil sites, places where people of the Earlier, Middle and Later Stone Age lived in open sites, river gravels, rock shelters and caves, Iron Age sites, graves, and a variety of historical sites and structures in rural areas, towns and cities. Palaeontological sites are those with fossil remains of plants and animals where people were not involved in the accumulation of the deposits. The basic principle of cultural heritage conservation is that archaeological and other heritage sites are valuable, scarce and *non-renewable.* Many such sites are unfortunately lost on a daily basis through development for housing, roads and infrastructure and once archaeological sites are damaged, they cannot be re-created as site integrity and authenticity is permanently lost. Archaeological sites have the potential to contribute to our understanding of the history of the region and of our country and continent. By preserving links with our past, we may not be able to revive lost cultural traditions, but it enables us to appreciate the role they have played in the history of our country.

- Categories of significance

Rating the significance of archaeological sites, and consequently grading the potential impact on the resources is linked to the significance of the site itself. The significance of an archaeological site is based on the amount of deposit, the integrity of the context, the kind of deposit and the potential to help answer present research questions. Historical structures are defined by Section 34 of the National Heritage Resources Act, 1999, while other historical and cultural significant sites, places and features, are generally determined by community preferences. The guidelines as provided by the NHRA (Act No. 25 of 1999) in Section 3, with special reference to subsection 3 are used when determining the cultural significance or other special value of archaeological or historical sites. In addition, ICOMOS (the Australian Committee of the International Council on Monuments and Sites) highlights four cultural attributes, which are valuable to any given culture:

- *Aesthetic value:*

Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria include consideration of the form, scale, colour, texture and material of the fabric, the general atmosphere associated with the place and its uses and also the aesthetic values commonly assessed in the analysis of landscapes and townscape.

- *Historic value:*

Historic value encompasses the history of aesthetics, science and society and therefore to a large extent underlies all of the attributes discussed here. Usually a place has historical value because of some kind of influence by an event, person, phase or activity.

- *Scientific value:*

The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality and on the degree to which the place may contribute further substantial information.

- *Social value:*

Social value includes the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a certain group.

It is important for heritage specialist input in the EIA process to take into account the heritage management structure set up by the NHR Act. It makes provision for a 3-tier system of management including the South Africa Heritage Resources Agency (SAHRA) at a national level, Provincial Heritage Resources Authorities (PHRAs) at a provincial and the local authority. The Act makes provision for two types or forms of protection of heritage resources; i.e. formally protected and generally protected sites:

Formally protected sites:

- Grade 1 or national heritage sites, which are managed by SAHRA
- Grade 2 or provincial heritage sites, which are managed by the provincial HRA (MP-PHRA).
- Grade 3 or local heritage sites.

Generally protected sites:

- Human burials older than 60 years.
- Archaeological and palaeontological sites.
- Shipwrecks and associated remains older than 60 years.
- Structures older than 60 years.

With reference to the evaluation of sites, the certainty of prediction is definite, unless stated otherwise and if the significance of the site is rated high, the significance of the impact will also result in a high rating. The same rule applies if the significance rating of the site is low. The significance of archaeological sites is generally
ranked into the following categories.

Significance	Rating Action
No significance: sites that do not require mitigation.	None
Low significance: sites, which may require mitigation.	2a. Recording and documentation (Phase 1) of site; no further action required 2b. Controlled sampling (shovel test pits, augering), mapping and documentation (Phase 2 investigation); permit required for sampling and destruction
Medium significance: sites, which require mitigation.	3. Excavation of representative sample, C14 dating, mapping and documentation (Phase 2 investigation); permit required for sampling and destruction [including 2a & 2b]
High significance: sites, where disturbance should be avoided.	4a. Nomination for listing on Heritage Register (National, Provincial or Local) (Phase 2 & 3 investigation); site management plan; permit required if utilised for education or tourism
High significance: Graves and burial places	4b. Locate demonstrable descendants through social consulting; obtain permits from applicable legislation, ordinances and regional by-laws; exhumation and reinterment [including 2a, 2b & 3]

Furthermore, the significance of archaeological sites was based on six main criteria:

- Site integrity (i.e. primary vs. secondary context),
- Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter),
- Social value,
- Uniqueness, and

Potential to answer current and future research questions.

11 ADDENDUM 2: CONVENTIONS USED TO ASSESS THE SIGNIFICANCE OF HERITAGE

11.1 Site Significance Matrix

According to the NHRA, Section 2(vi) the **significance** of heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these. The following matrix is used for assessing the significance of each identified site/feature.

2. SITE EVALUATION			
2.1 Heritage Value (NHRA, section 2 [3])	High	Medium	Low
It has importance to the community or pattern of South Africa's history or pre-colonial history.			
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.			
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.			
It is of importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.			
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.			
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.			
It has marked or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).			
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.			
It has significance through contributing towards the promotion of a local sociocultural identity and can be developed as a tourist destination.			
It has significance relating to the history of slavery in South Africa.			
It has importance to the wider understanding of temporal changes within cultural landscapes, settlement patterns and human occupation.			
2.2 Field Register Rating			
National/Grade 1 [should be registered, retained]			
Provincial/Grade 2 [should be registered, retained]			
Local/Grade 3A [should be registered, mitigation not advised]			
Local/Grade 3B [High significance; mitigation, partly retained]			
Generally Protected A [High/Medium significance, mitigation]			
Generally protected B [Medium significance, to be recorded]			
Generally Protected C [Low significance, no further action]			
2.3 Sphere of Significance	High	Medium	Low
International			
National			
Provincial			
Local			
Specific community			

11.2 Impact Assessment Criteria

The following table provides a guideline for the rating of impacts and recommendation of management actions for sites of heritage potential.

Significance of the heritage resource
This is a statement of the nature and degree of significance of the heritage resource being affected by the activity. From a heritage management perspective it is useful to distinguish between whether the significance is embedded in the physical fabric or in associations with events or persons or in the experience of a place; i.e. its visual and non-visual qualities. This statement is a primary informant to the nature and degree of significance of an impact and thus needs to be thoroughly considered. Consideration needs to be given to the significance of a heritage resource at different scales (i.e. sitespecific, local, regional, national or international) and the relationship between the heritage resource, its setting and its associations.

Nature of the impact
This is an assessment of the nature of the impact of the activity on a heritage resource, with some indication of its positive and/or negative effect/s. It is strongly informed by the statement of resource significance. In other words, the nature of the impact may be historical, aesthetic, social, scientific, linguistic or architectural, intrinsic, associational or contextual (visual or non-visual). In many cases, the nature of the impact will include more than one value.

Extent
Here it should be indicated whether the impact will be experienced:
- On a site scale, i.e. extend only as far as the activity;
- Within the immediate context of a heritage resource;
- On a local scale, e.g. town or suburb
- On a metropolitan or regional scale; or
- On a national/international scale.

Duration
Here it should be indicated whether the lifespan of the impact will be:
- Short term, (needs to be defined in context)
- Medium term, (needs to be defined in context)
- Long term where the impact will persist indefinitely, possibly beyond the operational life of the activity, either because of natural processes or by human intervention; or
- Permanent where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Of relevance to the duration of an impact are the following considerations:
- Reversibility of the impact; and
- Renewability of the heritage resource.

Intensity
Here it should be established whether the impact should be indicated as:
- Low, where the impact affects the resource in such a way that its heritage value is not affected;
- Medium, where the affected resource is altered but its heritage value continues to exist albeit in a modified way; and
- High, where heritage value is altered to the extent that it will temporarily or permanently be damaged or destroyed.

Probability
This should describe the likelihood of the impact actually occurring indicated as:
- Improbable, where the possibility of the impact to materialize is very low either because of design or historic experience;
- Probable, where there is a distinct possibility that the impact will occur;
- Highly probable, where it is most likely that the impact will occur; or
- Definite, where the impact will definitely occur regardless of any mitigation measures

Confidence
This should relate to the level of confidence that the specialist has in establishing the nature and degree of impacts. It relates to the level and reliability of information, the nature and degree of consultation with I&AP's and the dynamic of the broader socio-political context.
- High, where the information is comprehensive and accurate, where there has been a high degree of consultation and the socio-political context is relatively stable.

- Medium, where the information is sufficient but is based mainly on secondary sources, where there has been a limited targeted consultation and socio-political context is fluid.
- Low, where the information is poor, a high degree of contestation is evident and there is a state of socio-political flux.

Impact Significance

The significance of impacts can be determined through a synthesis of the aspects produced in terms of the nature and degree of heritage significance and the nature, duration, intensity, extent, probability and confidence of impacts and can be described as:

- Low; where it would have a negligible effect on heritage and on the decision
- Medium, where it would have a moderate effect on heritage and should influence the decision.
- High, where it would have, or there would be a high risk of, a big effect on heritage. Impacts of high significance should have a major influence on the decision;
- Very high, where it would have, or there would be high risk of, an irreversible and possibly irreplaceable negative impact on heritage. Impacts of very high significance should be a central factor in decision-making.

11.3 Direct Impact Assessment Criteria

The following table provides an outline of the relationship between the significance of a heritage context, the intensity of development and the significance of heritage impacts to be expected

	TYPE OF DEVELOPMENT			
HERITAGE CONTEXT	**CATEGORY A**	**CATEGORY B**	**CATEGORY C**	**CATEGORY D**
CONTEXT 1 High heritage Value	Moderate heritage impact expected	High heritage impact expected	Very high heritage impact expected	Very high heritage impact expected
CONTEXT 2 Medium to high heritage value	Minimal heritage impact expected	Moderate heritage impact expected	High heritage impact expected	Very high heritage impact expected
CONTEXT 3 Medium to low heritage value	Little or no heritage impact expected	Minimal heritage impact expected	Moderate heritage impact expected	High heritage impact expected
CONTEXT 4 Low to no heritage value	Little or no heritage impact expected	Little or no heritage impact expected	Minimal heritage value expected	Moderate heritage impact expected
NOTE: A DEFAULT "LITTLE OR NO HERITAGE IMPACT EXPECTED" VALUE APPLIES WHERE A HERITAGE RESOURCE OCCURS OUTSIDE THE IMPACT ZONE OF THE DEVELOPMENT.				

HERITAGE CONTEXTS	**CATEGORIES OF DEVELOPMENT**
Context 1: Of high intrinsic, associational and contextual heritage value within a national, provincial and local context, i.e. formally declared or potential Grade 1, 2 or 3A heritage resources **Context 2:** Of moderate to high intrinsic, associational and contextual value within a local context, i.e. potential Grade 3B heritage resources. **Context 3:** Of medium to low intrinsic, associational or contextual heritage value within a national, provincial and local context, i.e. potential Grade 3C heritage resources **Context 4:** Of little or no intrinsic, associational or contextual heritage value due to disturbed, degraded conditions or extent of irreversible damage.	**Category A: Minimal intensity development** - No rezoning involved; within existing use rights. - No subdivision involved. - Upgrading of existing infrastructure within existing envelopes - Minor internal changes to existing structures - New building footprints limited to less than 1000m2. **Category B: Low-key intensity development** - Spot rezoning with no change to overall zoning of a site. - Linear development less than 100m - Building footprints between 1000m2-2000m2 - Minor changes to external envelop of existing structures (less than 25%) - Minor changes in relation to bulk and height of immediately adjacent structures (less than 25%). **Category C: Moderate intensity development** - Rezoning of a site between 5000m2-10 000m2.

	- Linear development between 100m and 300m. - Building footprints between 2000m2 and 5000m2 - Substantial changes to external envelop of existing structures (more than 50%) - Substantial increase in bulk and height in relation to immediately adjacent buildings (more than 50%) **Category D: High intensity development** - Rezoning of a site in excess of 10 000m2 - Linear development in excess of 300m. - Any development changing the character of a site exceeding 5000m2 or involving the subdivision of a site into three or more erven. - Substantial increase in bulk and height in relation to immediately adjacent buildings (more than 100%)

11.4 Management and Mitigation Actions

The following table provides a guideline of relevant heritage resources management actions is vital to the conservation of heritage resources.

No further action / Monitoring
Where no heritage resources have been documented, heritage resources occur well outside the impact zone of any development or the primary context of the surroundings at a development footprint has been largely destroyed or altered, no further immediate action is required. Site monitoring during development, by an ECO or the heritage specialist are often added to this recommendation in order to ensure that no undetected heritage\ remains are destroyed.
Avoidance
This is appropriate where any type of development occurs within a formally protected or significant or sensitive heritage context and is likely to have a high negative impact. Mitigation is not acceptable or not possible. This measure often includes the change / alteration of development planning and therefore impact zones in order not to impact on resources.
Mitigation
This is appropriate where development occurs in a context of heritage significance and where the impact is such that it can be mitigated to a degree of medium to low significance, e.g. the high to medium impact of a development on an archaeological site could be mitigated through sampling/excavation of the remains. Not all negative impacts can be mitigated.
Compensation
Compensation is generally not an appropriate heritage management action. The main function of management actions should be to conserve the resource for the benefit of future generations. Once lost it cannot be renewed. The circumstances around the potential public or heritage benefits would need to be exceptional to warrant this type of action, especially in the case of where the impact was high.
Rehabilitation
Rehabilitation is considered in heritage management terms as a intervention typically involving the adding of a new heritage layer to enable a new sustainable use. It is not appropriate when the process necessitates the removal of previous historical layers, i.e. restoration of a building or place to the previous state/period. It is an appropriate heritage management action in the following cases: - The heritage resource is degraded or in the process of degradation and would benefit from rehabilitation. - Where rehabilitation implies appropriate conservation interventions, i.e. adaptive reuse, repair and maintenance, consolidation and minimal loss of historical fabric. - Where the rehabilitation process will not result in a negative impact on the intrinsic value of the resource.
Enhancement
Enhancement is appropriate where the overall heritage significance and its public appreciation value are improved. It does not imply creation of a condition that might never have occurred during the evolution of a place, e.g. the tendency to sanitize the past. This management action might result from the removal of previous layers where these layers are culturally of low significance and detract from the significance of the resource. It would be appropriate in a range of heritage contexts and applicable to a range of resources. In the case of formally protected or significant resources, appropriate enhancement action should be encouraged. Care should, however, be taken to ensure that the process does not have a negative impact on the character and context of the resource. It would thus have to be carefully monitored

APPENDIX C4 -
PALEONTOLOGICAL IMPACT ASSESSMENT

MATERIAL SOURCES FOR UPGRADE OF NATIONAL ROUTE 1 (SECTION 16) FROM ZANDKRAAL TO WINBURG SOUTH, FREE STATE PROVINCE

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1. EXECUTIVE SUMMARY

The South African National Roads Agency SOC Limited (SANRAL) is proposing to exploit road material from a series of twelve borrow pits and two quarries in the vicinity of the National Route 1 (Section 16) from Zandkraal (km 33.8) to Winburg South (km 78.0) in the Brandfort & Winburg Districts of the Free State Province.

All 27 of the potential quarry and borrow pit sites under consideration are very largely or entirely underlain by Early Jurassic Karoo dolerite which is the main target for quarrying operations. Small surface exposures of channel sandstones assigned to the Late Permian Normandien Formation (Lower Beaufort Group) are encountered at a few sites, but generally the Karoo Supergroup sedimentary bedrocks are entirely mantled by Late Caenozic soils, doleritic gravels and alluvium. The Karoo dolerites themselves are unfossiliferous igneous rocks, although they may locally contain sizeable enclosures or xenoliths of Karoo Supergroup sediments (*e.g.* in Bell's Pass near Winburg), while intrusion of hot dolerite magma may well have compromised fossil heritage originally preserved within the surrounding country rocks through baking and injection of hot fluids.

No fossil vertebrates, trace fossils or *in situ* plant remains were recorded during fieldwork at any of the quarry and borrow pit study sites, either within the Karoo bedrocks or overlying superficial sediments. The only fossils recorded here are sparse to locally common small blocks of petrified wood weathered-out of the Beaufort Group bedrocks and incorporated into local soils and alluvial deposits. Such reworked, fragmentary wood fossils are probably ubiquitous at or near-surface within this region of the Free State Province and in themselves are of very limited scientific importance – in contrast to the large, almost intact petrified tree trunks that are well-known from the Winburg – Senekal area. Thicker alluvial deposits – seen, for example in the southern portion of the QAlt to 1A & 1B study area (Farm Ceylonia 1358) – may *potentially* contain Late Caenozoic vertebrate remains (*e.g.* mammalian bones & teeth) as well as reworked fossil wood, although no such remains have as yet been recorded here.

It is concluded that all of the quarry and borrow pit material sources under consideration are of overall low to very low palaeontological sensitivity. This assessment applies to all 27 of the sites assessed here, and there is no marked preference for, or objection against, any particular pit site or sites on palaeontological heritage grounds. However, should the QAlt to 1A & 1B quarry site (Farm Ceylonia 1358) be selected for exploitation, any substantial excavations into potentially sensitive alluvial sediments along the drainage line in the southern portion of the site or close to the proposed access road (area outlined in pale blue in Fig. 8 herein) should be monitored by the

ECO on an on-going basis for fossil remains such as blocks of petrified wood or mammalian bones and teeth.

In the case of any significant fossil finds exposed by access road building, quarry or borrow pit excavations during development, these should be safeguarded - preferably *in situ* - and reported by the ECO as soon as possible to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). This is so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented *before* rehabilitation of the access road cuttings, quarries or borrow pits takes place (Please refer to the tabulated Chance Fossil Finds Procedure attached to this report). These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed quarry and borrow pit developments.

2. INTRODUCTION & BRIEF

The South African National Roads Agency SOC Limited (SANRAL) is proposing to upgrade the National Route 1 (Section 16) from Zandkraal (km 33.8) to Winburg South (km 78.0) in the Brandfort & Winburg Districts of the Free State Province. The Environmental Authorisation (EA) for the road upgrade itself has already been authorised by the Department of Environmental Affairs (DEA). In addition, environmental authorisation is required for a proposed series of twelve borrow pits and two quarries in the vicinity – to selected from among the sites listed in Tables 1 and 2 below - that will be exploited as material sources for the planned road upgrade (See als map Fig. 1). The material sources will be utilised for natural / crushed gravel for earthworks, layer works, asphalt and concrete layers. Asphalt and concrete aggregate may be sourced from the quarries, while gravel materials will be sourced from the borrow pits.

EOH Coastal and Environmental Services (EOH CES) has been appointed by SANRAL as the Environmental Assessment Practitioner (EAP) to apply for the required Environmental Authorisation from the Department of Mineral Resources (DMR) for the proposed quarries and borrow pits (Contact details: Mr Roberto Almanza, EOH Coastal & Environmental Services. Address: 13 Stanley Street, Richmond Hill, Port Elizabeth. Tel: +27 (41) 585 1715. Cell: +27 (82) 930 8711. E-mail: roberto.almanza@eoh.co.za).

SANRAL has appointed the company SMEC South Africa as project managers for the road development (Contact details: Ms Lizmary Alfirs. SMEC. Address: 23, Second Avenue, Bloemfontein, 9301. Tel: 051 411 8700. E-mail: Lizmary.alfirs@smec.com). Since the proposed quarries and borrow pits may impact potentially fossiliferous bedrocks of the Karoo Supergroup, the present combined desktop and field-based palaeontological heritage assessment (PIA) has been commissioned by SMEC South Africa as part of the full Scoping and EIA process, as per the National Environmental Management Act (NEMA) (Act No. 107 of 1998, as amended) Amended EIA Regulations (2017), to be submitted to the DMR.

The brief for the palaeontological study, as defined by SANRAL, includes the following:

• Determination of the likelihood of paleontological remains of significance on the proposed site and surrounds;

• Identification and mapping (where applicable) of the location of any significant remains referred to above;

• Assessment of the sensitivity and significance of paleontological remains on the site and surrounds;

• Suggested measures to mitigate any negative impacts to paleontological remains during the construction and operational phases of the proposed project;
• Identification and assistance with application of any relevant permits;
• Preparation of a written report on the above.

Table 1. Original list of proposed quarries and borrow pits to be exploited as material sources for the planned upgrade of the N1 (Section 16) between Zandkraal and Winburg, Free State (Table provided by SANRAL). Further site options considered for this palaeontological study are showing in Table 2.

ID	Source	Area (ha)	Property Description	Type
1	BP 39.6	7.29	Kleinfontein 859	Borrow Pit
2	BP 42.7	13.86	Die Pan 1034	Borrow Pit
3	BP 44.6	6.83	Graspan 553	Borrow Pit
4	Q 50.6 (Q2)	19.01	Brandkop 1594	Quarry
5	BP 51.0	19.46	Tweefontein 66	Borrow Pit
6	BP 52.8	22.8	Helpman 1438	Borrow Pit
7	BP 56.3	10.27	Welgevondon 64	Borrow Pit
8	BP 57.3	9.5	Kraal 62	Borrow Pit
9	BP 64.2	12.78	Welkom 55	Borrow Pit
10	BP 67.3	5.76	Pleasant View 1356	Borrow Pit
11	BP 72.7	6.23	Kruidbaden 1245	Borrow Pit
12	BP 73.8	8.04	Kruidbaden 1245	Borrow Pit
13	Q 77.5 (Q1B)	18.64	Rietfontein 18	Quarry
14	BP 77.7	10.81	Hartplaats 17	Borrow Pit

Table 2: Summary of all quarry and borrow pit sites considered as potential material sources for the N1 (Section 16) road project.

SITE	Alternative designation	FARM	GEOLOGY	FOSSIL HERITAGE
			QUARRY SITES	
Q1A		De Haartplaats 17	Karoo dolerite plateau (major sill) with good exposure of bedrock at surface, downwasted surface gravels. Local evidence of shallow bedrock quarrying.	
Q1B		Rietfontein 18	Plateau-like area underlain at or near surface by Karoo dolerite (finely-jointed), coarse doleritic surface gravels.	
Q1B Alt		Rietfontein 18	Karoo dolerite – low bouldery ridge with grassy *vlaktes* around margins. Surface gravels in latter area of dolerite and sparse quartzite, with local concentrations of boulders and blocks. Dolerite shows zones of finely-spaced, steep fractures. Existing gulley-like excavations show finely-jointed or fractured, weathered dolerite overlain by gravelly lateritic soils. Sparse dolerite stone artefacts.	
Q Alt to 1A &1B		Ceylonia 1358	Karoo dolerite with extensive surface exposure, locally displaying columnar jointing, vertical sheet jointing. Rubbly dolerite gravels on plateau. Pale sandy alluvium along NW-SE drainage line in southern portion of site.	Reworked blocks of petrified wood and other fossilsmay occur within thick alluvial sediments (but not recorded).
Q2		Brandkop 1594, Grisella 1595	Karoo dolerite. Extensive existing quarry exposures. *Possible* columnar jointing in quarry cut face.	
Q2 Alt		Verkeerde Vley 59	No bedrock exposure at N foot of dolerite ridge. Surface gravels mainly of dolerite pebbles & cobbles, occasional reddish-brown quartzite clasts, often well-rounded.	Sparse small blocks of silicified wood in surface gravels.
			BORROW PIT SITES	
BP2A	BP 39.6	Kleinfontein 859	Karoo dolerite building bouldery ridge to E side of site with some areas probably underlain by Normandien Fm sandstone (flaggy surface blocks). Surface gravels of dolerite, pale feldspathic sandstone, pale hornfels.	Sparse small blocks of silicified wood in surface gravels within borrow pit and access road footprint.
BP2B		Kleinfontein 859	Karoo dolerite overlain by gravelly soils. Locally low exposures of pale brown, gritty Normadien channel sandstone with angular to subrounded feldspathic and quartz clasts.	
BP5	BP 56.3	Welgevonden 64	Karoo dolerite. Pale baked Normandien sandstone at surface on NE margins of existing borrow pit. Large (m-scale) oblate concretions of dark brown ferruginous carbonate weathering out in vicinity but no surface exposure of mudrocks observed.	Sparse small blocks of silicified wood in surface gravels near existing borrow pit.
BP6	BP 57.9	Kraal 62	Extensive existing pit excavated into dolerite and baked Normandien Fm sandstones. Exposures of feldspathic sandstone at pit edge partially mantled with gravelly to sandy diamictite (possibly artificial). Well-jointed dolerite exposed in deeper levels of pit, stream gulley, mantled in sandy soil and gravels.	
BP7	BP 64.2	Welkom 55	Karoo dolerite underlain by Normandien cross-bedded, thin- to medium-bedded channel sandstone at depth (as seen in banks of Groot-Vetrivier). Sandstone reported on western site margin. Dark hornfels stone artefacts observed along the river banks.	

BP8	BP 67.3	Pleasant View 1356	Karoo dolerite. Good exposures of weathered, pale yellow-brown Normadien channel sandstones, medium- to thick-bedded, on southern site margins (possibly karstified). Sandstone beds is massive or showing well-developed tabular cross-bedding (palaeocurrents to SW), thin mudrock intraclast breccias. Sandstone locally coarsely gritty (larger clasts of quartz and kaolinitised feldspar). Underlain by friable grey-green mudrocks cut by dyke of well-jointed dolerite.	Sparse small blocks of silicified wood in surface gravels.
BP11	BP 44.5	Graspan 553	Karoo dolerite exposed in margins of existing borrow pit. Surface blocks of pale grey-green baked mudrock and fine sandstone. Surface gravels of dolerite in disturbed area, including large rounded corestones.	
BP12	BP 44.6	Graspan 553	Karoo dolerite, locally showing well-developed corestone and onionskin weathering. Gently-sloping grassy area with no bedrock exposure. Surface blocks of dolerite and flaggy, brown-weathering baked feldspathic sandstone.	
BP13	BP 42.2	Die Pan 1034	Coarse doleritic surface gravels, also ferruginised sandstone. Mudrock reported in some test pits.	
BP14	BP 42.7	Die Pan 1034	Karoo dolerite. Flat terrain without bedrock exposure. Sparse surface gravels of grey-green siltstone, dolerite (incl. rounded corestones). Mudrock recorded from edge of site.	
BP15	BP 51.0	Tweefontein 66	Karoo dolerite. Weathered material extensively exposed in existing shallow borrow pit.	
BP16		Tweefontein 66	Karoo dolerite, extensive surface exposure, locally with finely-spaced jointing.	Sparse small blocks of silicified wood weathering out of thick soils in vicinity.
BP17	BP 72.7	Kruidbaden 1245	Karoo dolerite with surface exposure.	
BP18		Kruidbaden 1245	Karoo dolerite. Thick sandy to sparely gravelly soils over parts of site. Local development of pale nodular calcrete.	
BP19	BP 73.8	Kruidbaden 1245	Kranz / low cliff of weathered, gritty, feldspathic Normanien Formation large-scale cross-bedded channel sandstone on SE margins of site. Underlies and cross-cut by Karoo dolerite of main site (sandstone body may be xenolithic). Alluvial sands and surface gravels to SE of pit area (close to access road) contain resistant reworked clasts of hornfels (some flaked), petrified wood, agates, vein quartz.	Small reworked blocks of silicified wood within sandy alluvium close to footprint of access road.
BP20		Kruidbaden 1245	Karoo dolerite and downwasted doleritic rubble on plateau.	
BP21		Tafelkop 52	Karoo dolerite with surface exposure on small *koppie*.	
BP22	BP 72.4	Kruidbaden 1245	Karoo dolerite, downwasted doleritic rubble.	Small reworked blocks of silicified wood along access road just N of pit site.
BP23	BP 77.7	De Haartplaats 17	Karoo dolerite with mudrock recorded locally. Coarse colluvial gravels of dolerite.	
BP24		De Haartplaats 17	Karoo dolerite and colluvial rubble on SE-facing hillslope (including some hornfels clasts). Pale brown Normandien channel sandstone body (massive to horizontally-laminated to ripple cross-laminated) at higher elevation (possibly enclosed as large xenolith by dolerite, as seen nearby in Bell's Pass).	Surface etching of Normandien channel sandstones by lichen colonies.
BP25	BP 52.8	Helpman 1438	Karoo dolerite. Good cutface section in existing quarry through weathered dolerite cross-cut by thin later doleritic dyke.	

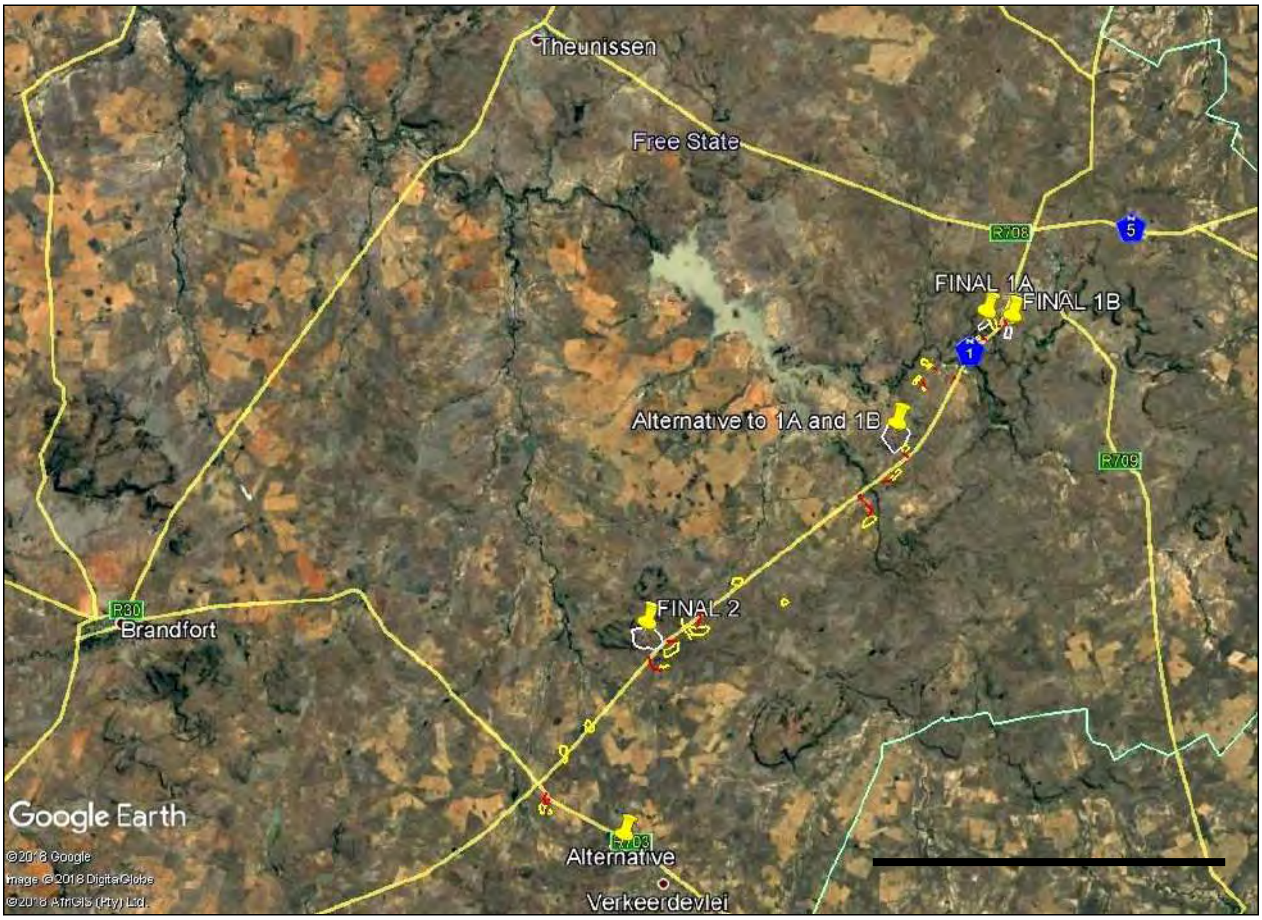


Figure 1. Google Earth© satellite image showing the various quarry and borrow pit sites under consideration as material sources for the upgrading of the N1 (Section 16) between Zandkraal and Winburg, Free State Province (yellow polygons). The sites are shown in more detail and identified by number in Figures 2 to 10 below. Scale bar = 20 km. N towards the top of the image.

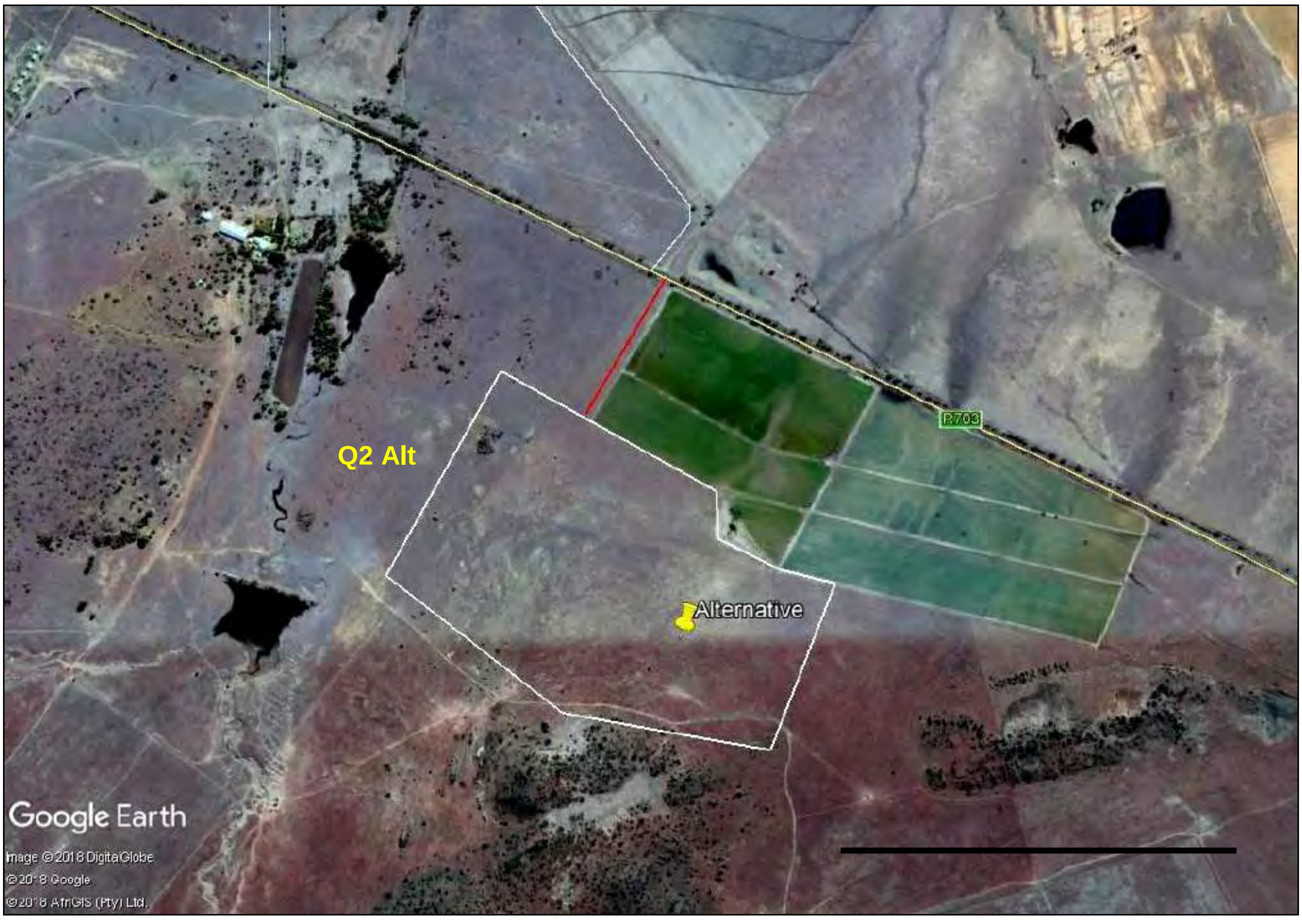


Figure 2. Google Earth© satellite image showing the Quarry 2 Alternative site on farm Verkeerde Vley 59 (white polygon) (Scale bar = 800 m). Access roads shown in red.

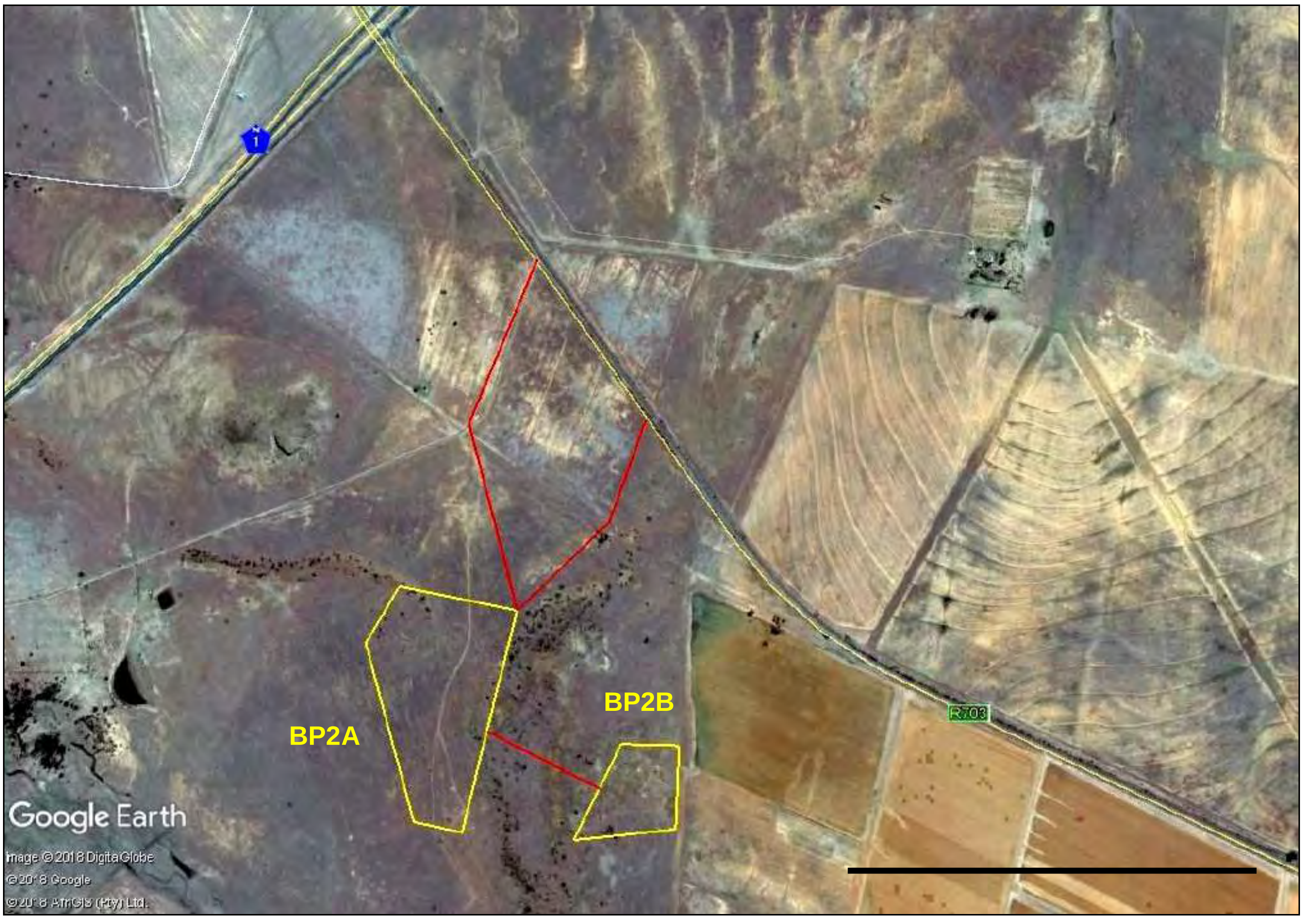


Figure 3. Google Earth© satellite image showing the BP2A & BP2B sites on farm Kleinfontein 859 (yellow polygons) (Scale bar = 900 m). Access roads shown in red.

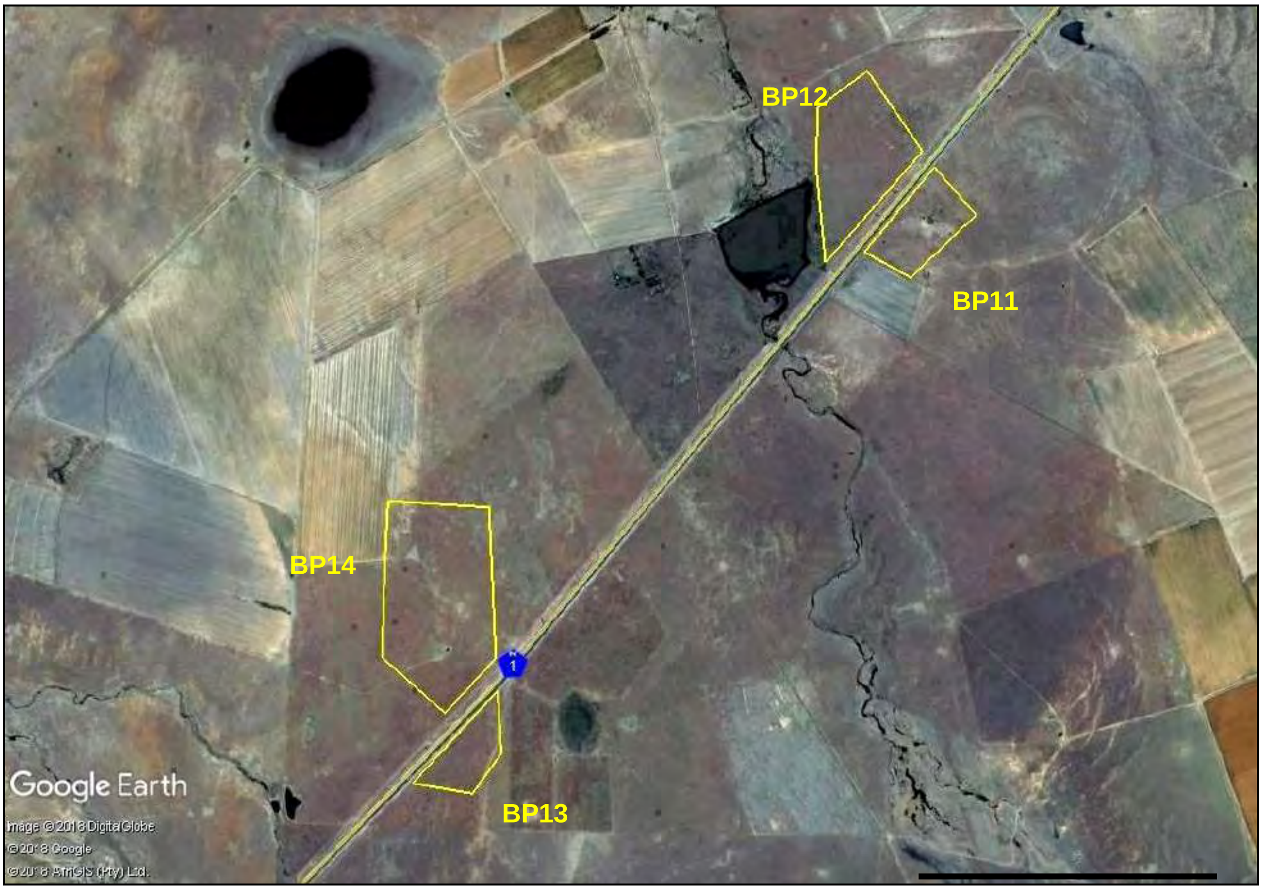


Figure 4. Google Earth© satellite image showing the BP11-BP14 sites on farms Die Pan 1034 and Grasspan 553 (yellow polygons) (Scale bar = 1 km).

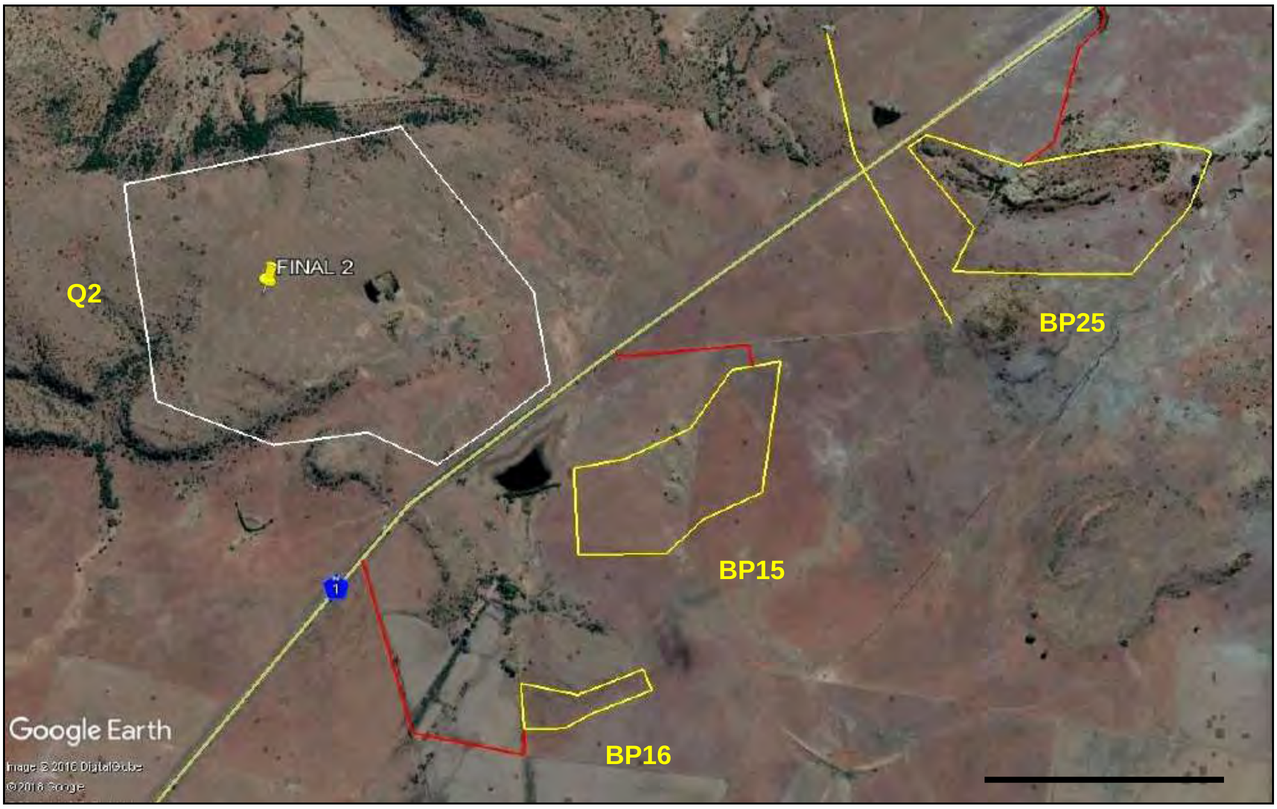


Figure 5. Google Earth© satellite image showing the BP15, BP16, BP25 & Q2 sites (yellow & white polygons) on farms Tweefontein 66, Brandkop 1594 and Helpman 1438 (Scale bar = 1 km). Access roads shown in red.

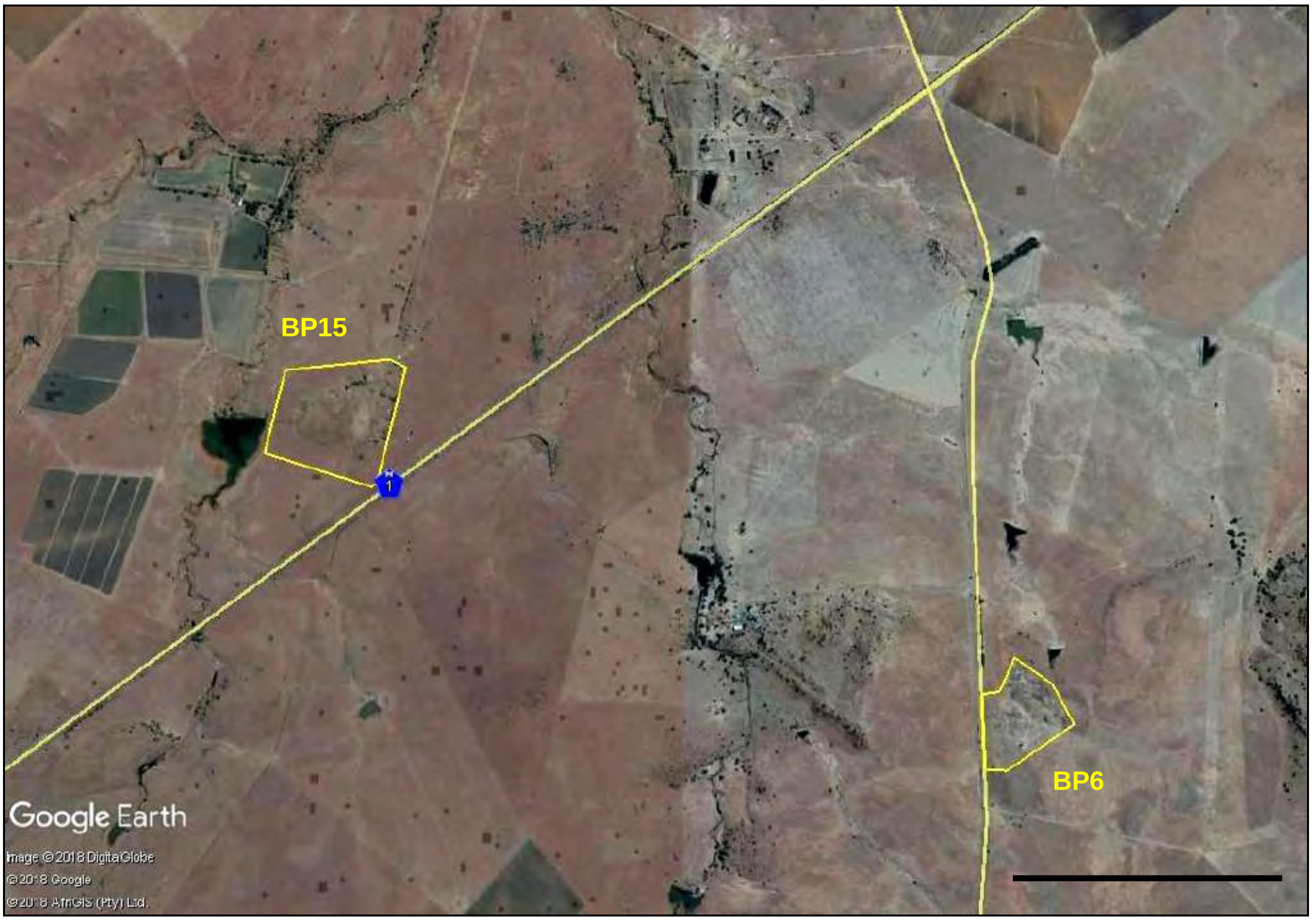


Figure 6. Google Earth© satellite image showing the BP5 & BP6 sites on farms Welgevonden 64 and Welkom 55 (yellow polygons) (Scale bar = 1 km).

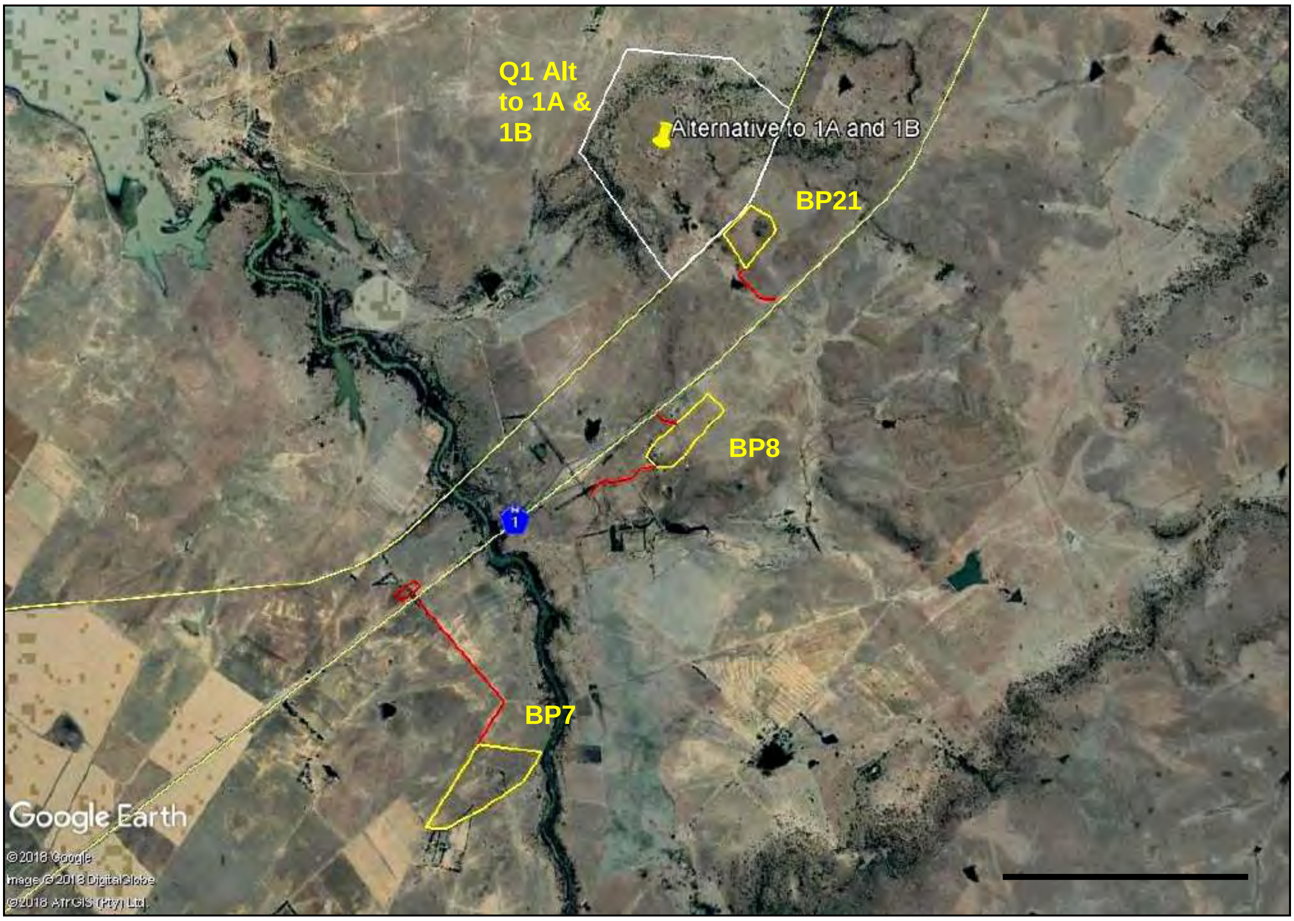


Figure 7. Google Earth© satellite image showing the BP7, BP8 and BP21 sites as well as the Q1 Alt to 1A & 1B quarry site (yellow and white polygons) (Scale Bar = 3 km). Access roads shown in red. The Groot-Vetrivier seen here flows northwards into the Erfenis Dam.

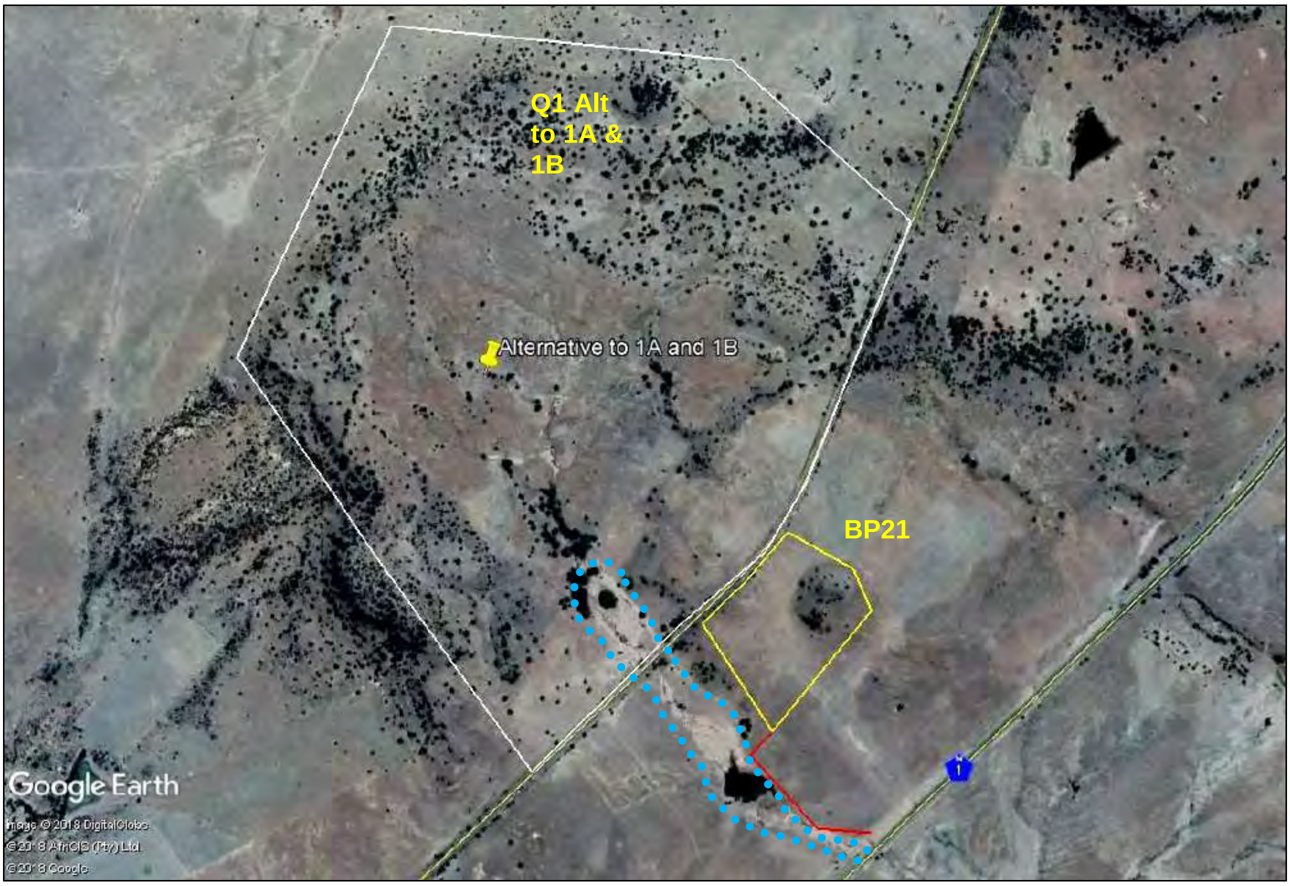


Figure 8. Google Earth© satellite image of the BP21 site as well as the Q1 Alt to 1A & 1B quarry site. Potentially-fossiliferous alluvial sediments are outlined by the pale blue dotted shape. Substantial excavations into these sediments for quarrying or access roads should be monitored by the ECO for sizeable blocks of fossil wood, mammalian bones and teeth or other fossil remains.

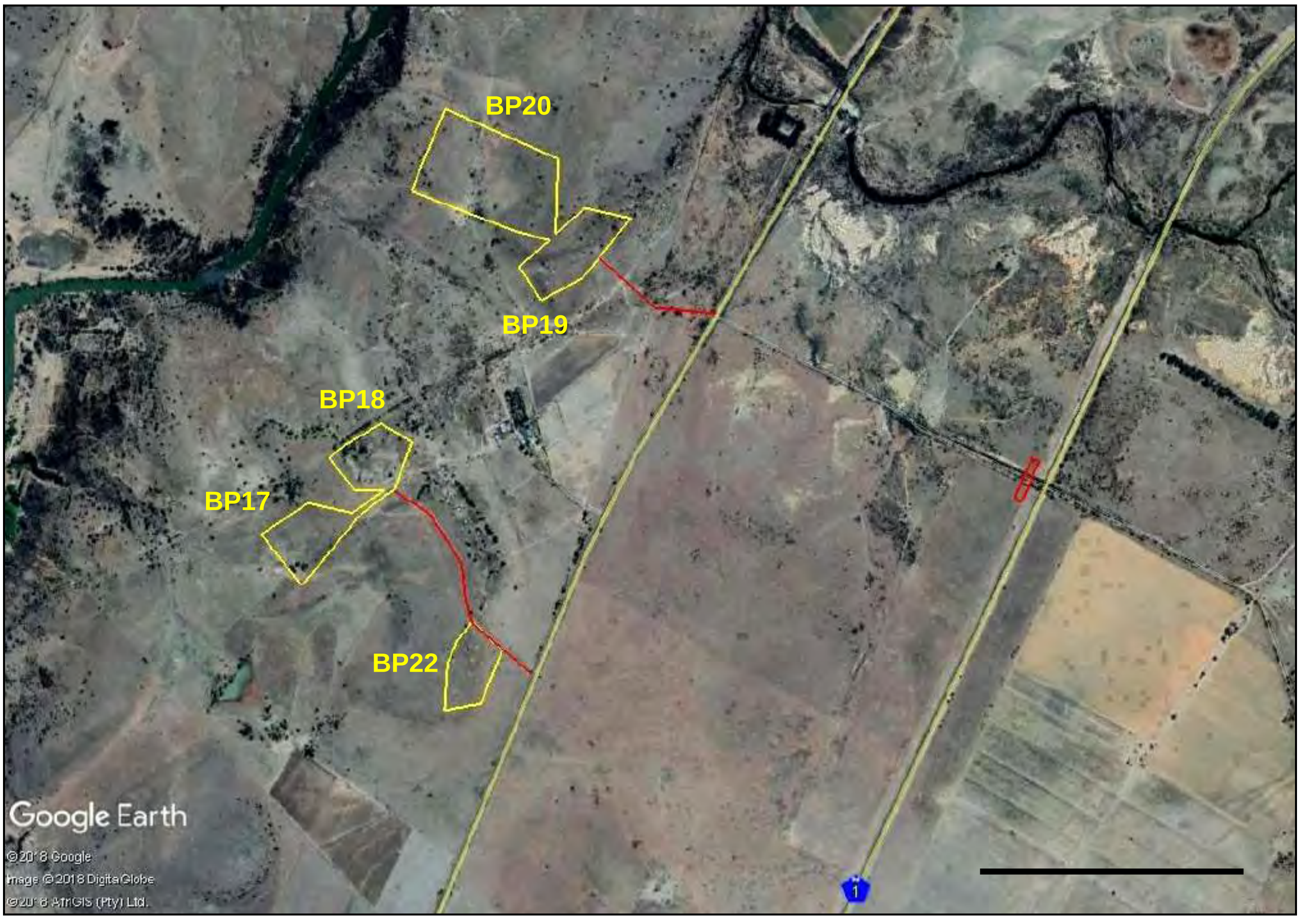


Figure 9. Google Earth© satellite image showing the BP17, BP18, BP19, BP20 and BP22 borrow pit sites (yellow polygons) (Scale bar = 1 km). Access roads shown in red.

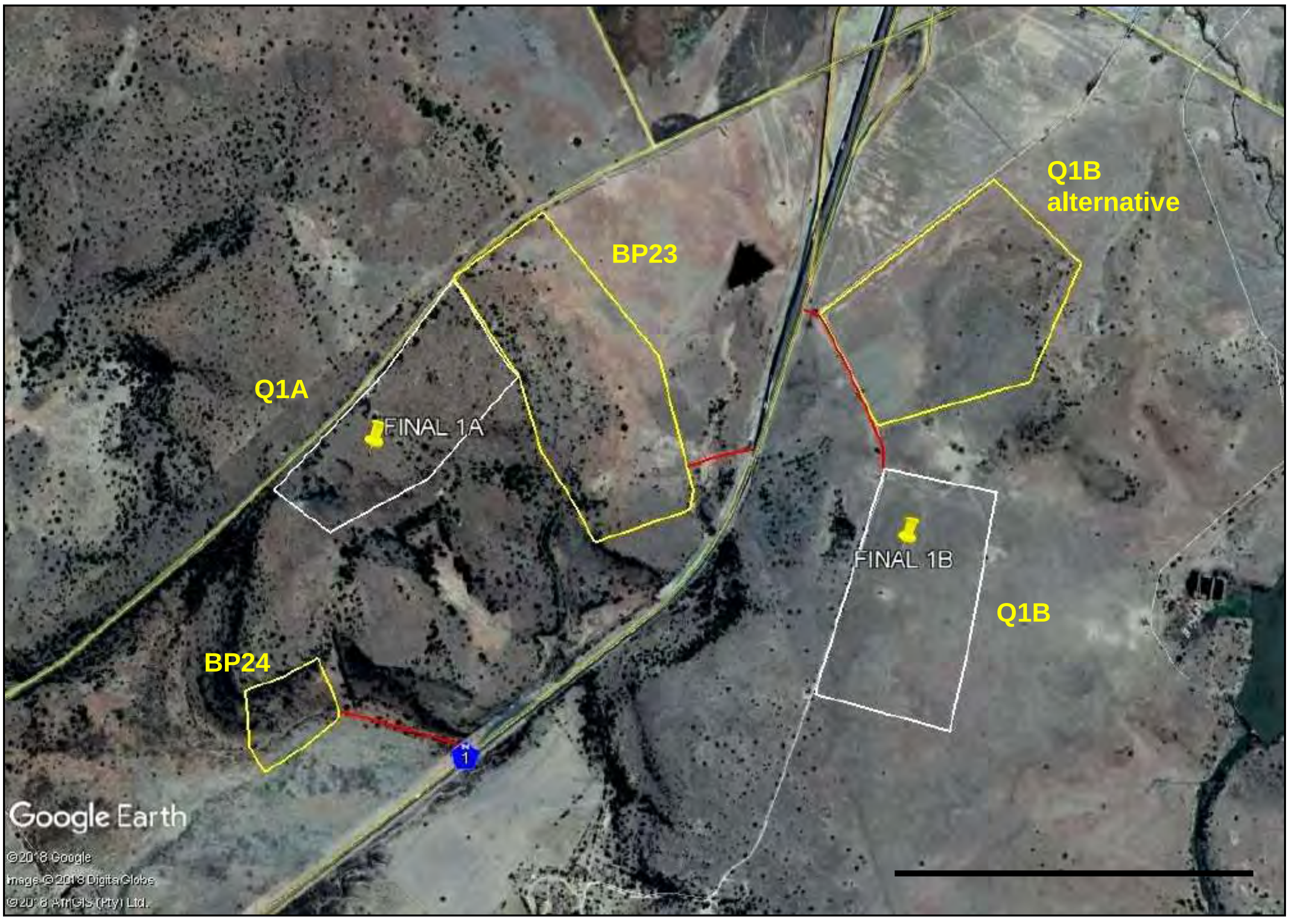


Figure 10. Google Earth© satellite image showing the BP23, BP24 borrow pit sites and Q1A, Q1B and Q1B alternative quarry sites (yellow and white polygons) (Scale bar = 1 km). Access roads shown in red.

2. APPROACH TO THE PALAEONTOLOGICAL HERITAGE STUDY

The approach to this palaeontological heritage study is briefly as follows. Fossil bearing rock units occurring within the broader study area are determined from geological maps and satellite images. Known fossil heritage in each rock unit is inventoried from scientific literature, previous assessments of the broader study region, and the author's field experience and palaeontological database. Based on this data as well as field examination of representative exposures of all major sedimentary rock units present, the impact significance of the proposed development is assessed with recommendations for any further studies or mitigation.

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations *etc*) represented within the study area are determined from geological maps and satellite images. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience. Consultation with professional colleagues as well as examination of institutional fossil collections may play a role here, or later following field assessment during the compilation of the final report. This data is then used to assess the palaeontological sensitivity of each rock unit to development. The likely impact of the proposed development on local fossil heritage is then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned and (2) the nature and scale of the development itself, most significantly the extent of fresh bedrock excavation envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a Phase 1 field assessment study by a professional palaeontologist is usually warranted to identify any palaeontological hotspots and make specific recommendations for any monitoring or mitigation required before or during the construction phase of the development.

On the basis of the desktop and Phase 1 field assessment studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Phase 2 mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological data) may be required (a) in the pre-construction phase where important fossils are already exposed at or near the land surface and / or (b) during the construction phase when fresh fossiliferous bedrock has been exposed by excavations. To carry out mitigation, the palaeontologist involved will need to apply for palaeontological collection permits from the relevant heritage management authorities, *i.e.* the South African Heritage Resources Agency, SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). It should be emphasized that, *providing appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

2.1. Information sources

The information used in this scoping palaeontological heritage study was based on the following:

1. Project and site descriptions, maps, kmz files and supporting documents provided by SMEC South Africa, Bloemfontein;

2. A review of the relevant satellite images, topographical maps and scientific literature, including published geological maps and accompanying sheet explanations, as well as several previous desktop and field-based palaeontological assessment studies in the broader Bloemfontein – Winburg region and comparable bedrocks elsewhere (*e.g.* Groenewald 2012, Almond 2014, Kibii Undated, Rossouw Undated 1-3).

3. The author's previous field experience with the formations concerned and their palaeontological heritage (See also Free State palaeotechnical report by Groenewald & Groenewald 2014).

4. A 2-day palaeontological field assessment of the various N1 borrow pit and quarry sites over the period 21 to 22 December 2018 by the author.

2.2. Assumptions & limitations

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-

truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil *etc*), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (*e.g*. of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

(a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

(b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist.

In the case of the present study area near Winburg in the Free State Province levels of natural sedimentary bedrock exposure are very limited due to extensive dolerite intrusion, mantling by superficial deposits such as alluvium and sandy soils, as well as natural grassy vegetation. However, several road cuttings, quarry and borrow pit exposures that were examined in the region during the course of the field study allow the broader palaeontological heritage sensitivity of the rock units represented within the project footprint to be assessed. Comparatively few academic palaeontological studies or field-based fossil heritage impact studies have been carried out in the region (See References). Any new palaeontological data from impact studies here are therefore of scientific interest.

All 27 of the borrow pit and quarry sites covered by this study (Tables 1 & 2, Figs. 1 to 10) were visited – albeit only briefly, given the time constraints - during the field study with the exception of BP13 on Die Pan 1034 where barbed wire fencing precluded ready access (this small site was viewed from the N1) and BP7 on Welkom 55 (the geological succession beneath the pit area could be observed, however, in the banks of the Groot-Vetrivier – see Fig. 27). The visit to the BP5 site on Welgevonden 64 was curtailed so as not to inconvenience the busy land owner, Mr J. Scott, who kindly took me there. Potentially-interesting alluvial deposits (well-seen on satellite images) towards the southern end of the QAlt to 1A & 1B site (Farm Ceylonia 1358) could not be examined due to a heavy summer downpour. These omissions are not considered to be a serious constraint for the present palaeontological heritage assessment since the geology here can be inferred from geological maps and is likely to be very similar to that encountered at nearby pit sites of very low to low palaeontological sensitivity.

2.3. Legislative context for palaeontological assessment studies

The proposed or alternative borrow pits and quarries are located in a region that is underlain by potentially fossiliferous sedimentary rocks of Permian and younger, Late Tertiary or Quaternary, age (Sections 3 and 4). The proposed developments will entail voluminous excavations into the superficial sediment cover and the underlying bedrock as well. This development may adversely affect potential fossil heritage within the study area by destroying, disturbing or permanently sealing-in fossils at or beneath the surface of the ground that are then no longer available for scientific research or other public good.

The present combined desktop and field-based palaeontological heritage study falls under the South African Heritage Resources Act (Act No. 25 of 1999). It will also inform the Environmental Management Programme (EMPr) for this project.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.

(2) All archaeological objects, palaeontological material and meteorites are the property of the State.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority—

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—

(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;

(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;

(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph *(a)* to apply for a permit as required in subsection (4); and

(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by SAHRA (2013).

3. GEOLOGICAL BACKGROUND

The study area near Bloemfontein for the N1 (Section 16) road upgrade material sources, between Zandkraal and Winburg in the Free State Province, lies within the Southern Highveld Geomorphic Province of Partridge *et al.* (2010). The predominantly grassy terrain here, situated between *c*. 1450 and 1500 m amsl, is generally flat-lying gently undulating with low *koppies* and *kranzes* of Karoo dolerite, such as Tabaksberg (1517 m amsl), Spitskop (1580 m amsl) and the highlands traversed by Bell's Pass west of Winburg (Figs. 13 to 17). The main drainage courses are the Groot- and Klein-Vetrivier and their tributaries which feed into the Erfenis Dam NW of the N1, and ultimately into the Vaal Rivier. In general exposure of the more readily-weathered sedimentary bedrocks are concerned is very poor due to extensive soil and grass or *bossieveld* cover, while good exposures of resistant Karoo dolerite are seen in several road cuttings, quarries, borrow pits and steeper hillslopes along or close to the N1. Several of the most informative road cuttings are seen in the outskirts of Winburg, including along Bell's Pass to the southwest of town. The geology of the N1 (Section 16) project area is shown on 1: 250 000 geology sheet 2820 Winburg (Council for Geoscience, Pretoria) (Figs. 11 & 12) with a short sheet explanation by Nolte (1995).

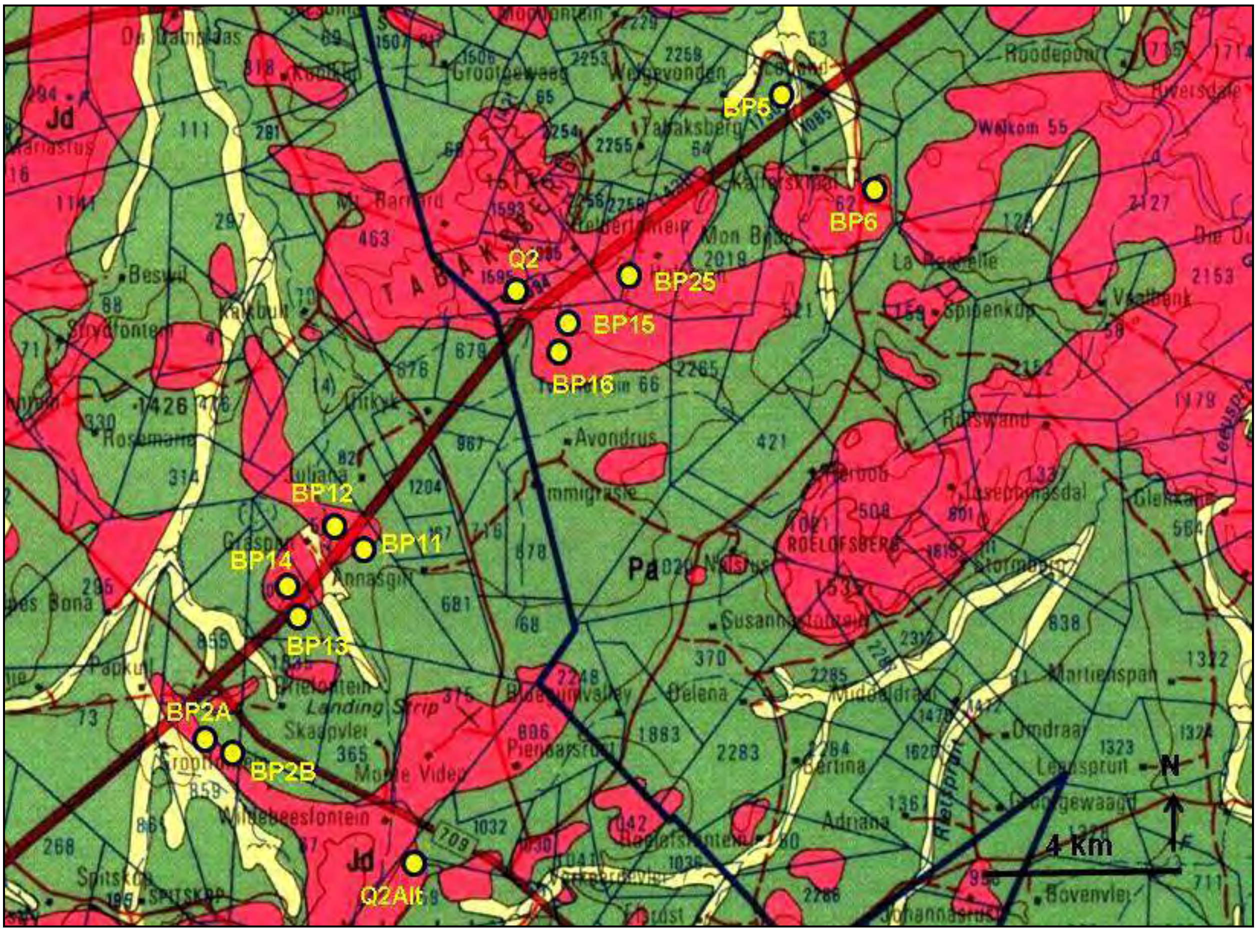


Figure 11. Extract from 1: 250 000 geology sheet 2826 Winburg (Council for Geoscience, Pretoria) showing the location of potential proposed borrow pits and quarries in the southern sector of the N1 (Section 16) study area. Note that all sites are mapped as overlying Karoo dolerite (Jd, red); the apparent exception, BP5, is in fact also largely underlain by dolerite. Natural and artificial exposures of sedimentary bedrocks of the Adelaide Subgroup (Pa, grey-green) are very limited in this region. Pale yellow areas are mantled by thick deposits of Late Caenozoic alluvial sands and gravels (flying bird symbol).

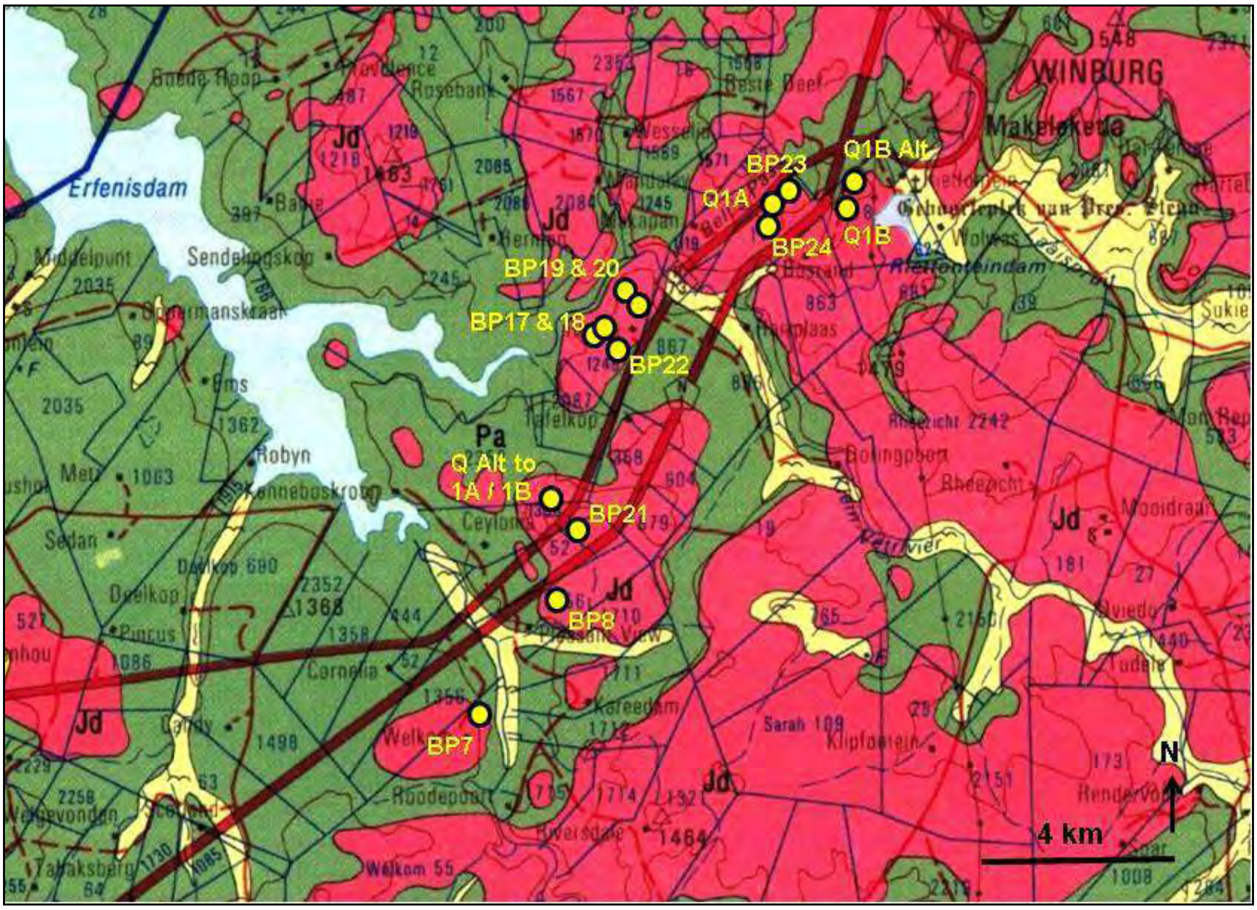


Figure 12. Extract from 1: 250 000 geology sheet 2826 Winburg (Council for Geoscience, Pretoria) showing the location of potential proposed borrow pits and quarries in the northern sector of the N1 (Section 16) study area near Winburg. Note that all sites are mapped as overlying Karoo dolerite (Jd, red). Natural and artificial exposures of sedimentary bedrocks of the Adelaide Subgroup (Pa, grey-green) are very limited in this region. Pale yellow areas are mantled by thick deposits of Late Caenozoic alluvial sands and gravels (flying bird symbol).

Figure 13. Typical low-relief terrain with little or no bedrock exposure and sparse downwasted surface gravels as encountered in many of the borrow pit and quarry study sites (here BP14).

Figure 14. Low exposure of Normandien (Lower Beaufort Group) channel sandstones in the BP2B study area.

Figure 15. View eastwards across the BP25 study area showing dolerite exposure in the foreground and background separated by featureless grassy terrain.

Figure 16. Low *koppies* of Karoo dolerite within the outcrop area of a major sill to the SE of the Erfenis Dam (QAlt to 1A & 1B study area in foreground, BP21 study area in background).

Figure 17. SE-facing escarpment formed by a major dolerite sill and minor Normandien Formation bedrocks (including xenolithic channel sandstone bodies) near BP24 study area SW of Winburg.

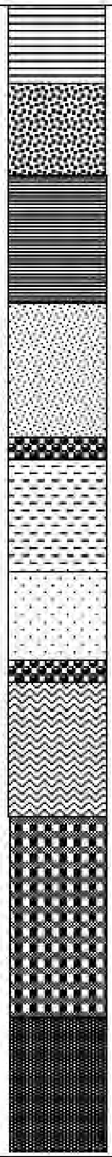
3.1. Adelaide Subgroup

The N1 (Section 16) project area lies within the northern sector of the Main Karoo Basin, to the north of the hinge line that marks the stratigraphic boundary zone between the southern and northern Karoo Supergroup successions (*cf* Hancox *et al.* 2002, their figs. 1 & 2). The Lower Beaufort Group succession here youngs broadly from WNW to ESE and is mapped as undifferentiated **Adelaide Subgroup** (Pa, grey-green in Figs. 11 & 12). It can be referred to the Middle Permian to Early Triassic **Normandien Formation** (Johnson *et al.* 2006, their Fig. 3) which comprises some 100-320 m of deltaic to fluvial and lacustrine mudrocks (grey, grey-green, red) and impure, prominent-weathering sandstones that crop out in the northern Free State and western KwaZulu-Natal. Key accounts of the Normandien succession are given by Groenewald (1984, 1989) as well as Johnson and Verster (1994), with useful summaries given by Johnson *et al.* (2006) and Groenewald (2012a).

Figure 18 below, taken from Groenewald (2012a), shows the stratigraphic subdivision of the Normandien Formation into several members of contrasting lithology, sedimentology and palaeontological content. These members have not been mapped within the present study area near Winburg, however. This area lies geographically approximately half way between the mapped base of the Adelaide Subgroup (here unconformably overlying the Tierberg Formation of the Ecca Group) and the base of the Verkykerskop Formation of the Tarkastad Subgroup (documented, for example, at Senekal by Hancox *et al.* 2002). Therefore the bedrocks here probably belong to the middle portion of the Normandien Succession (*cf* Rooinek – Schoondraai Members). According to the most recent biostratigraphic zonation map of the Main Karoo Basin, the Adelaide Subgroup bedrocks between Bloemfontein and Senekal are referred to the Late Permian *Dicynodon*

Assemblage Zone, recently renamed the *Daptocephalus* Assemblage Zone (Viglietti *et al.* 2015, Viglietti 2016) (Section 4).

According to Nolte (1995) the Normandien Formation (Adelaide Subgroup) in the Winburg 1: 250 000 sheet area consists of alternating packages of tabular-bedded, blue-grey overbank mudrocks (Fig. 51) and pale brown lenticular channel sandstones. Large (m-scale) oblate ferruginous carbonate concretions commonly occur within sandstone facies low down in the succession (Fig. 20). The sandstone facies are markedly immature (coarse-grained, feldspathic, poorly-sorted) and locally contain well-rounded to angular extra-basinal clasts up to 5 cm in diameter composed of basement lithologies (granite, gneiss, quartzite) as well as mudrock intraclasts. Sedimentary structures include horizontal lamination, tabular cross-bedding with a few ripple cross-laminated beds as well (Figs. 21 to 27). Palaeocurrents are predominantly towards the west and a nearby granitic provenance in the east or southeast is inferred. The sedimentology of the uppermost Normandien Formation and its erosional contact with the overlying Verkykerskop Formation near Senekal, *c*. 60 km east of Winburg, has been described in detail by Hancox *et al.* (2000).



Burgersdorp/Driekoppen Formation. Red mudstone and thin yellow-brown sandstone. Cynognathus Assemblage Zone vertebrate fossils and trace fossils.
Katberg/Verkykerskop Formation. Coarse-grained sandstone with manganese enriched conglomerates – Braided River Fluvial deposit. No record of fossil finds to date.
Harrismith Member – Normandien Formation. Brightly coloured siltstone – highly dissipating and expansive. Concretions with numerous fossils of Lystrosaurus Assemblage Zone material and vertebrate burrows
Schoondraai Member – Normandien Formation. Fine to medium-grained sandstone with prominent conglomerate of granitic pebbles at the base. Large scale petrified tree fossils of Glossopteris and very thin coal beds.
Green and grey mudstone and siltstone with prominent concretions of Calcium and Gypsum. Fossils of plants and coal beds in upper layers and very productive vertebrate fossil layers of the Dicynodon Assemblage Zone.
Rooinek Member – Normandien Formation. Coarse-grained fluvial feldspathic sandstone with basal conglomerates, fossil trees of Glossopteris and coal beds.
Green and grey mudstone and siltstone with thin coal beds. Fluvial crevasse splay deposits with micro cross-bedding in silt deposits. Trace fossils abundant on sandstone bedding planes. (Fossil remains of Rhachiocephalus recorded towards the west where weathering is not as severe as along the escarpment).
Frankfort Member – Normandien Formation - Dark grey shale and siltstone, interbedded with lenses of deltaic very coarse-grained feldspathic sandstone deposits of up to 20 m thick. Lenses of sandstone discontinuous over 500 m. Plant fossils of Glossopteris abundant. Prominent but discontinuous coal beds and abundant trace fossils on bedding planes of sandstones, siltstones and mudstones. No vertebrate remains recorded to date.
Volksrust Formation – Ecca Group. Dark grey shale – deep water sedimentary deposits with very little recorded evidence of vertebrate life. Trace fossils recorded in the upper part of the formation.

Figure 18. Stratigraphic subdivision of the Beaufort Group in the northern Free State showing the various subunits recognised within the Normandien Formation (Adelaide Subgroup) (From Groenewald 2012a). Bedrocks in the present study area near Winburg are probably referable to the central part of the Normandien succession.

Figure 19. Rare exposure of hackly, grey-green Normandien Formation mudrocks, here capped by a dolerite sill, road cutting on southern outskirts of Winburg (Hammer = 30 cm).

Figure 20. Large oblate sphaeroidal nodules of rusty-brown diagenetic ferruginous carbonate weathered out from the Normandien Formation, area just N of BP5 study area (Hammer = 30 cm).

Figure 21. Good riverine exposures of Normandien Formation channel sandstone body showing large-scale cross-bedding, Klein-Vetrivier SW of Winburg.

Figure 22. Tabular cross-bedded gritty channel sandstone of the Normandien Formation, road cutting near SW corner of QAlt to 1A & 1B site (Hammer = 30 cm). Palaeocurrents due SW.

Figure 23. Channel sandstone body of the Normandien Formation enclosed as xenolith within a major dolerite sill, road cutting along Bell's Pass, SW of Winburg.

Figure 24. Large-scale tabular cross-sets (SW-palaeocurrents) within gritty Normandien Formation channel sandstone, BP19 study area (Hammer = 30 cm).

Figure 25. Normandien Formation cross-bedded channel sandstone exposed along the SW margins of the BP9 study area (Hammer = 30 cm).

Figure 26. Close-up of immature, gritty, feldspathic Normandien chanel sandstone facies seen above showing kaolinitised feldspar clasts up to 1 cm long.

3.2. Karoo Dolerite Suite

The Lower Beaufort Group succession near Winburg is extensively intruded by dolerites of the **Karoo Dolerite Suite** (Jd, red in Figs. 11 and 12). The Karoo dolerites form part of a suite of basic igneous bodies (dykes, sills, sheets and irregular bodies) that were intruded into sediments of the Main Karoo Basin in the Early Jurassic Period, about 183 million years ago (Duncan & Marsh 2006). They form part of the Karoo – Ferrar Igneous Province of Southern Africa and Antarctica that developed in response to crustal doming and stretching preceding the break-up of Gondwana (*cf* Pálfy & Smith 2000, Jourdan *et al.* 2005). According to Nolte (1995) dolerite intrusion in the Winburg 1: 250 000 sheet area is most highly developed within the Beaufort Group succession of the Karoo Supergroup. Close to the margins of the intrusions the country mudrocks have been thermally metamorphosed or baked to form tough, splintery hornfels; Beaufort Group mudrocks are typically bleached within the thermal aureole of the intrusions. Karoo dolerite occurs at or near surface in all of the borrow pit and quarry sites investigated and these basic igneous rocks are the primary target for material sources for the N1 (Section 16) road project (Figs. 27 to 35).

Figure 27. View across the Groot-Vetrivier NW into the BP7 study area showing a thick dark brown, rubbly dolerite sill overlying a paler, well-bedded channel sandstone of the Normandien Formation.

Figure 28. Probable dolerite dyke intruding Normandien Formation country rocks just SW of the BP8 study area.

Figure 29. Cut face of existing quarry in the Q2 study area showing dolerite bedrocks with well-developed vertical sheet-like jointing.

Figure 30. Surface exposures of the top of a major dolerite sill in the Q1 study area.

Figure 31. Possible small-scale columnar jointing within a major dolerite sill, QAlt to1A &1B study area.

Figure 32. Quarry exposure of well-jointed, weathered dolerite bedrocks overlain by corestones and orange-brown lateritic soils, possible replacement site for Q1B near Winburg.

Figure 33. Cut face in existing quarry, BP25 study area showing deeply-weathered massive dolerite (*sabunga*) cut by an inclined dolerite dyke with fresher dolerite at surface.

Figure 34. Well-developed dolerite corestone weathering, BP11 study area (Hammer = 30 cm).

Figure 35. Rubbly downwasted dolerite corestones overlying a major dolerite sill on the southern outskirts of Winburg, possible Q1B replacement site.

3.3. Late Caenozoic superficial deposits

Thick (several-m) *donga*-eroded, semi-consolidated, gravelly to sandy alluvial deposits typically occur along major drainage lines where they may be partially cemented by calcrete. Some of these older alluvial, or mixed alluvial and colluvial deposits can be broadly referred to the Pleistocene - Holocene **Masotcheni Formation** that is widely recognised in the Eastern Cape, Free State and KwaZulu-Natal (*cf* Botha *et al.* 1990, Botha 1992, Partridge *et al.* 2006, Evans 2015). Good examples of these deposits can be seen along the Klein-Vetrivier to the southwest of Winburg (Fig. 36). They will not be directly impacted by the proposed exploitation of road materials, with the possible exception of some new access roads (*e.g.* to BP19 & 20) and pale deposits seen on satellite images in the southern sector of Q Alt to 1A & 1B site (Fig. 8).

Other common to pervasive Late Caenozoic superficial sediments encountered in the study region include (1) poorly-sorted, rubbly colluvial **scree** on steeper hillslopes that is usually dominated by subangular to well-rounded blocks and corestones of rusty-brown dolerite (Fig. 35), occasionally with an admixture of feldspathic Normandien sandstone and locally calcretised, as well as (2) **sandy soils** with a sparse admixture of gravel clasts (Figs. 13, 20 & 37). These last are mainly composed of dolerite and sandstone with minor hornfels, vein quartz, agate (weathered out from dolerite intrusions) and cherty petrified wood (See Section 4).

Figure 36. Extensive, gulley-eroded sediments of the Klein-Vetrivier just east of the BP19 & 20 study area. Calcretised older alluvium in such areas might contain fossil mammal remains.

Figure 37. Sparsely gravelly alluvial deposits close to the proposed access road to the BP19 & 20 study areas. The gravels include small reworked blocks of petrified fossil wood (See Fig. 41).

4. PALAEONTOLOGICAL HERITAGE

The upper part of the Lower Beaufort Group (Adelaide Subgroup) succession in the Winburg – Senekal area, represented here in the northern part of the Main Karoo Basin by the Normandien Formation, is characterised by latest Permian fossil biotas of the *Dicynodon* Assemblage Zone (Rubidge 1995, Van der Walt *et al.* 2010) which has recently been revised and renamed the *Daptocephalus* Assemblage Zone (AZ) (Viglietti *et al.* 2015, Viglietti 2016).

This *Daptocephalus* AZ has been assigned to the Changhsingian Stage (= Late Tartarian) right at the end of the Permian Period, with an approximate age range of 253.8-251.4 million years (Rubidge 1995, 2005; *N.B.* Smith *et al.* 2012 refer the biozone to the Wuchiapingian and Changhsingian Stages). Good accounts, with detailed faunal lists, of the fossil biotas of the biozone have been given by Kitching (*in* Rubidge 1995), Cole *et al*. (2004) and Smith *et al.* (2012) and more recently by Viglietti *et al.* (2015) and Viglietti (2016). Also useful are reviews by Cluver (1978), MacRae (1999), McCarthy & Rubidge (2005) as well as recent papers on Permo-Triassic boundary tetrapod faunas of the Main Karoo Basin by Smith and Botha (2005) as well as Botha and Smith (2006, 2007). In general, the following broad categories of fossils might be expected within these latest Permian continental successions:

- isolated petrified bones as well as articulated skeletons of terrestrial vertebrates such as true reptiles (notably large pareiasaurs, small millerettids) and therapsids (diverse dicynodonts such as *Aulacephalodon*, *Oudenodon*, *Dicynodon / Daptocephlaus* and the much smaller *Diictodon*, gorgonopsians, therocephalians such as *Theriognathus*, primitive cynodonts like *Procynosuchus*, and biarmosuchians) (Fig. 18);
- aquatic vertebrates such as large temnospondyl amphibians like *Rhinesuchus* and *Uranocentrodon* (usually disarticulated), and palaeoniscoid bony fish (*Atherstonia*, *Namaichthys*);

- freshwater bivalves;
- trace fossils such as worm, arthropod and tetrapod burrows and trackways, coprolites;
- vascular plant remains including leaves, twigs, roots and petrified woods ("*Dadoxylon*") of the *Glossopteris* Flora (usually sparse, fragmentary), especially glossopterids and arthrophytes (horsetails).

From a palaeontological viewpoint, these diverse *Daptocephalus* Assemblage Zone biotas are of extraordinary interest in that they provide some of the best available evidence for the last flowering of ecologically-complex terrestrial ecosystems immediately preceding the catastrophic end-Permian mass extinction (*e.g.* Smith & Ward, 2001, Rubidge 2005, Retallack *et al*., 2006, Smith & Botha 2005, Botha & Smith 2006, 2007). The faunal turnover at the Permian – Triassic boundary, which has been identified within the Palingkloof Member of the Balfour Formation in the southern part of the Main Karoo Basin and may be correlated with the Schoondraai Member of the Normandien Formation in the northern basin, is discussed in some detail by Smith and Botha (2005), Botha and Smith (2007) as well as more recently by Smith *et al.* (2012) (See also Groenewald 2012a and references therein). In the northern part of the basin the overlying Verkykerskop Formation (Tarkastad Subgroup) contains vertebrate, amphibian and wood fossils of the *Lystrosaurus* Assemblage Zone. It is variously considered to be earliest Triassic in age (with no Harrismith Member represented near Senekal where the Normandien / Verkykerskop boundary may represent an erosional hiatus) or alternatively to contain the Permian – Triassic boundary (*cf* Hancox *et al.* 2002).

As far as the biostratigraphically important tetrapod remains are concerned, the best fossil material within the *Daptocephalus* AZ is generally found within overbank mudrocks, whereas fossils preserved within channel sandstones tend to be fragmentary and water-worn (Kitching 1995, Smith 1993). Many fossils are found in association with ancient soils (palaeosol horizons) that can usually be recognised by bedding-parallel concentrations of calcrete nodules. The abundance and variety of fossils within the *Daptocephalus* AZ decreases towards the top of the succession according to Cole *et al*. (2004).

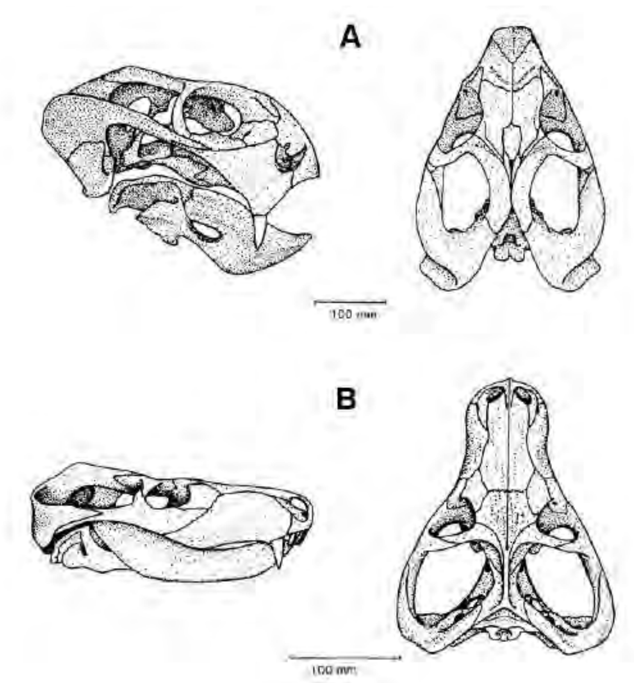


Figure 38. Skulls of key therapsids ("mammal-like reptiles") from the Late Permian *Daptocephalus* Assemblage Zone: the dicynodont *Dicynodon* and the therocephalian *Theriognathus* (From Kitching 1995).

The fossil record of the Normandien Formation has been reviewed by Groenewald (2012a) as well as in relevant geological map sheet explanations such as Johnson and Verster (1994) and Nolte (1995). The diverse fossil plant and insect biotas associated with the previously-recognised Estcourt Formation are now assigned to the basal Normandien Formation (Frankfort Member; see Fig. 18) that lies outside the present study area. Biostratigraphically important Normandien glossopterid floras from the NE Free State are described by Claasen (2008). Tetrapod and other fossil records from the Normandien succession in the Winburg – Senekal region of the Free State Province are outlined by Van Hoepen (1911), Kitching (1977), Nolte (1995) and Hancox *et al.* (2000). They include large temnospondyl amphibians (*Uranocentrodon*), therapsids (*Daptocephalus*, previously *Dicynodon*) and abundant petrified wood ("*Dadoxylon*"), including large logs of gymnosperms. These well-preserved fossil woods have been assigned to the genera *Agathoxylon* (previously *Araucarioxylon*) and *Australoxylon*, based in part on material collected from the Harrismith area (Bamford 1999, Bamford 2004). The famous petrified tree trunks up to 30 m long displayed around the Dutch Reformed Church at Senekal (Fig. 44) have been described by Botha and Visser (1970; see also Nolte 1995, p. 14); this article was not available at the time of writing and the stratigraphic position of the fossil trees is unclear. Fossil wood material from the Senekal area – but referred here to the Balfour Formation – has recently been analysed from a palaeoenvironmental viewpoint by Kock (2018).

Recorded fossil sites in northern Main Karoo Basin near Winburg are very sparse and mainly confined to the area east of the N1 and between Winburg and Senekal (Fig. 39). Apart from the small study by Groenwald (2012b), who recorded abundant petrified wood within the Normandien Formation just to the east of Senekal, the few previous palaeontological assessments carried out in the broader Bloemfontein – Winburg - Senekal area of the Free State have not reported new fossil material from the Beaufort Group bedrocks (*e.g.* Kibii Undated, Rossouw Undated 1-3). No fossil vertebrate remains were recorded in the Normandien Formation during this study, although this may be attributed in part to the very low levels of bedrock exposure here, especially as regards the more fossiliferous mudrock facies. No trace fossils were observed within the Permian bedrocks, and Nolte (1995) notes the paucity of evidence for bioturbation here.

Dispersed to locally common small (< 10 cm across), angular to subrounded blocks of silicified wood were recorded within several of the material source sites examined during the present field-based study (Table 2; Figs. 40 to 43) (GPS locality data for these finds is not provided here because the material appears to be pervasive). They generally show clearly defined seasonal growth rings and often display well-preserved woody tissue, as is apparent when examined with a hand lens. The blocks occur at surface where they are weathering-out from sandy to finely-gravelly soils or stream alluvium (Fig. 37). They are most easily observed in farm tracks and areas that are bare of vegetation; elsewhere they are easily obscured by grass and *bossies*. The fossil wood fragments have been reworked from local to distant outcrop areas of the Late Normandien Formation - probably from within channel sandstone bodies, but this has not been confirmed from *in situ* occurrences. Compared to sizeable tree trunk segments, or even trunks up to 30 m long (Fig. 44), documented elsewhere within the Winburg – Senekal region, the very widely distributed, reworked petrified wood material recoded within the present study area is of limited scientific value.

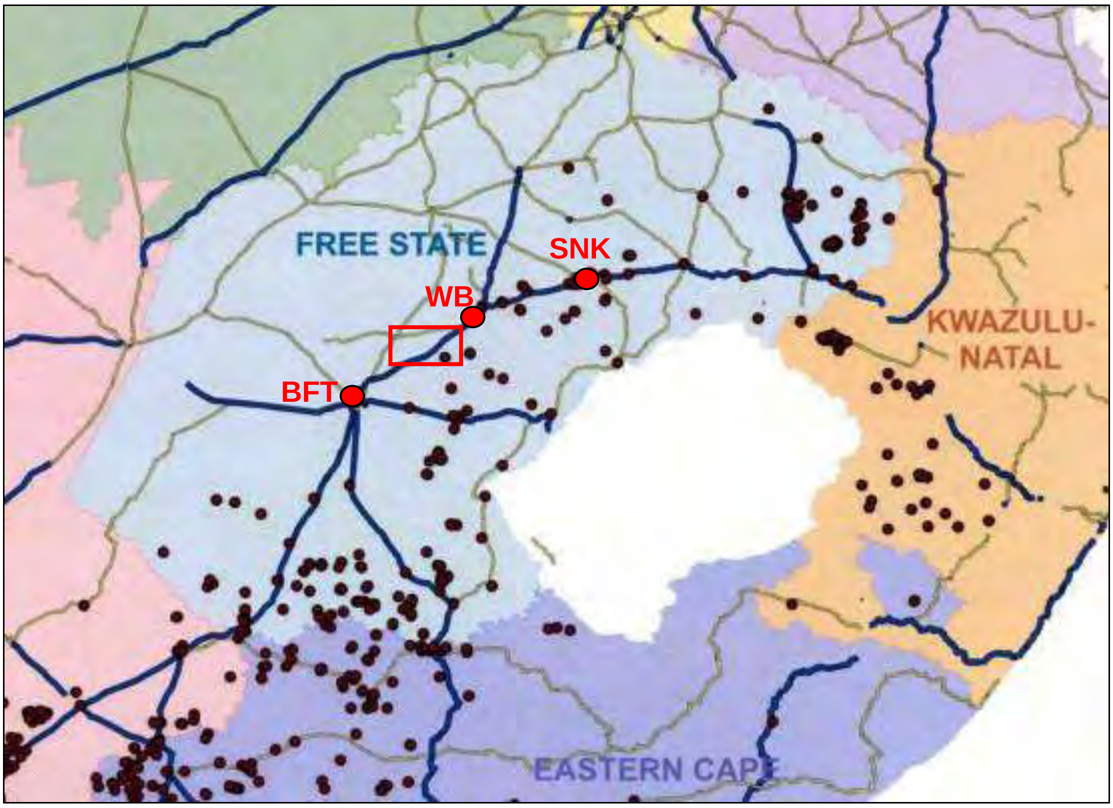


Figure 39. Distribution of recorded vertebrate fossil sites within the northern portion of the Main Karoo Basin (modified from Nicolas 2007). The approximate location of the present study area is indicated by the open red square. Recorded fossil sites in this part of the Karoo are sparse and mainly confined to the area east of the N1 and between Winburg and Senekal. BFT = Bloemfontein WB = Winburg SNK = Senekal

4.4. Fossil heritage in the Late Caenozoic superficial deposits

The Neogene to Recent superficial or "drift" deposits in the arid karroid areas of southern Africa have been comparatively neglected in palaeontological terms for the most part. Coarser-grained, conglomeratic alluvial sediments and derived debris flow and scree deposits are unlikely to contain useful fossil remains given the destructive, high-energy depositional environment and their highly permeable nature. In most areas, at most occasional rolled bones or teeth of vertebrates, reworked petrified wood and perhaps fragmentary freshwater mollusc shells might be expected. However, finer-grained silty to sandy alluvial facies may occasionally contain important Late Caenozoic fossil biotas, notably the bones, teeth and horn cores of mammals within calcretised older alluvium (*e.g.* Cornelia-UItzoek near Frankfort in the NE Free State studied by Botha & Visser 1975, Brink & Rossouw 2000, Nolte 1995; Erfkroon west of Bloemfontein reported by Churchill *et al.* 2000). These may include ancient human remains of considerable palaeoanthropological significance (*cf* Hofmeyer Man in the Eastern Cape). Other late Caenozoic fossil biotas from these superficial deposits include non-marine molluscs (bivalves, gastropods), ostrich egg shells, tortoise scutes and bones, trace fossils (*e.g.* calcretised termitaria, coprolites, rhizoliths), and plant remains such as wood, lignites, peats or palynomorphs (pollens) in fine-grained, organic-rich alluvial horizons (Nolte 1995, p. 23). Quaternary alluvial and other superficial sediments may contain reworked Stone Age artifacts that are useful for constraining their maximum age. For example, naturally incorporated Middle Stone Age artifacts suggest an age of less than 250-300 000 years BP, whereas embedded Early Stone Age (Acheulian) tools indicate an age of less than 1.6-1.8 Ma.

Important Plio-Pleistocene mammalian remains and stone artefacts have been recorded from Late Caenozic alluvial sediments in the Virginia-Theunissen area *c*. 50 km NNW of Winburg (*e.g.* Matjhabeng site) by De Ruiter *et al*. 2010, 2011). Rossouw (Undated 1 & 2) mentions mammalian remains and associated from alluvial contexts from the Doring, Sand and Vet Rivers in this part of the Free State which occasionally include unassociated Middle Stone Age tools. However, no new Late Caenozoic mammalian or other fossil remains were recorded during the present field-based study or previous PIA studies in the broader region (*cf* Rossouw Undated 1 to 3).

An interesting geo-biological feature observed on weathered Normandien channel sandstone surfaces are shallow subcircular to irregular etched depressions generated by epilithic lichens (Fig. 45). They have been well-studied on younger Clarens Formation feldspathic sandstones in the Golden Gate National Park (Grab *et al.* 2011) and have since been reported on Katberg and other Beaufort Group sandstone units in the Main Karoo Basin.

Figure 40. Small angular blocks of petrified wood among surface gravels in the Q2Alt study area. The largest block is 5 cm across.

Figure 41. Selection of small blocks of petrified wood weathering out of alluvial sediments close to the access road to the BP19 & 20 study areas (See Fig. 37) (Scale in cm).

Figure 42. Small blocks of reworked petrified wood among surface gravels in the BP5 study area (Scale in cm and mm).

Figure 43. Angular block of petrified wood showing broad growth rings – presumably part of a sizeable tree – from float gravels in the BP8 study area (Scale in cm).

Figure 44. Reassembled petrified tree trunk of the Lower Beaufort Group (probably Normandien Formation) near Senekal, displayed here around the local Dutch Reformed Church.

Figure 45. Surface etching of weathered Normandien channel sandstones attributed to epilithic lichens, BP24 study site (Scale in cm and mm). These features are better known from the younger Katberg Formation of the Free State (*e.g.* Golden Gate National Park).

5. SUMMARY & RECOMMENDATIONS

All 27 of the potential quarry and borrow pit sites under consideration as material sources for the N1 (Section 16) road upgrade project between Zandkraal and Winburg are very largely or entirely underlain by Early Jurassic Karoo dolerite which is the main target for quarrying operations. Small surface exposures of channel sandstones assigned to the Late Permian Normandien Formation are encountered at a few sites, but generally the Lower Beaufort Group (Adelaide Subgroup, Karoo Supergroup) sedimentary bedrocks are entirely mantled by Late Caenozic soils, doleritic gravels and alluvium. The Karoo dolerites themselves are unfossiliferous igneous rocks, although they may locally contain sizeable enclosures or xenoliths of Karoo Supergroup sediments (*e.g.* in Bell's Pass near Winburg), while intrusion of hot dolerite magma may well have compromised fossil heritage originally preserved within the surrounding country rocks through baking and injection of hot fluids.

No fossil vertebrates, trace fossils or *in situ* plant remains were recorded during fieldwork at any of the quarry and borrow pit study sites, either within the Karoo bedrocks or overlying superficial sediments. The only fossils recorded here are sparse to locally common, small blocks of petrified wood that have weathered-out of the Beaufort Group bedrocks and become incorporated into local soils and alluvial deposits. Such reworked, fragmentary wood fossils are probably ubiquitous at or near-surface within this region of the Free State Province and are of very limited scientific importance – in contrast to the large, almost intact petrified tree trunks that are well-known from the Winburg – Senekal area. Thicker alluvial deposits – seen, for example in the southern portion of the QAlt to 1A & 1B study area (Farm Ceylonia 1358) – may *potentially* contain Late Caenozoic vertebrate remains (*e.g.* mammalian bones & teeth) as well as reworked fossil wood, although no such remains have as yet been recorded here.

It is concluded that all of the quarry and borrow pit material sources under consideration are of overall low to very low palaeontological sensitivity. This assessment applies to all 27 of the sites assessed here, and there is no marked preference for, or objection against, any particular pit site or sites on palaeontological heritage grounds. However, should the QAlt to 1A & 1B quarry site (Farm Ceylonia 1358) be selected for exploitation, any substantial excavations into potentially sensitive alluvial sediments along the drainage line in the southern portion of the site or close to the proposed access road (area outlined in pale blue in Fig. 8 herein) should be monitored by the ECO on an on-going basis for fossil remains such as blocks of petrified wood or mammalian bones and teeth.

In the case of any significant fossil finds exposed by access road building, quarry or borrow pit excavations during development, these should be safeguarded - preferably *in situ* - and reported by the ECO as soon as possible to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). This is so that appropriate mitigation (*i.e.* recording, sampling or collection) by a palaeontological specialist can be considered and implemented *before* rehabilitation of the access road cuttings, quarries or borrow pits takes place (Please refer to the tabulated Chance Fossil Finds Procedure attached to this report). These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed quarry and borrow pit developments.

6. ACKNOWLEDGEMENTS

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8. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Mpumalanga, Free State, Limpopo, Northwest and KwaZulu-Natal under the aegis of his Cape Town-based company *Natura Viva* cc. He has been a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

John E. Almond

Dr John E. Almond, Palaeontologist, *Natura Viva* cc

<table>
<tr><td colspan="3">CHANCE FOSSIL FINDS PROCEDURE: N1 (Section 16) material sources between Zandkraal and Winburg, Free State Province</td></tr>
<tr><td>Province & region:</td><td colspan="2">Free State, Brandfort & Winburg Districts</td></tr>
<tr><td>Responsible Heritage Management Authority</td><td colspan="2">SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Normandien Formation (Lower Beaufort Group, Karoo Supergroup), Late Caenozoic alluvium</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Petrified wood (e.g. logs), plant compressions, bones and teeth of vertebrates, mammals and other vertebrates</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
Context – describe position of fossils within stratigraphy (rock layering), depth below surface
Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
Alert Heritage Management Authority and project palaeontologist (if any) who will advise on any necessary mitigation
Ensure fossil site remains safeguarded until clearance is given by the Heritage Management Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
Photograph fossils against a plain, level background, with scale
Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
Alert Heritage Management Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Management Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Management Authority</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Management Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Management Authority minimum standards.</td></tr>
</table>