Environmental Management Group

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ECOLOGICAL REPORT OF THE PROPOSED NURSING COLLEGE ANDSTUDENT ACCOMODATION DEVELOPMENT KIMBERLEY, NORU

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Specialist investigator: Mr R Nel (BSc Honours majoring in Botany (ecology))

Declaration of independence:

I, the above-mentioned specialist investigator responsible for conducting this particular specialist ecological study, declare that

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development, except for financial compensation for work done in a professional capacity;
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part;
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience, and scientific data;
- I do not have any influence over decisions made by the governing authorities;
- I have the necessary qualifications and guidance from professional experts (registered Pr. Nat. Sci.) in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity
- This document and all information contained herein are and will remain the intellectual property of Environmental Management Group. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the respective specialist investigator.

Ricus Nel

To whom it may concern,

Review of specialist ecological assessment:

Of

The proposed nursing college and student accommodation development on the RE of Erf Number 42654 in Kimberley, NC

I, SE van Rooyen, member and principal consultant of Environmental Management Group (EMG), a SACNASP registered scientist in ecological sciences, and a registered environmental assessment practitioner, evaluated the ecological assessment of the specialist as mentioned above.

In general, criticism lodged against ecological studies includes poor use of relevant scientific literature, lack of or inadequate field surveys and associated data collection, poor use of regional information datasets, lacking general knowledge of the subject, failure to describe limitations or constraints on survey methodology, insufficient or inadequate data, vague generalisations with no indication of the relative importance of a particular component. Regarding the above criticism, none of it is relevant to the ecological assessment of the aforementioned report. It is concluded that the report complies with the general provincial requirements, and the content as discussed in the report is relevant and concise.

Regards

SE van Rooyen,
Director Managing & Environmental Assessment Practitioner & Ecologist
(MSc. Cand.Sci.Nat.116554; IAIA Reg No. 5901)

1. Review of report:

Ecological report prepared by: Environmental Management Group (PTY)Ltd.

Report prepared for: Hospital Design Group

Locality: Kimberley, North Cape

Reviewer	Qualification	Professional registration	Signature
Mr. SE van Rooyen	MSc Environmental Sciences (*Ecological remediation and Sustainable Management*)	SACNASP:Cand.Sci.Nat.116554; IAIA Reg No. 5901	
Mr. I.S. Venter	MSc Agriculture	Pr Sci Nat. 400057/10	

2. Executive summary

The proposed nursing college and accommodation will take place in the southern parts of Kimberley (Figure 1). The development will be located on the remainder of Erf Number 42654, situated immediately south of the R31, between the R357 and N12 roads. The first phase of construction for the student accommodation has already commenced and forms part of the initial authorisation for the Kimberley mental health facility. A site visit was conducted on 01 June 2021. The entire footprint of the nursing college and phase two student accommodation was surveyed for one day. The survey had to be conducted in winter, which is not optimal for plant identification since many plant species only flower during the rainy season (November to April) and or summer season.

The proposed development is situated in the southern parts of Kimberley, Northern Cape. The site falls within the Kimberley thornveld vegetation type (SVk4), listed as a vegetation type of least conservation concern. The proposed development site does not fall within any of the critical biodiversity or ecological support areas as indicated by the Northern Cape critical biodiversity areas map (DENC, 2016)

The site's natural vegetation is severely degraded due to the current construction of the first phase of student accommodation. Uncontrolled littering, footpaths, dirt roads, unorganised movement of construction vehicles, grading large areas of land, randomly distributed dump heaps and an intense infestation of exotic plant species all contribute to the high level of disturbance the site has experienced. The heavily degraded ecosystem will be a costly project to rehabilitate. Given the opportunity to rehabilitate itself through the natural process of succession, a somewhat representative of previous vegetation might arise. However, this is unlikely since much of the shallow seed bank is severely degraded by the many dump sites and grading of large areas of natural vegetation. Additionally, the intense infestation of exotic plant species will most likely outcompete many native species, preventing succession towards a natural occurring climax community. When considering the site's current levels of disturbance and the ecological condition, it is considered to have very little conservation value as a whole. However, it should be highlighted that there were a few plant species of significance found on the site.

Two protected plant species, namely *Vachellia erioloba* and *Nerine laticoma* were located on the site. The localities of these species were logged. It is advised that these species be incorporated into the landscape design. The removal of these species should only take place when absolutely necessary and the required permits are obtained. It is advised that *N. laticoma* be transplanted into a suitable non-disturbed habitat. The transplant of *N. laticoma* may only occur after the relevant plant species harvesting permit is obtained.

A biodiversity sensitivity rating (BSR) was conducted to evaluate the current ecological condition and the site's sensitivity to development. The BSR evaluation concluded that the site is in an advanced degraded state with an overall low species richness.

Rehabilitation will be costly since much of the ecological function has been severely hampered. The BSR rating concluded that the site is preferred for development.

An impact assessment was performed and resulted in an overall low impact significance score. With adequate mitigation measures, the impacts emanating from the development will be very low.

Contents

3. Introduction:

Ecological infrastructure refers to the natural functioning ecosystems which provide essential services to people. Examples of these ecosystems include healthy mountain catchments, rivers, wetlands, rangelands and coastal dunes (SANBI, 2014). An ecosystem functions as a collective of components, both living and non-living interacting with one another (Wohlitz, 2016). Ecosystem services include provisioning services (food, raw materials, freshwater), regulating services (climate and air quality, carbon sequestration, water purification), supporting services (habitats and genetic diversity), and cultural services (recreation, tourism and spiritual) (Costanza et al., 1997; Fy et al., 2015; Wohlitz, 2016). Ecosystems can only provide these services as long as they are in a healthy state. Habitat fragmentation, pollution, erosion and unsustainable harvest are only a few that threaten healthy ecosystems.

In terms of biological diversity, South Africa ranks third in the world with a high level of endemism (found only in South Africa) (Hoveka et al., 2020). Because of this, South Africa's vegetation is highly localised and experiences a greater threat of extinction.

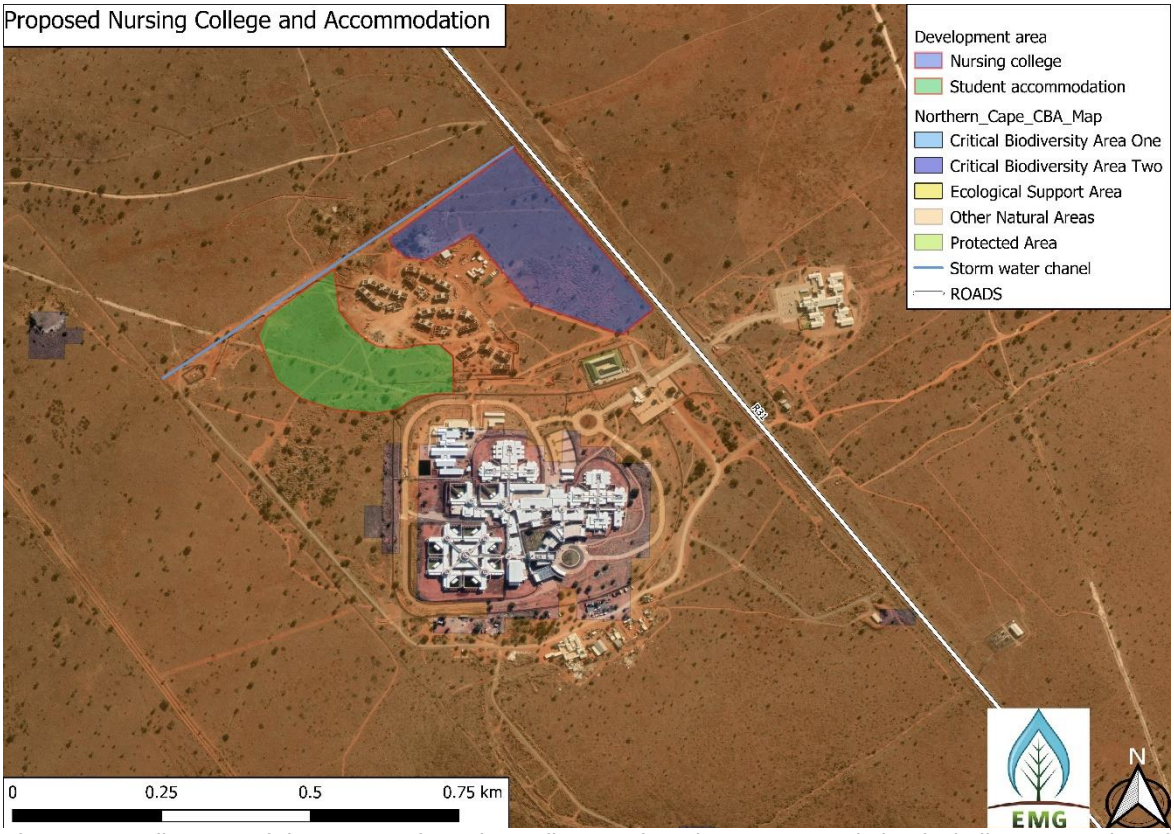

Figure 1 Locality map of the proposed nursing college and student accommodation including an overlay of critical biodiversity- and ecological support areas. A storm water channel was introduced on the north western border of the farm.

Despite the seeming homogeneity and low diversity of vegetation, an area may contain endangered and rare species. The presence of these red data species may make the development unfeasible at that specific location. If this occurs, the project should be moved to an alternative location or cease immediately.

Development is a necessity, especially for a developing country such as South Africa. New developments create job opportunities, increase capital growth, and overall create a better country. However, these developments should not come at the cost of pristine ecosystems as they produce invaluable services humans reap for free. For this reason, sustainable development practices should balance the need for development and the conservation of natural resources (Wohlitz, 2016).

The proposed nursing college and accommodation will take place in the southern parts of Kimberley (Figure 1). The first phase of construction for the student accommodation has already commenced and forms part of the initial authorisation for the Kimberley mental health facility. The remaining area (approximately 15 ha) within which the proposed development will occur is severely degraded due to the existing construction.

A site visit was conducted on 01 June 2021. The entire footprint of the nursing college and phase two student accommodation was surveyed for one day. The survey had to be conducted in winter, which is not optimal for plant identification since many plant species only flower during the rainy season (November to April) and or summer season.

For the aforementioned reasons, it is necessary to conduct an ecological assessment to assess the possible environmental impacts of the proposed nursing college and accommodation. The recommendations and mitigation measures generated in this report should be used to minimise the impact of the proposed development.

4. Scope and limitations of the study:

- Evaluating the present ecological functioning of the area within which the proposed development will take place.
- Identifying and assessing possible environmental impacts that the proposed development could generate.

4.1. Vegetation:

Vegetation related topics to be investigated include:

- The vegetation type within which the proposed development lies and the importance thereof.
- Assessing the overall ecosystem health in terms of its vegetation with emphasis on the level of disturbance (grazing- and anthropological impacts).
- Identification of the area's species composition with emphasis on dominant-, rare-, endangered- and protected species

4.2. Fauna:

Fauna related topics to be investigated include:

- A survey primarily concerned with visual observations of species and supporting evidence of their presence in a given region, such as burrows, excavations, animal tracks, dung, etc.
- A species list including both observed and probable species occurrence.

4.3. Limitations:

- Not all plants have the same flowering period, and thus it is likely that the survey could have occurred outside of the flowering period of a specific species.
- Some geophytic and succulent plants might have been overlooked due to their cryptic nature.
- For most plant species, especially grasses, inflorescences are vital for accurate identification. Due to high levels of disturbance such as those accompanied by construction activities, some species might have been overlooked due to an absence of inflorescences.
- Some animal species exhibit a nocturnal and or shy habit and will most likely not be observed during the daytime.

5. Methodologies:

5.1. Literature used for additional information:

Vegetation:

- Red Data List (Raymondo et al. 2009)
- Vegetation types (Mucina and Rutherford 2006; SANBI, 2006-2018)
- Field guides used for species identification (van Wyk and Malan, 1998; van Tooyen et al., 2001; van Wyk and van Wyk, 2013; van Oudtshoorn, 2014; Manning, 2019)

Terrestrial fauna:

- Field guides for species identification (Marais, 2004; Sinclair and Ryan, 2010)

5.2. Survey:

Before visiting the site, a desktop study commenced where the following information was determined:

- Vegetation type.
- Climatic conditions.
- Probable rare- endemic- and protected species lists.
- Various homogenous vegetation units in which surveying will commence.
- Probable environmental impacts of the proposed development.

The site survey was performed through sample plots and transects. Plant species observed were recorded with particular emphasis on rare-, endemic-, protected- and dominant species. Attention was given to the current state of the environment regarding grazing impacts, anthropogenic disturbances, erosion and the presence of alien or invasive species. Animal species observed were taken note of, as well as the

probability of other animal species' presence (dung, habitat requirements, excavations, animal tracks, burrows, and nests)

5.3. Assessment criteria:

Several assessment criteria were used to determine the overall status of the environment.

5.3.1. Vegetation characteristics:

The current state of the vegetation in terms of its plant diversity, habitats sensitivity, and importance of the ecosystem.

Habitat diversity:

Areas that are more heterogenous in terms of different habitats have a higher likelihood of hosting a greater plant diversity.

Criteria:	Score
High species richness with many fulfilled niches	(1)
Variety of species occupying a few niches	(2)
Few or a single species dominating an area	(3)

Rare and endangered plant species:

The presence or potential presence of a rare or endangered plant species on the site presents an ever-important role in the feasibility of the development.

Criteria:	Score
Presence of or high likelihood of presence	(1)
Possible occurrence	(2)
Presence is highly unlikely	(3)

Ecological function:

Each ecosystem functions as an interconnected unit part of the greater system. Removing to many or critical units can result in an entire ecological breakdown of an area. However, the ecological importance of various areas can differ considerably.

Criteria:	Score
Critical ecological function as part of the greater system	(1)
Moderate ecological function	(2)
No special ecological function (greater system will not fail if absent)	(3)

Conservation value:

The conservation value of an ecosystem is influenced by its natural/pristine condition, rehabilitation costs, and importance to the larger system's functioning.

Criteria:	Score
Natural/ pristine condition (very valuable)	(1)
Fair to good condition i.t.o. its natural condition	(2)
Heavily transformed, degraded and not rare	(3)

5.3.2. Vegetation condition:

Comparison to an objectively good/ natural condition ecosystem. Veld management practices such as fire regime and grazing intensity can have a significant influence on vegetation condition.

Percentage ground cover:

Ground cover is influenced by climate and biophysical conditions such as overgrazing, frequent fires, anthropogenic activities.

Criteria:	Score
Good ground cover	(1)
Moderate ground cover (few patches of exposed soil)	(2)
Very poor ground cover (large areas of barren soil)	(3)

Vegetation structure:

A comparison between of various vegetation layers, i.e. the ratio between the top (trees/ tall shrubs), middle (shrubs) and lower (herbaceous/dwarf shrub) layers.

Criteria:	Score
All layers present with their various age classes	(1)
Lower layer highly grazed while top layer unaffected	(2)
A mono layer dominating an area (presence of degradation notable)	(3)

Infestation of exotic and invasive plants:

Exotic/ alien plant species are those that are not native to South Africa, while invasive species are those that adversely affect the environment.

Criteria:	Score
No or a small presence of alien/invasive species	(1)
Moderate infestation by one or more alien/invasive species	(2)
Area with a very high presence of many alien/invasive species	(3)

Impact of grazing/ browsing:

The overall vegetation structure and vegetation condition is heavily influenced by the intensity of grazing and browsing.

Criteria:	Score
Very little or no signs of grazing/browsing	(1)
Some signs of grazing/browsing (browse lines, shrubs/trees with signs of browsing and grass with signs of grazing)	(2)
Very clear browse level in trees, shrubs heavily pruned and grass layer heavily grazed.	(3)

Erosion:

Signs of erosion is an indicator of environmental disturbance. The severity of erosion usually increases with a lack of ground cover.

Criteria:	Score
No or very little signs of erosion	(1)
Small erosion gullies or the presence of slight sheet erosion	(2)
High degree of gully erosion and/ or high degree of sheet erosion	(3)

5.3.3. Faunal characteristics:

Rare and endangered species:

The presence or potential presence of a rare or endangered fauna species on the site presents an ever-important role in the feasibility of the development.

Criteria:	Score
Presence of or high likelihood of presence	(1)
Possible occurrence	(2)
Presence is highly unlikely	(3)

5.4. Biodiversity sensitivity rating (BSR):

The summed scores for the environmental assessment criteria indicated above were used to determine the biodiversity sensitivity for the site. The BSR score is set at a maximum of 30 which strongly favours development's incentive, while a lower score closer to 0 indicates an ecosystem more valuable left undeveloped.

Table 1 Biodiversity sensitivity rating evaluation

BSR	Environmental description according to the BSR	BSR score class
Ideal for development	The vegetation has been entirely transformed or is in a highly degraded state. The area can no longer be regarded as being in a natural condition. The site generally has a very low plant and animal species richness, does not contain any species of concern and is heavily populated by invasive plant. This area has lost its inherent ecological function. The area has no conservation value, and the costs outweigh rehabilitation potential. This site is ideal for the proposed development.	29-30
Preferred for development	The vegetation is in an advanced degraded state, displaying a low plant and animal species richness and reasonably populated by invasive species. The site's ecological function is severely affected, and it has inadequate conservation potential. The potential for successful rehabilitation is relatively low. The site is preferred for the proposed development.	26-28
Acceptable for development	Vegetation displays moderate levels of degradation and exhibits a medium level of plant and animal species richness. No species of concern are present. The degree of infestation is controllable. The site's ecological function is still intact and may be affected by the proposed development's activities. Rehabilitation is possible and should be considered. The site's conservation value is regarded as low. The site is acceptable for development.	21-25
Not preferred for development	The area is in overall good condition. There are some indications of environmental disturbance. Plant and animal species richness is reasonably high, and species of conservation concern may be present. The area's ecological function is intact, and minimal rehabilitation efforts are needed. The site is of medium conservation value. The site is not preferred for development.	11-20
Very sensitive not suitable for development	The site is in a pristine or near pristine condition with very few indications of a disturbance. The site exhibits a very high plant and animal species richness along with several species of conservation concern. The ecological function is very well intact, and the conservation value is very high. The area is susceptible and should be avoided for the proposed development.	0-10

6. Study area:

The proposed site is located in the southern parts of Kimberley, Northern Cape. The nursing college and accommodation will be located on the remainder of Erf Number 42654, situated immediately south of the R31, between the R357 and N12 roads. The student housing construction has begun as part of the original authorisation for the Kimberley mental health hospital.

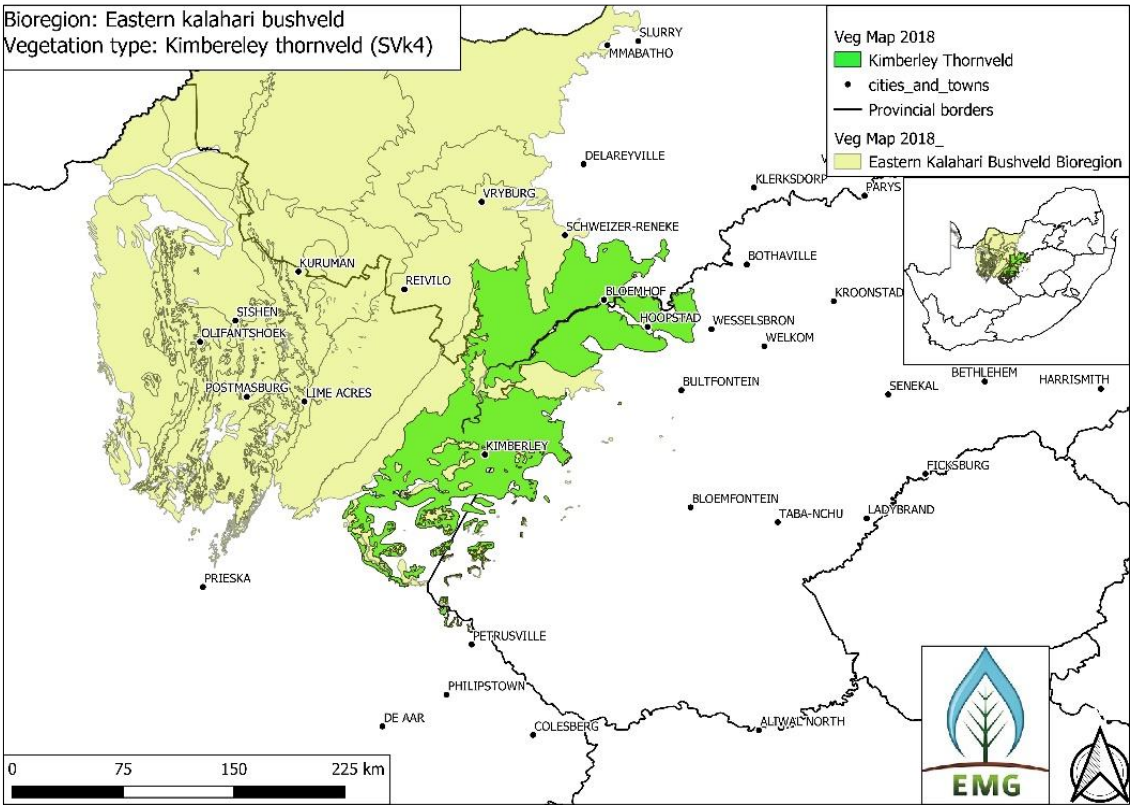

Figure 2 Inter-provincial map indicating the distribution of the Kimberley thornveld (SVk4) vegetation type within the broader Eastern Kalahari Bushveld Bioregion. The Proposed development falls within the city of Kimberley cantered on the map.

6.1. Regional vegetation:

The proposed development is situated in the southern parts of Kimberley, Northern Cape. The development falls within the Savanna Biome. The Savanna is the largest Biome in South Africa and covers an area of roughly 399 600 km^2. The Savanna is divided into several bioregions (the organisation level between biome and vegetation types). These are (1) Sub-escarpment Savanna, (2) Eastern Kalahari bushveld, (3) Lowveld Savanna, (4) Mopane Savanna, (5) Central bushveld Savanna, and (6) Kalahari dune veld Savanna. The nursing college and student accommodation fall within the Eastern Kalahari bushveld bioregion (Figure 2). Bioregions are then further subdivided into vegetation types based on their unique floristic composition. SVk4 or more commonly known as the Kimberley thornveld is prevalent in the area in which the proposed development is planned (Figure 2). Most savannas have a sub-shrub layer consisting mainly of grass species intertwined with a continuous or sometimes discontinuous tree/ shrub layer (Scholes and Archer, 1997).

SVk4 presents a slightly irregular topography with a well-developed tree layer. Trees dominant in the areas are *Vachellia karoo, V. erioloba, V. tortilis,* and *Boscia albitrunca* (Mucina and Rutherford, 2006). The environment also presents a shrub layer concentrated in dense stands of *Senegalia mellifera* and *Tarchonanthus camphorates.* In arid regions of the Kalahari, dense encroachments of *S. mellifera* are indicators of overgrazed or mismanaged field conditions (Skarpe, 1990). The grass layer in SVk 4 is frequently left barren with many areas of uncovered red sand (Mucina and Rutherford, 2006).

The Kimberley thornveld vegetation type is declared as least threatened, with less than 2% of the targeted 16% conserved in conservation areas (Government Gazette no. 34809, 2011; Department of Environmental Affairs, 2016).

6.2. Climate:

The area experiences summer and autumn precipitation with very dry winter periods (Mucina and Rutherford, 2006). The average annual precipitation ranges from 300 to 500 mm from the southwest to the northeast (Mucina and Rutherford, 2006). Frost is common in winter. A study conducted closer to the area of the proposed development indicated that mean annual precipitation (MAP) was just over 400 mm (Bezuidenhout, 2009). Kimberley's maximum and minimum monthly temperatures are 37.5°C and –4.1°C in January and July, respectively.

6.3. Geology:

There exist andesitic lavas of the Allanridge Formation to the north and west of the vegetation type and fine-grained sediments of the Karoo Supergroup to the south and east. A slightly undulating sandy plain with deep (0.6-1.2 m) sandy to loamy soils of the Hutton soil type (Ae and Ah land types). Ae Land Types are red, high-base soils with a depth ranging from 0.1 to 3.0 m. In contrast, the Ah Land Type consists of yellow soil and is mostly deeper than 3 meters.

7. Results:

A comprehensive plant species list is available on appendix 5.

7.1. Floral survey:

Five different vegetation units (VU) were identified on the proposed site (Figure 3).VU-A, B and E were delineated on the basis of plant homogeneity and overall physiognomy while VU-C and D were delineated on the basis of anthropogenic disturbance. Each of these vegetation units will be discussed in detail. Even though five VUs were identified, it should be stressed that a severe level of degradation runs distinctly through the entire site. Most of the disturbance takes form of littering especially close to footpaths, dirt roads, randomly distributed dumping sites, soil compaction, erosion and levelling of large areas by grading away top sol.

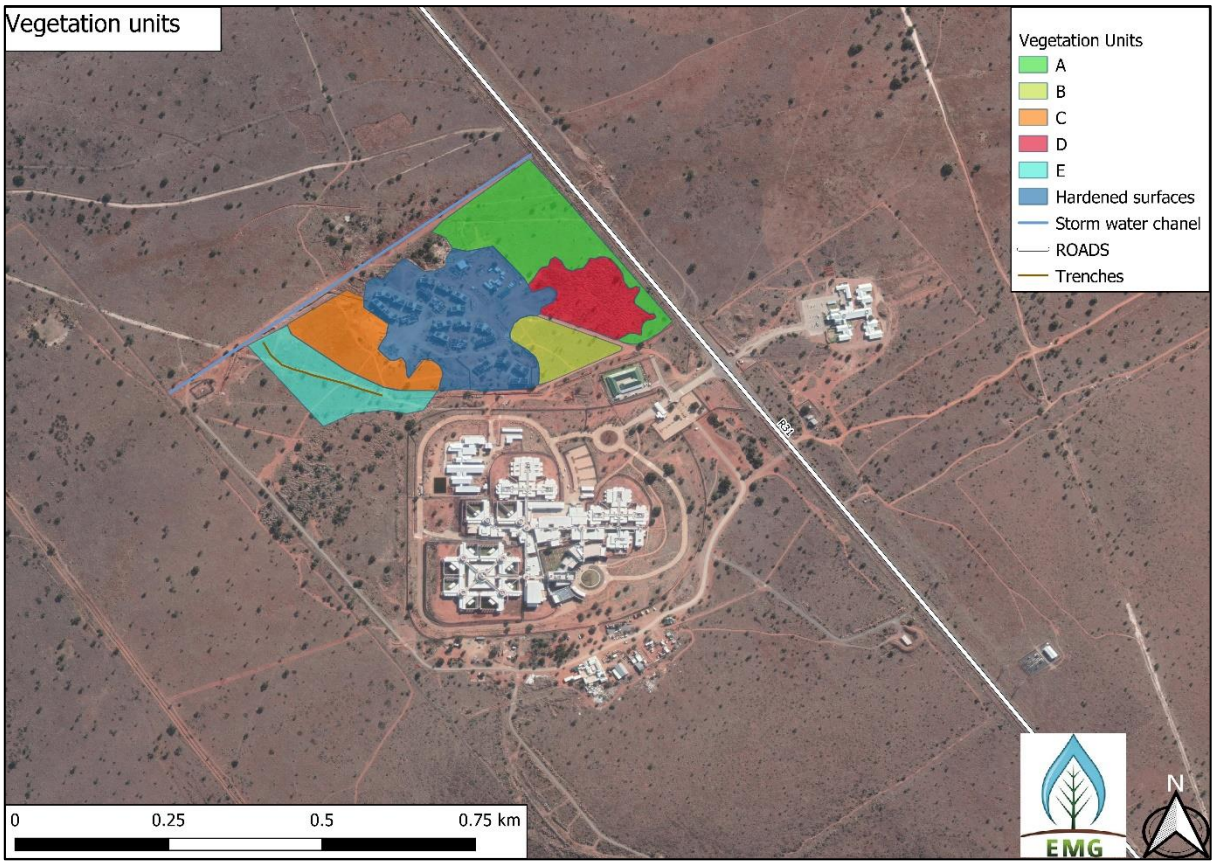

Figure 3 Map indicating the five vegetation units (VUs) identified on the site. Additionally, hardened surfaces (blue) are represented by various manmade structures and areas where regular movement takes place.

7.1.1. VU-A:

This unit is located in the most northern parts of the proposed development site and will host the nursing college's academic facilities on completion. This unit has a very dense population of *Conyza sumatrensis* regularly exceeding 1.8 m (Figure 4 A). Other exotic species such as *Bidens pilosa, Pseudognaphalium album*, and *Tagetes minuta* are distributed closer to VU-B and the site's northern border. An almost fully covered herbaceous layer characterises this unit with grasses such as *Aristida congesta, Schmidtia kalihariensis, Eragrostis lehmanniana*, *Stipagrostis ciliata* and *S. obtusa*. VU-A presents a discontinuous tree layer representing a more open savanna with

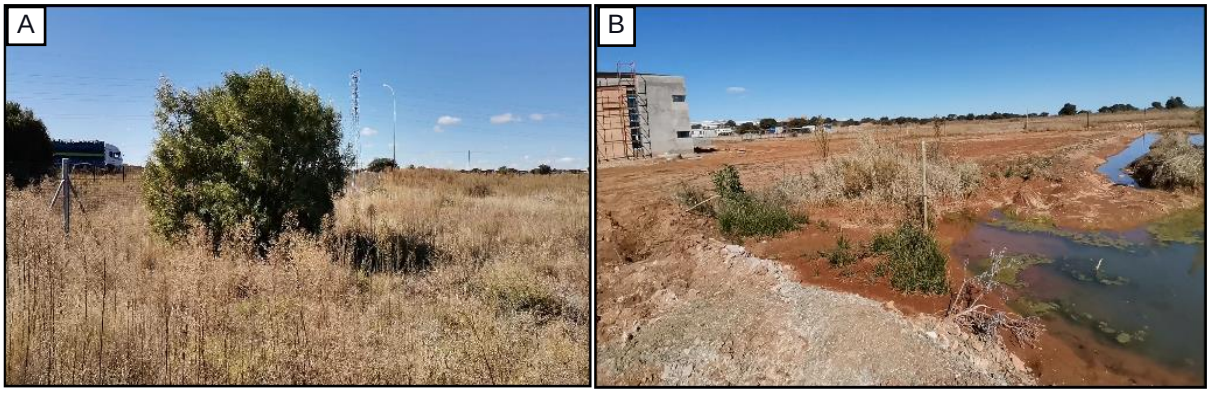

Figure 4 (A) View of the dense population of *Conyza sumatrensis* with scattered *Searsia lancea*. (B) Water from the stormwater channel accumulates where it broke through the channel's levee. Ongoing construction of the first phase student accommodation is viewed in the background.

Vachellia erioloba, *V. tortilis* and *Sersia lancea*. A relatively quick flowing stream of water is rushing down the stormwater channel situated near the western border of the site. The stream eventually breaks through the stormwater channel and enters the phase 1 accommodation area (Figure 4 B). This water body is polluted by littering and construction debris. The water eventually re-enters the stormwater channel and exits the site down the southwestern border.

7.1.2. VU-B:

This unit is situated on the western border of the development between the first phase student accommodation and the dumping site (Figure 3). This VU will later be replaced by the nursing college's sports field/ sports centrum. VU-B has not experienced the same level of disturbance as the rest of the area. VU-B's low species richness is a consequence of its isolation, being cut off by the main dirt road entering the site and the ongoing student housing development. The herbaceous layer is represented by several pioneering and sub-climax grass species such as *Aristida congesta, Schmidtia kalihariensis, Eragrostis lehmanniana* and *Pogonarthria squarrosa*. The shrub/tree layer is represented by a discontinuous distribution of *Ziziphus mucronata, Vachellia hebeclada, V. tortilis* and *V. erioloba.* For *V. erioloba* a Department of Forestry, Fisheries and the Environment (DFFE) permit must be issued for its removal. The sources of disturbance in this VU include the isolation/ fragmentation by dirt roads, foot paths and littering close to footpaths and main dirt road.

7.1.3. VU-C:

This unit is located between VU-E and the first phase of student accommodation (Figure 3). This VU will later be replaced by the second phase of student accommodation on completion of the project. The majority of topsoil close to the student accommodation was removed, leaving this unit highly degraded (Figure 5). This unit's sparse ground cover is represented primarily by pioneering grass species such as *Aristida congesta, Melinis repens, Tragus racemosa* and *Schmidtia kalihariensis*. The grading of topsoil has invited many exotic species such as *Bidens pilosa, Tagetes minuta, Verbesina encelioides* and *Conyza sumatrensis*. This unit experiences frequent heavy vehicle traffic, as indicated by the many tire tracks (Figure 5 red lines). The frequent movement of construction vehicles have compacted the remaining soil and only worsens the unit's degraded state. Other sources of disturbance include littering and random dumping of construction debris across the VU.

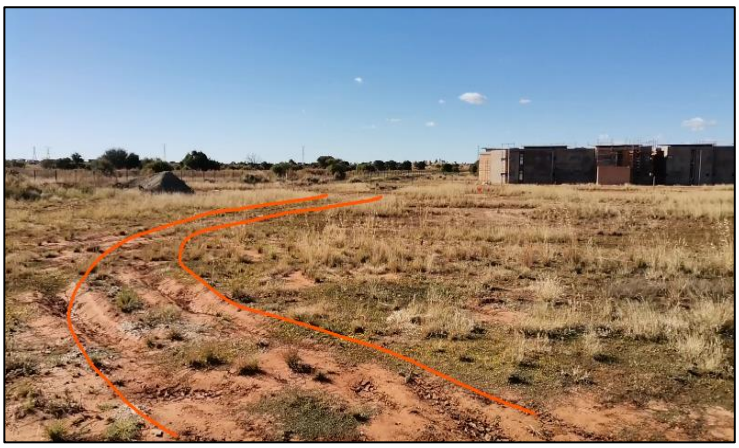

Figure 5 Extreme degradation followed the removal of topsoil. Ground cover represented by pioneering grass species. (Red) tire tracks of construction vehicle adding to the compaction of the soil.

7.1.4. VU-D:

This unit is located within the north-eastern parts of the proposed development, which borders the R31 (Figure 3). This area is being used as a dumping site for many purposes but mainly for dug up soil. Historical imagery indicates that the dumping activities have been ongoing for the past five years. The dumping of unearthed soil and construction debris has left this area entirely degraded (Figure 6). Other sources of degradation include footpaths, movement of heavy vehicles and the high level of infestation of exotic species. This unit consists of a broken herbaceous layer dominated by the grasses *Eragrostis lehmanniana* and *Schmidtia kalihariensis* with large areas of exposed and compacted soil. *Conyza sumatrensis*, *Verbesina encelioides* and *Bidens pilosa* are only but a few exotic species frequently observed in this unit and increases in density moving towards VU-A. Furthermore, the presence

Figure 6 View of the severe degradation caused by dumping of overburden and other construction waste material.

of medium-large *Sersia lancea* and *Vachellia erioloba* represents the discontinuous tree layer.

7.1.5. VU-E:

VU-E is situated in the most southern parts of the site (Figure 3). This vegetation unit is separated from VU-C by a temporary road constructed from piled-up topsoil, mudstone and calcareous deposits most likely procured during the grading of VU-C. This unit's herbaceous layer is represented by numerous pioneering and sub-climax grass species such as *Aristida congesta, Melinis repens, Schmidtia kalihariensis, Eragrostis echinocloidea* and *Heteropogon contortus*. However, the herbaceous layer does not completely cover the ground surface, with many exposed ground patches present. Exotic species present in the VU are *Conyza sumatrensis, Verbesina encelioides* and *Bidens pilosa.* The tree layer in this unit is represented by many medium to tall *Vachellia erioloba, V. tortilis, Senegalia mellifera*, and *Sersia lancea*. This unit has experienced a moderate level of disturbance. Sources of degradation include a 50-70 cm deep trench running east to west across most of the VU (Figure 7), footpaths, littering and the temporary road separating VU-E from VU-C.

Figure 7 An open trench 50-70cm deep, running across VU-E. The first phase of student accommodation is visible in the background.

7.1.6. Floral survey conclusion:

The site's natural vegetation is severely degraded due to the current construction of the first phase of student accommodation. Uncontrolled littering, footpaths, dirt roads, unorganised movement of construction vehicles, grading large areas of land, development of randomly distributed dump heaps and an intense infestation of exotic species all contribute to the immense level of disturbance the site has experienced. The site is situated in the Kimberley thornveld (SVk4). SVk4 is declared as least threatened, with less than 2% of the targeted 16% conserved in conservation areas (Government Gazette no. 34809, 2011; Department of Environmental Affairs, 2016).

The heavily degraded ecosystem will be a costly project to rehabilitate. Given the opportunity to rehabilitate itself through the natural process of succession, a somewhat representative of previous vegetation might arise. However, this is unlikely since much of the shallow seed bank is severely degraded by the many dump sites and grading of large areas of natural vegetation. Additionally, the intense infestation of exotic

species will most likely outcompete many native species, preventing succession towards a natural occurring climax community. The site is not included in any of the critical biodiversity- or ecological support areas network (Figure 8, Appendix 6). When considering the site's current levels of disturbance and the ecological condition, it is considered to have very little conservation value as a whole. However, it should be highlighted that there were a few species of significance found on the site.

A few scattered individuals of *Nerine laticoma* were located on the site. *N. laticoma* is a protected species in the Northern Cape. This species was not in flower, making identification difficult; nevertheless, due to its unique characteristics, it can be confidently classified within the Amaryllidaceae family, a protected taxon in the Northern Cape. Where specimens will be affected by construction, the necessary permits should be obtained to transplant them into suitable habitats. *Vachellia erioloba* (camel thorn) is scattered throughout the site. The camel thorn tree is a protected species showing indications of a declining population (von Staden and Raimondo, 2015). A DFFE permit should be acquired to remove *V. erioloba* in areas where it will be influenced by construction. Due to the site's poor ecological condition, it is unlikely that other rare or endangered species will be found. If any such species were missed during the site survey and become visible in the rainy season, construction should halt until the species is removed or transplanted into a suitable habitat.

7.2. Faunal survey overview:

The site had very few signs of animal life. Indications of mammalian presence are presented by a few sparsely distributed burrows and molehills. The low levels of animal life are most likely due to the intense levels of disturbance accompanying the first phase of student accommodation's construction. During the site visit, *Cynictis penicillata* (Yellow mongoose) and a few small mounds of earth, possibly from *Cryptomys hottentotus* (Southern African mole-rat), were observed (Appendix 1, Table 6). Both these species are listed as least concerned. In addition, the partial skeletal remains of a jackal, most likely *Lupulella mesomelas* (Southern black-backed jackal), were found near the southern borders of the site. Pawprints of stray dogs give some explanation to the dispersing of the jackals' skeleton. Finally, an animal trap configured to trap small animals was located near the southwestern border of the site. Any such activity must be prohibited throughout the duration of the development.

The site did not have a substantial presence of reptiles. During the site survey, a reptile species resembling *Karusasaurus polyzonus* (Karoo Girdled Lizard) was observed. Unfortunately, a positive ID on this individual was not possible since it quickly took shelter between a pile of construction material. No other reptile species were observed during the site visit; however, other species of reptile could still possibly inhabit the area (Appendix 2, Table 7). Habitat compatibility and observations from locals indicate that three different reptile species could be present in the area. These are *Boaedon capensis* (Common brown house snake), *Bitis arietans* (Puff adder) and possibly *Karusasaurus polyzonus*, all of which are listed least concerned.

The proposed development will transform most of the site's vegetation and consequently the remaining habitat for fauna. It should be noted that the existing ecological condition of the site is deplorable as a result of the ongoing construction. The construction has undoubtedly introduced a significant level of disturbance which is most likely responsible for the lack of any notable animal species presence. Several animal species were likely overlooked during the site survey; however, it is improbable that any rare or endangered species would still reside in the area due to the site's current condition and proximity to the city.

7.3. Biodiversity sensitivity rating:

The vegetation is in an advanced degraded state, which has led to a low animal and plant species richness and an impressive presence of exotic plants. No rare or endangered species were recorded, and owing to the poor ecological condition, it is unlikely that any such species will be present. Therefore, the BSR score concluded that the site is preferred for development.

Table 2 Final biodiversity sensitivity rating evaluation.

Vegetation characteristics:	**Score (1-3)**
Habitat diversity	3
Rare and endangered species	3
Ecological function	3
Conservation value	3
Vegetation condition:	
Percentage ground cover	2
Vegetation structure	2
Infestation of exotic and invasive plants	3
Impact of grazing/ browsing	1
Erosion	3
Animal characteristics:	
Rare and endangered species	3
BSR total score:	**26**
Development preference rating	**Preferred**

7.3.1. Habitat diversity and plant species richness:

The site consists of slightly irregular plains with a well-developed tree layer. Most vegetation units present a slight discontinuous tree layer. Most VUs display an almost continuous ground cover consisting primarily of pioneering and sub-climax species. The above counts true for most VUs, excluding VU-C, which lacks groundcover entirely due to grading and the frequent movement of construction vehicles (Figure 5). The site's vegetation represents the characteristics of a heavily degraded ecosystem.

7.3.2. Rare and endangered plant species:

The site survey did not result in the identification of any rare or endangered plant species. Due to the site's ongoing construction and degraded condition, it is improbable that any such species could occur. Two protected species were present

on the site; *Nerine laticoma* and *Vachellia erioloba*, both protected in the Northern Cape province (Northern Cape Nature Conservation Act no 9, 2009).

7.3.3. Ecological function:

The ongoing construction for the nursing college's accommodation has adversely affected the ecological functioning of the site. The grading of large areas of indigenous vegetation and the dense populations of exotic plant species severely hampers the ecosystem's ability to uphold a sustainable faunal community. Thus, this site does not represent a healthy functioning ecosystem.

7.3.4. Conservation value:

The site consists of Kimberley thornveld vegetation (SVk4) listed as a vegetation type of least conservation concern (Mucina and Rutherford, 2006; Government Gazette no. 34809, 2011; Department of Environmental Affairs, 2016). This site is not listed as any of the ecological support or critical biodiversity areas under the Northern Cape Biodiversity Management Plan (Figure 8, Appendix 6) (Northern Cape Department of Environmental and Nature Conservation, 2016). The site's placement outside the city of Kimberley allows for better connectivity to other natural ecosystems, increasing the conservation value. However, due to the site's poor ecological functioning, it is considered to have little conservation value.

7.3.5. Percentage ground cover:

The site has many VUs that presents an open grass layer with many patches of exposed soil. A patchy grass layer does not always indicate degradation since areas with bare soil are recognised as a characteristic of SVk4's natural appearance (Mucina and Rutherford, 2006). However, this does not include the large areas that have been graded or disturbed to such an extent that most of the grass layer has been removed. Most areas on site that present a patchy grass layer are inhabited by secondary successional plant species indicative of environmental disturbance.

7.3.6. Vegetation structure:

When excluding the large area that has been graded, the overall vegetation structure is in a moderate condition. However, it is essential to note that much of the grass layer is succumbing to the invasion of exotic species and the removal of indigenous vegetation.

7.3.7. Infestation of exotic and invasive plant species:

The majority of the site is experiencing the adverse effects of a high presence of exotic species such as *Conyza sumatrensis, Bidens pilosa, Tagetes minuta* and *Verbesina encelioides. Datura stramomium* and *Lantana rugosa* are both category 1b invasives (NEMBA, 2016), however these species were not present in high densities.

7.3.8. Impact of grazing/ browsing:

The site is entirely fenced off, and current construction activities do not present a livestock/ game-friendly environment.

7.3.9. Erosion:

Erosion is evident on the site and includes sheet erosion promoted by the grading of a large area in the western parts of the site. Additionally, channel erosion is promoted by fast-flowing water after excavation, which formed the stormwater channel down the site's north western boundary. A comprehensive stormwater plan should be installed to prevent further erosion.

7.3.10. Rare and endangered animal species:

No rare or endangered animal species were recorded during the site visit. The site's current construction and degraded ecological condition make it improbable that any such species would occur on the site. Furthermore, the site's proximity to the city introduces feral animals, presenting a threat to rare and endangered animal species. The evidence here off is represented by fresh dog paw prints located near the site's southern boundary. These animals can access the site through various shallow tunnels dug under the fence.

8. Anticipated impacts:

This project will result in an overall loss of biodiversity through habitat destruction and reduction of species diversity. The site is situated in the Kimberley thornveld vegetation type (SVk4), regarded as a vegetation type of least conservation concern (Mucina and Rutherford, 2006; Government Gazette no. 34809, 2011; Department of Environmental Affairs, 2016). The site consists of a well-developed discontinuous tree layer characteristic of SVk4 (Mucina and Rutherford, 2006) and a broken grass layer heavily degraded by construction activities and an extensive presence of exotic plants.

The site contains two protected plant species, *Vachellia erioloba* and *Nerine laticoma*. Both species are relatively widespread in the Northern Cape, Botswana and Namibia, which lowers their conservation value; However, *V. erioloba* is described with having a declining population trend (Snijman, and Victor, 2004; von Staden and Raimondo, 2015). Both these species are listed as protected in the Northern Cape which increases their conservation value. A permit has to be obtained to transplant *N. laticoma* into a suitable habitat outside the influence of any direct developments. A DFFE permit is required to remove *V. erioloba* individuals who will be affected by the development. If removing these species can be avoided and incorporated into the landscape design, it should be treated as a viable/ preferred option.

The disturbance caused by the construction of the college and phase two student accommodation will create susceptible conditions for the further invasion of exotic plants. These exotic weeds will most likely outcompete the establishment of native plant species and should be avoided by implementing a comprehensive exotic species management program. Seeing that much of the indigenous vegetation has been removed, the anticipated impact on indigenous plants will be low. Channel erosion in the stormwater canal transports has transported a significant volume of sediment down the stream. Further channel erosion should be avoided by installing a comprehensive stormwater management plan.

The development will result in an overall loss of animal species diversity. Long-term disturbance due to the continual construction activities and the site's proximity to the city, which introduces feral animals and hunting small animals, has most likely removed any sensitive animal species. Therefore, the proposed development will have a low anticipated impact on animal species diversity.

8.1. Concerned ecological aspects:

Habitat loss and or fragmentation is a leading cause of the global biodiversity crisis. The removal of environmental units will lead to the destabilisation of the entire ecosystem and eventually ecological breakdown. The proposed development will result in an overall loss of habitat and have an overall low impact significance. The current construction activities have severely disturbed the site and leave the site with very little conservation value.

Table 3 Ecological impact on habitat loss assessed using Table 8, Appendix 3 and final evaluation form from Table 9, Appendix 4.

Concerned aspect:	**Impact characteristic**	**Score**
Habitat loss	Geographical extend	1
	Probability	3
	Duration	3
	Reversibility	2
	Cumulative impacts	2
	Intensity	2
	TOTAL	**22**
Significance rating	**Low**	

Indigenous vegetation has a far greater conservation value to exotic species. Indigenous species have adapted to the surrounding environment and have established many stable networks of energy transfer. The removal of indigenous species disrupts this balance which has formed over many years. The proposed development will result in an overall loss of indigenous species; however, the strong presence of exotic plants and current construction has severely degraded the site. The estimated impact on the surrounding transformed vegetation will thus be of a low degree.

Table 4 The anticipated impact on the loss of indigenous plant and animal species diversity assessed using Table 8, Appendix 3 and final evaluation form from Table 9, Appendix 4.

Concerned aspect:	Impact characteristic	Score
Loss of indigenous plant and animal species diversity	Geographical extend	1
	Probability	2
	Duration	3
	Reversibility	3
	Cumulative impacts	2
	Intensity	2
	TOTAL	**22**
Significance rating	**Low**	

Protected species have been assigned protected status either nationally or provincially. These species are of unique conservation concern for many purposes. These include socio-economic importance, scarcity, limited distribution, and ecological significance. Removing these species should be avoided at all costs. If removal is unavoidable, the necessary permits should be acquired for their removal and translocation if possible. The proposed development may result in the removal of various *V. erioloba* and *N. laticoma* individuals. Both species enjoy a relatively broad distribution across southern Africa; however, this should not be the motive for removing them. *V. erioloba* should be introduced into the design of the development to the furthest extend possible. *N. laticoma* should be used in the horticultural layout of the development as far as possible.

Table 5 The anticipated impact on the loss of protected plant and animal species assessed using Table 8, Appendix 3 and final evaluation form from Table 9, Appendix 4.

Concerned aspect:	Impact characteristic	Score
Loss of protected plant and animal species	Geographical extend	1
	Probability	4
	Duration	4
	Reversibility	3
	Cumulative impacts	2
	Intensity	2
	TOTAL	**28**
Significance rating	**Low**	

9. Recommendations:

- The site contains two protected plant species namely, *Vachellia erioloba* and *Nerine laticoma*. The GPS locations of these species were logged. *V. erioloba* is a slow-growing tree with a declining population trend, and it is recommended that this tree be incorporated into the layout of the development. The removal of *V. erioloba* may only occur after the necessary DFFE permits are obtained.
- *N. laticoma* creates stunning flowers, and it is recommended that it be incorporated into the development's horticultural design. In areas where *N.*

laticoma will be influenced by construction activities, it should be transplanted, and the necessary permit should be obtained. The transplant of *N. laticoma* should be performed by a qualified individual.

- It is strongly advised that indigenous plants be incorporated into the landscape and horticultural design of the development.
- Due to the dense presence of exotic plants, adequate monitoring of weed establishment and their continued eradication should be maintained during and after construction.
- A comprehensive stormwater management program should be implemented.
- The hunting, capturing and trapping of fauna should be prevented throughout the construction and operation of the facility.
- Unnecessary removal of vegetation should be prohibited.
- All construction-related waste material should be temporarily stored at a designated place on site. The designated waste point should be easily accessed by waste removal trucks.
- All construction-related waste/material should be appropriately disposed of after the construction has ceased.

10. Discussion and conclusion:

The proposed development is situated in the southern parts of Kimberley, Northern Cape. The site falls within the Kimberley thornveld vegetation type (SVk4), listed as a vegetation type of least conservation concern. The proposed development site does not fall within any of the critical biodiversity or ecological support areas as indicated by the Northern Cape critical biodiversity areas map (DENC, 2016)

The site is experiencing ongoing construction of the first phase of student accommodation, which is included in the environmental authorisation obtained for the Kimberley Mental Health Hospital adjacent to the proposed development. The construction activities have severely impacted the site leaving it in a severely degraded state. The clearing of large areas for construction has created a susceptible environment for the proliferation of exotic plants. *Conyza sumatrensis*, *Tagetes minuta, Bidens pilosa*, and *Verbesina encelioides* are all exotic species with dense populations scattered around the site. The majority of the site's vegetation and consequently habitat for fauna has been severely disturbed and transformed. The transformed vegetation does not deserve a high conservation value.

Two protected plant species, namely *Vachellia erioloba* and *Nerine laticoma* were located on the site. The localities of these species were logged. It is advised that these species be incorporated into the landscape design. The removal of these species should only take place when absolutely necessary and the required permits obtained. It is advised that *N. laticoma* be transplanted into a suitable non-disturbed habitat. The transplant of *N. laticoma* may only occur after the relevant plant species harvesting permit is obtained.

A biodiversity sensitivity rating was conducted to evaluate the current ecological condition and the site's sensitivity to development. The BSR evaluation concluded that the site is in an advanced degraded state with an overal low species richness. Rehabilitation will be costly since much of the ecological function has been severely hampered. The site is thus concluded as preferred for development.

An impact assessment was performed and resulted in an overall low impact significance score. With adequate mitigation measures, the impacts emanating from the development will be very low.

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12. Appendices:

12.1. Appendix 1: Species list of mammals

Table 6 Species list of mammals both present and possibly occurring. Probability rating: (1) very low probability, (2) low probability, (3) medium probability, (4) High probability. (Green) observed during field survey. Red list category: (Orange) endangered, (Yellow), vulnerable, (Green) Least concerned.

Family	Scientific Name	Common name	Red list category	Probability rating
Bathyergidae	*Cryptomys hottentotus*	Southern African Mole-rat	Least Concern (2016)	4
Bovidae	*Antidorcas marsupialis*	Springbok	Least Concern (2016)	1
Bovidae	*Cephalophus sp.*	Common Duikers		2
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern (2016)	1
Canidae	*Otocyon megalotis*	Bat-eared Fox	Least Concern (2016)	2
Cercopithecidae	*Chlorocebus pygerythrus*	Vervet Monkey	Least Concern (2016)	2
Felidae	*Caracal caracal*	Caracal	Least Concern (2016)	2
Felidae	*Felis catus*	Domestic Cat	Introduced	4
Felidae	*Felis nigripes*	Black-footed Cat	Vulnerable (2016)	2
Herpestidae	*Cynictis penicillata*	Yellow Mongoose	Least Concern (2016)	4
Herpestidae	*Herpestes sanguineus*	Slender Mongoose	Least Concern (2016)	3
Herpestidae	*Suricata suricatta*	Meerkat	Least Concern (2016)	3
Hyaenidae	*Proteles cristata*	Aardwolf	Least Concern (2016)	2
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern	2
Leporidae	*Lepus capensis*	Cape Hare	Least Concern	2
Leporidae	*Lepus saxatilis*	Scrub Hare	Least Concern	2
Macroscelididae	*Macroscelides proboscideus*	Short-eared Elephant Shrew	Least Concern (2016)	2
Mustelidae	*Ictonyx striatus*	Striped Polecat	Least Concern (2016)	1
Nesomyidae	*Saccostomus campestris*	Southern African Pouched Mouse	Least Concern (2016)	3
Orycteropodidae	*Orycteropus afer*	Aardvark	Least Concern (2016)	1
Procaviidae	*Procavia capensis*	Cape Rock Hyrax	Least Concern (2016)	1

Suidae	*Phacochoerus africanus*	Common Warthog	Least Concern (2016)	1
Viverridae	*Genetta genetta*	Common Genet	Least Concern (2016)	2

12.2. Appendix 2: Species list of reptiles

Table 7 Species list of reptiles both present and possibly occurring. Probability rating: (1) very low probability, (2) low probability, (3) medium probability, (4) High probability. (Green) observed during field survey. Red list category: (Orange) endangered, (Yellow), vulnerable, (Green) Least concerned.

Family	Scientific name	Common name	Red list	Probability rating
Amphisbaenidae	*Monopeltis capensis*	Cape Worm Lizard	Least Concern (SARCA 2014)	3
Cordylidae	*Karusasaurus polyzonus*	Karoo Girdled Lizard	Least Concern (SARCA 2014)	4
Elapidae	*Elapsoidea sundevallii media*	Highveld Garter Snake		
Elapidae	*Naja nivea*	Cape Cobra	Least Concern (SARCA 2014)	4
Gekkonidae	*Chondrodactylus bibronii*	Bibron's Gecko	Least Concern (SARCA 2014)	3
Gekkonidae	*Lygodactylus bradfieldi*	Bradfield's Dwarf Gecko	Least Concern (SARCA 2014)	1
Gekkonidae	*Lygodactylus capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)	3
Gekkonidae	*Pachydactylus mariquensis*	Marico Gecko	Least Concern (SARCA 2014)	3
Lacertidae	*Nucras holubi*	Holub's Sandveld Lizard	Least Concern (SARCA 2014)	2
Lacertidae	*Nucras intertexta*	Spotted Sandveld Lizard	Least Concern (SARCA 2014)	2
Lamprophiidae	*Boaedon capensis*	Brown House Snake	Least Concern (SARCA 2014)	4
Lamprophiidae	*Psammophis trinasalis*	Fork-marked Sand Snake	Least Concern (SARCA 2014)	3
Pelomedusidae	*Pelomedusa galeata*	South African Marsh Terrapin	Not evaluated	
Scincidae	*Trachylepis spilogaster*	Kalahari Tree Skink	Least Concern (SARCA 2014)	3
Scincidae	*Trachylepis sulcata sulcata*	Western Rock Skink	Least Concern (SARCA 2014)	3
Scincidae	*Trachylepis variegata*	Variegated Skink	Least Concern (SARCA 2014)	4
Testudinidae	*Homopus femoralis*	Greater Padloper	Least Concern (SARCA 2014)	3
Testudinidae	*Psammobates oculifer*	Serrated Tent Tortoise	Least Concern (SARCA 2014)	3
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern (SARCA 2014)	3
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	Least Concern (SARCA 2014)	3
Varanidae	*Varanus albigularis albigularis*	Rock Monitor	Least Concern (SARCA 2014)	4
Viperidae	*Bitis arietans arietans*	Puff Adder	Least Concern (SARCA 2014)	4

12.3. Appendix 3: Impact assessment evaluation form

Table 8 Description of the rating system used to evaluate the possible impacts concerned with the proposed development.

Geographical extend: This describes the spatial reach an impact might have.		
Score		
1	Site specific	The impacts will only affect the specific site.
2	Local	The impacts will affect the local area or district.
3	Provincial	The impacts will be recognised across most of the province.
4	International/ national	Will affect the entire country or other countries.
Probability: This describes the probability that a specific environmental impact will occur.		
1	Unlikely	Less than 25% chance of occurrence.
2	Possible	Between 25-50% chance of occurrence.
3	Most likely	50-75% chance of occurrence.
4	Definite	Greater than 75% chance of occurrence.
Duration: This describes the amount of time an environment will be affected by the impact.		
1	Short term	The impact will disappear very quickly, either through mitigation or through natural processes. The impact should have disappeared within 1 year.
2	Medium term	The impact will endure for a short while after the construction processes and will be mitigated by either human intervention or natural processes. The impact should have disappeared between 2-10 years. .
3	Long term	The impact will persist through the construction phase and disappear by either human intervention or natural processes in 10-30 years.
4	Permanent	Mitigation either by man or natural processes is highly unlikely. The impact will have permanently affected the environment.
Reversibility: Describes the potential of an impact to be entirely reversed after development.		
1	Entirely reversable	The impact is entirely reversible and can be achieved with minor mitigation measures.
2	Possibly reversable	The impact might be reversible. Suitable mitigation measures will increase the chances of reversibility and should be considered.
3	Barely reversible	It is unlikely that the impact will be reversed. Extreme mitigation measures might increase the chances of successful reversibility.
4	Irreversible	The impact is irreversible. No mitigation measures can reverse the effects on the environment.
Cumulative impacts: Describes the cumulative impacts of the proposed development, i.t.o. the development process and all activities emanating from the operation of the facility.		
1	Very low cumulative impact	The impact will result in no or minimal cumulative effects.
2	Low cumulative impact	The impact will result in an overall low cumulative effect.
3	Moderate cumulative impact	The cumulative impacts will have moderate levels of impact.
4	High cumulative impact	The cumulative impact will result in high to very high environmental effects.
Intensity: Describes the severity of the impact on the environment		
1	Low	The impact's effect on the system will be hardly noticeable, if at all. Rehabilitation measures have to be in place if required.
2	Medium	The impact will have a recognisable effect on the environment. However, system functionality will still be present with negligible

		effects on ecosystem integrity. Rehabilitation measures have to be in place.
3	High	The impact will severely affect ecosystem integrity and function. Rehabilitation will be costly, and extreme mitigation measures have to be in place.
4	Very high	The impact will result in the entire ecological breakdown of the system or components thereof. Rehabilitation will be costly with minimal chances of success. Extreme mitigation measures must be in place.

12.4. Appendix 4: Impact significance on the environment

Impact significance describes the overall environmental impact resulting from the cumulation of impact characteristics. Significance gives a judgement of the effect a development will have on the environment. Significance is calculated as the total score for each criterion (geographical extend + probability + duration + reversibility + cumulative impacts) multiplied by the intensity. A greater significance score results in an overall greater environmental impact and should be avoided or allowed with extreme mitigation measures in place. A lower significance score results in an overall lesser environmental impact and may be allowed with very little or no mitigation measures needed.

Table 9 Impact significance evaluation form

Score	Impact significance rating	Description
5-19	Very low	Impact significance is of a very low order. Development is acceptable
20-34	Low	Impact significance is of a low order, and development is acceptable.
35-49	Moderate	The impact will be recognisable and may pose a problem to the development.
50-64	High	The impact is substantial and will significantly affect the environment. Development is unacceptable.
65-80	Very high	The impact is of the highest possible order and will cause irrefutable damage to the environment. Development unacceptable.

12.5. Appendix 5: Plant Species list

Species indicated with an * are exotic.

Protected species are coloured orange and Red Listed species red.

Table 10 Species list of the various plant species found on the proposed development site.

FAMILY	SPECIES	NEMBA category
Acanthaceae	*Barleria macrostegia*	
Aizoceae	*Ruschia hamata*	
Amaryllidaceae	*Nerine cf. laticoma*	
Anacardeaceae	*Searsia ciliata*	
Anacardeaceae	*Searsia lancea*	
Apiaceae	*Deverra denudata*	
Apocynaceae	*Pergularia daemia*	
Asparagaceae	*Asparagus nelsii*	
Asteraceae	**Bidens pilosa*	
Asteraceae	**Conyza sumatrensis*	
Asteraceae	**Pseudognaphalium album*	
Asteraceae	**Tagetes minuta*	
Asteraceae	**Verbesina encelioides*	
Asteraceae	*Amphiglossa triflora*	
Asteraceae	*Arctotis venusta*	
Asteraceae	*Berkheya pinnatifida*	
Asteraceae	*Chrysocoma obtusata*	
Asteraceae	*Eriocephalus cf. ambiguus*	
Asteraceae	*Felicia muricata*	
Asteraceae	*Gazania krebsiana*	
Asteraceae	*Nidorella resedifolia*	
Asteraceae	*Pentzia globosa*	
Asteraceae	*Senecio consanguineus*	
Boraginaceae	*Ehretia rigida*	
Cucurbitaceae	*Citrullus lanatus*	
Fabacaee	*Melolobium microphyllum*	
Fabaceae	*Lotononis sp.*	
Fabaceae	*Senegalia mellifera*	
Fabaceae	*Senna italica*	
Fabaceae	*Tribulus terrestris*	
Fabaceae	*Vachellia erioloba*	
Fabaceae	*Vachellia hebeclada*	
Fabaceae	*Vachellia tortilis*	
Lamiaceae	*Salvia cf. disermas*	
Poaceae	*Aristida congesta*	
Poaceae	*Eragrostis annulata*	

Poaceae	*Eragrostis echinochloidea*	
Poaceae	*Eragrostis lehmanniana*	
Poaceae	*Eragrostis nindensis*	
Poaceae	*Heteropogon contortus*	
Poaceae	*Melinis repens*	
Poaceae	*Pogonarthria squarrosa*	
Poaceae	*Schmidtia kalahariensis*	
Poaceae	*Schmidtia pappophoroides*	
Poaceae	*Stipagrostis ciliata*	
Poaceae	*Stipagrostis obtusa*	
Poaceae	*Stipagrostis uniplumis*	
Poaceae	*Themeda triandra*	
Poaceae	*Tragus racemosa*	
Poaceae	*Urochloa oligotricha*	
Rhamnaceae	*Ziziphus mucronata*	
Ruscaceae	*Eriospermum roseum*	
Scrophulariaceae	*Nemesia fruticans*	
Solanaceae	**Datura stramomium*	1b
Thymeleaceae	*Lasiosiphon polycephalus*	
Verbenaceae	**Lantana rugosa*	1b

12.6. Appendix 6: Maps

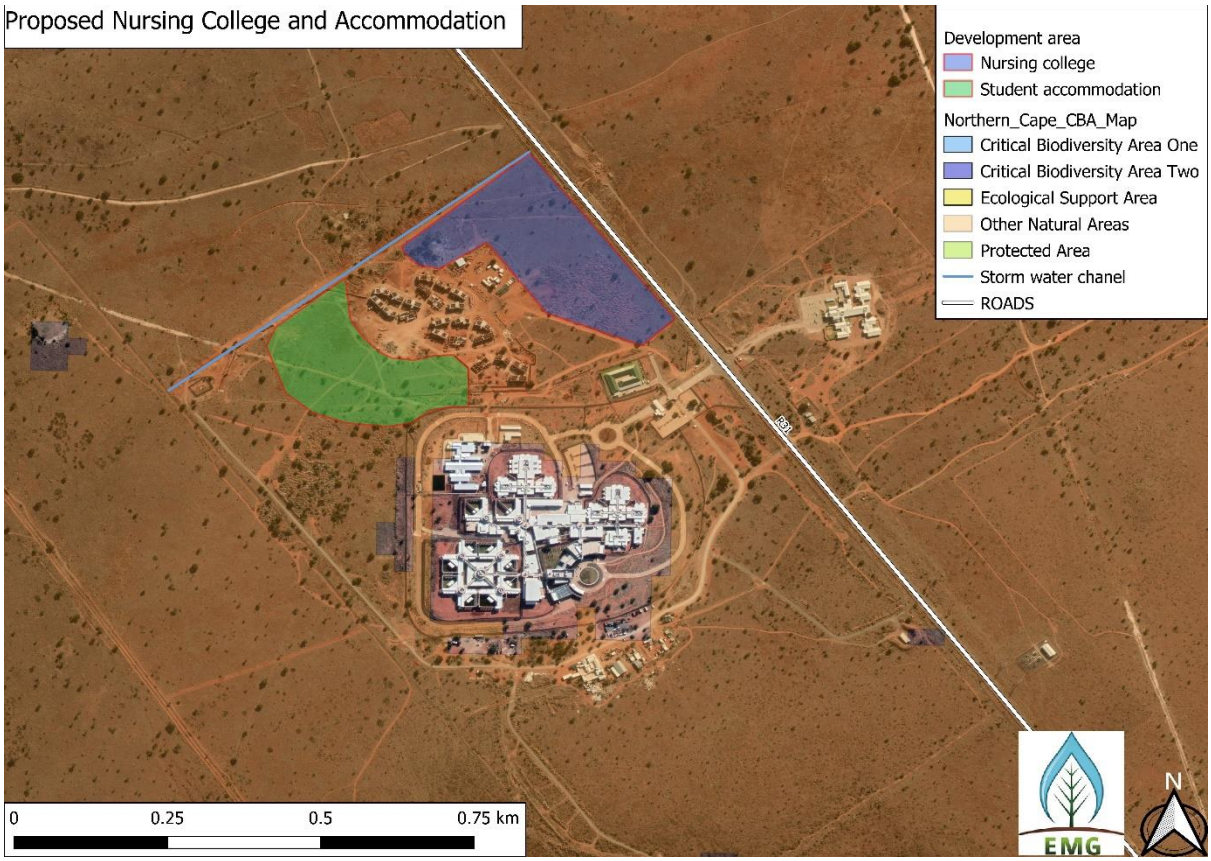

Figure 8 Sensitive biodiversity area map overlain by the proposed development. (Blue) indicates the locality of the proposed nursing college and (Green) the expansion of student accommodation.

Phase 1 Heritage Impact Assessment for a proposed new Nursing College facility in Kimberley, NC Province.

Report prepared by
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July 2021

Summary

A Phase 1 Heritage Impact Assessment was carried out for the proposed construction of a new nursing college facility on the farm Bultfontein 80 near Kimberley, NC Province. The affected area lies within an outcrop area of dolerite (Karoo Dolerite Suite) surrounded by Quaternary-age surface calcretes and aeolian sand. The terrain has been severely degraded by previous industrial and commercial activities. There are no indications of prehistoric structures or rock engravings within the footprint area. There is also no evidence of informal graves or historical structures older than 60 years within the confines of the footprint. The field assessment indicates that the proposed development will primarily affect degraded topsoils underlain by dolerite bedrock, which are not palaeontologically significant. Very little possibility exists that objects of palaeontological significance may be uncovered during the course of excavation activities into possibly *in situ* Quaternary soils overlying the terrain. In accordance with the types and ranges of heritage resources as outlined in the National Heritage Resources Act (No 25 of 1999), there is no aboveground evidence of historical structures or material of cultural significance, graves or archaeological sites within the demarcated area. The site is assigned a heritage rating of General Protection C.

Introduction

A Phase 1 Heritage Impact Assessment was carried out for the proposed construction of a new nursing college facility on the farm Bultfontein 80 near Kimberley, NC Province (**Fig. 1**). The extent of the proposed development (over 5000 m2) falls within the requirements necessary for a Heritage Impact Assessment (HIA) as required by Section 38 (Heritage Resources Management) of the South African National Heritage Resources Act (Act No. 25 of 1999). The site visit and subsequent assessment took place in February 2014. The task involved identification of possible archaeological and palaeontological sites or occurrences in the proposed zone, an assessment of their significance, possible impact by the proposed development and recommendations for mitigation where relevant.

Methodology

The palaeontological and archaeological significance of the affected area was based on existing field data, database information, published literature and geological maps. This was followed up with a field assessment by means of a pedestrian survey and investigation of exposures and outcrop within the footprint. A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera were used for recording purposes.

Locality Data

Maps: 1:50 000 topographical map 2824 DC Spytfontein

1:250 000 geological map 2824 Kimberley

Site Coordinates (**Fig. 2**):

A) 28°45'56.13"S 24°43'18.06"E
B) 28°46'4.71"S 24°43'25.46"E
C) 28°46'6.58"S 24°43'22.13"E
D) 28°46'1.57"S 24°43'15.02"E
E) 28°46'3.28"S 24°43'12.39"E
F) 28°46'1.35"S 24°43'10.16"E

The site is situated next to the N12 national road between Kimberley and Hopetown on the farm Bultfontein 80 (**Fig. 2**). The proposed site lies on a farm portion that is already partially developed (**Fig. 3**).

Geology

The geology of the region has been described by Bosch (1993). The area in question is underlain by sediments of widely different geological ages (**Fig. 4**, portion of 1: 250 000 scale geological map 2924 Koffiefontein, Council for Geoscience, Pretoria, 1991). From oldest to youngest, the geology in and around the affected area is made up of Permian Ecca shales (Whitehall Formation, *Pw*), Jurassic dolerite intrusions (*Jd*, Karoo Dolerite Suite), Quaternary calcretes, surface limestones (*Qc*) and aeolian sands (*Qs*) (Kalahari Group).

Background

Karoo Fossils

Basinal strata of the Prince Albert Formation from the lowermost Ecca Group (*Pw*), outcropping to the north of the development footprint, contains fossil-bearing, laminated mudrocks with petrified wood, invertebrates, fish, coprolites and palynomorphs from calcareous concretions previously recorded near Douglas (McLachlan and Anderson 1973, Visser *et al.,* 1977-78)**.**

Dolerites

Dolerite, in the form of dykes and sills, is common throughout the region. Regarded as feeders of Drakensberg lavas, dolerites are not palaeontologically significant and can be excluded from further consideration in the present evaluation. On the other hand, dolerite outcrop can be regarded as archaeologically significant since Stone Age lithic artifacts in the region are mostly made of hornfels, a fine-grained isotropic rock found in the hot-contact zone between the dolerites and shales in the area. As a result, stone tool factory sites are commonly found near dolerite-shale contact zones. In addition, rock engravings in the region are consistently found on dolerite.

Late Cenozoic Deposits

The occurrence of Plio-Pleistocene fossil remains is largely restricted to the alluvial gravel terraces of the Vaal River northeast of Kimberly and overbank sediments of the Modder and Riet Rivers situated to the east (Cooke 1949; Maglio and Cooke 1978; Partridge and Maud 2000; Churchill *et al.* 2001; Rossouw 2006). Gravel terraces of the Vaal River contain sandy lenses that have yielded several extinct vertebrate taxa.

Stone Age archaeology

The heritage footprint in the region is primarily represented by Stone Age sites and assemblages, either capped or occurring as surface occurrences, rock engraving sites, glacial pavements and structural remnants dating back to the Kimberley Diamond Rush

of the 1870's and the Anglo Boer War (**Fig. 5**). The early exploitation of the Vaal River Gravels by diamond diggers and the resulting development of infrastructure in the region exposed a wealth of archaeological sites that contributed to the development of prehistoric archaeology in southern Africa (Sohnge *et al*. 1937; Helgren 1979; Beaumont and Morris 1990; Forssman et al. 2010). As a result, Stone Age archaeological sites in the region are generally associated with, and mostly restricted to a variety of lacustrine contexts as well as the alluvial gravel terraces of the Vaal River. Some important sites located within 40 km of study area include

- an abundance of Fauresmith and Acheulian artifact assemblages found in an andesite cobble and worn exotics matrix capped by a thick layer of red sand at Nooitgedacht near The Bend on the Vaal;
- an abundance of Acheulian artifact assemblages found in thick calcrete deposits at Doornlaagte (a declared national monument), some 20 km east of Schmidtsdrif.
- the famous Nooitgedacht Glacial Pavements situated near the banks of the Vaal River consisting of multiple striations on amygdaloidal Ventersdorp andesite that was produced by an ice age that commenced in early Carboniferous times. In addition to the glacial striations the site is also known for its rock engravings (**Fig. 6**).
- ESA and MSA stone tools uncovered during mining operations between 1930 and 1955 at Pniel (Powers Site) near Nooitgedacht (**Fig. 7**).
- Canteen Koppie, which is the location of the first alluvial diamond diggings in South Africa that continued up until the 1920's. Proclaimed a National Monument in 1948, the alluvial gravels capping the underlying bedrock at the site has yielded a wealth of ESA stone tools while MSA lithics have been recovered from within the layer of red sands overlying the terrain.
- A large number of *Fauresmith* bifaces occur *in situ* within Quaternary-age surface deposits at Kromrand (Lebensraum) 22 km southwest of Boshof (**Fig. 8**).

Historical Heritage

The lower Vaal River basin region was central to the dynamics of colonial expansion along the northern Cape frontier zone and its impact on the Khoisan societies of the

Cape interior (Penn 2005) (**Fig. 9**). The proposed development footprint is located southwest of a historically significant area that also forms part of Kimberley's historical Diamond Route as related to the Kimberley Diamond Rush of the 1870's (Morton 1877; Williams 1902; Van Zyl 1986) (**Fig. 9**). Diamonds were discovered on the farms Dorstfontein and Dutoitspan in 1870 and at Bultfontein and Vooruitzicht in 1871. The first diamond mines on Vooruitzicht became known as Old De Beers. Later that year miners from the Old De Beers Mine discovered what would become the richest diamond mine in the world, namely the Kimberley Mine, known initially as New Rush or Colesberg Kopje. Another rich diamond deposit was discovered on the farm Benaauwdheidsfontein in 1890, later to become known as the Wesselton Mine.

Major battles occurred between the British and Boer forces in late 1899 south of the study area (**Fig. 10**). In November 1899, British general Methuen successfully fought the Boers at Belmont, Graspan and Modder River, while the Boers defeated the British forces at Magersfontein in December 1899 (Amery 1905; Von der Heyde 2013).

Field Assessment

The affected area lies within an outcrop area of dolerite (Karoo Dolerite Suite) surrounded by Quaternary-age surface calcretes and well-developed aeolian sand (**Fig. 11**). It has been severely degraded by previous and ongoing industrial and commercial activities. There are no indications of prehistoric structures or rock engravings within the footprint area. There is also no evidence of informal graves or historical structures older than 60 years within the confines of the footprint.

Impact Statement & Recommendation

The proposed project will primarily affect a well-developed (and geologically recent) aeolian sand overburden that is underlain by dolerite bedrock (**Fig 11**). It is therefore considered highly unlikely that the proposed development might negatively affect objects or sites of palaeontological significance.

Although situated within an area that is archaeologically significant as indicated by the prevalence of open site Stone Age accumulations, rock engravings and historical battlefield sites, the site is not archaeologically vulnerable, as it has been severely degraded by previous human disturbance. In accordance with the types and ranges of heritage resources as outlined in the National Heritage Resources Act (No 25 of 1999), there is no aboveground evidence of historical structures, graves or material of cultural

significance, or archaeological sites within the demarcated area. The site is assigned a heritage rating of General Protection C (**Table 1**).

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DECLARATION OF INDEPENDENCE

I, Lloyd Rossouw, declare that I act as an independent specialist consultant. I do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work as stipulated in the terms of reference and have no interest in secondary or downstream developments resulting from the authorization of this project.

Tables & Figures

Table 1. Field rating categories as prescribed by SAHRA

Field Rating	**Grade**	**Significance**	**Mitigation**
National Significance (NS)	Grade 1	-	Conservation; national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation; mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A (GP.A)	-	High/medium significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium significance	Recording before destruction
Generally Protected C (GP.C)	-	Low significance	Destruction

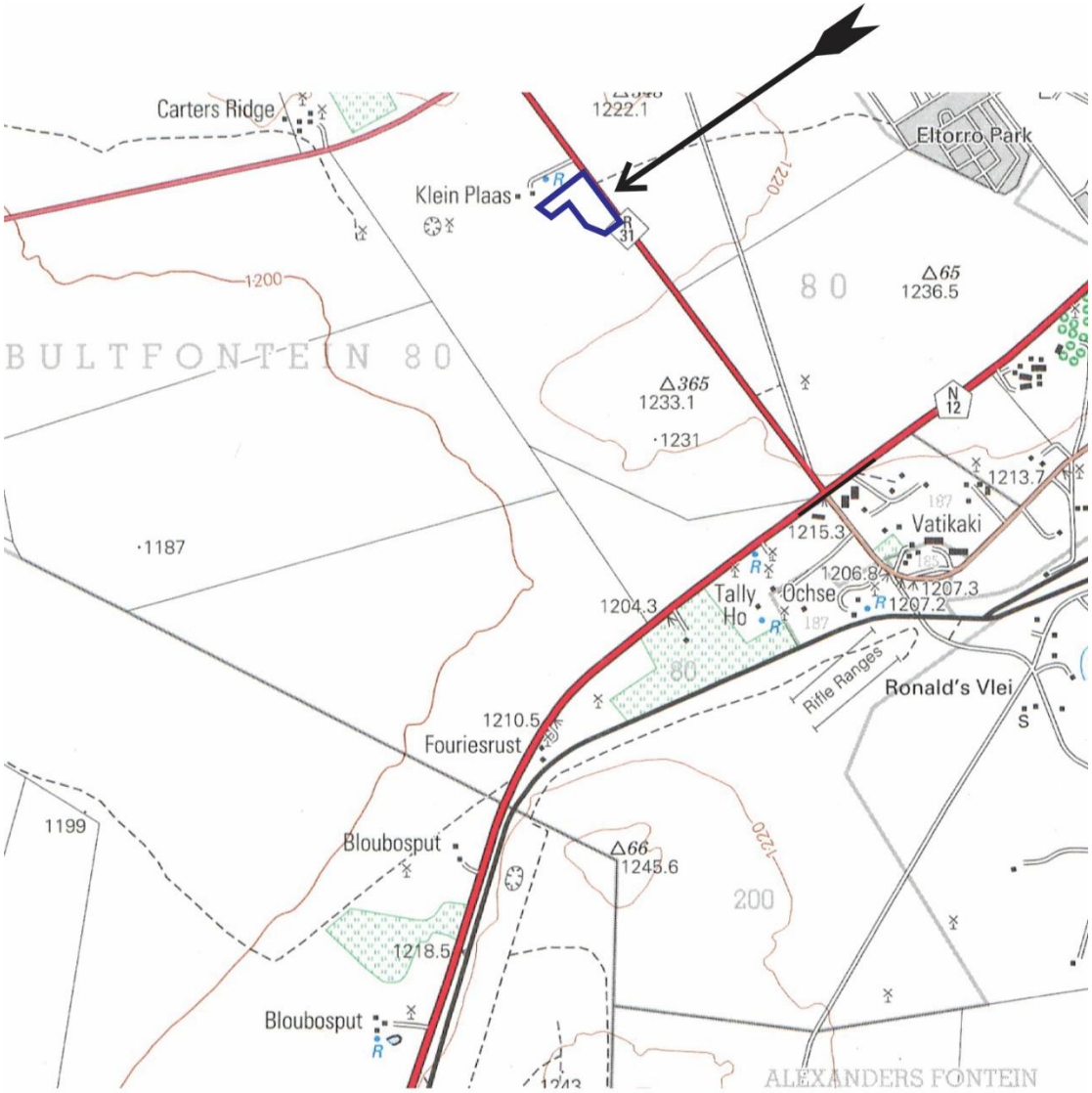

Figure 1. Map of the proposed development area (portion of 1:50 000 scale topographic map 2824 DC Spytfontein).

Figure 2. Aerial view and layout of the proposed study area.

Figure 3. General view of the site, looking west (above left), north (above right) east (below left) and south (below right).

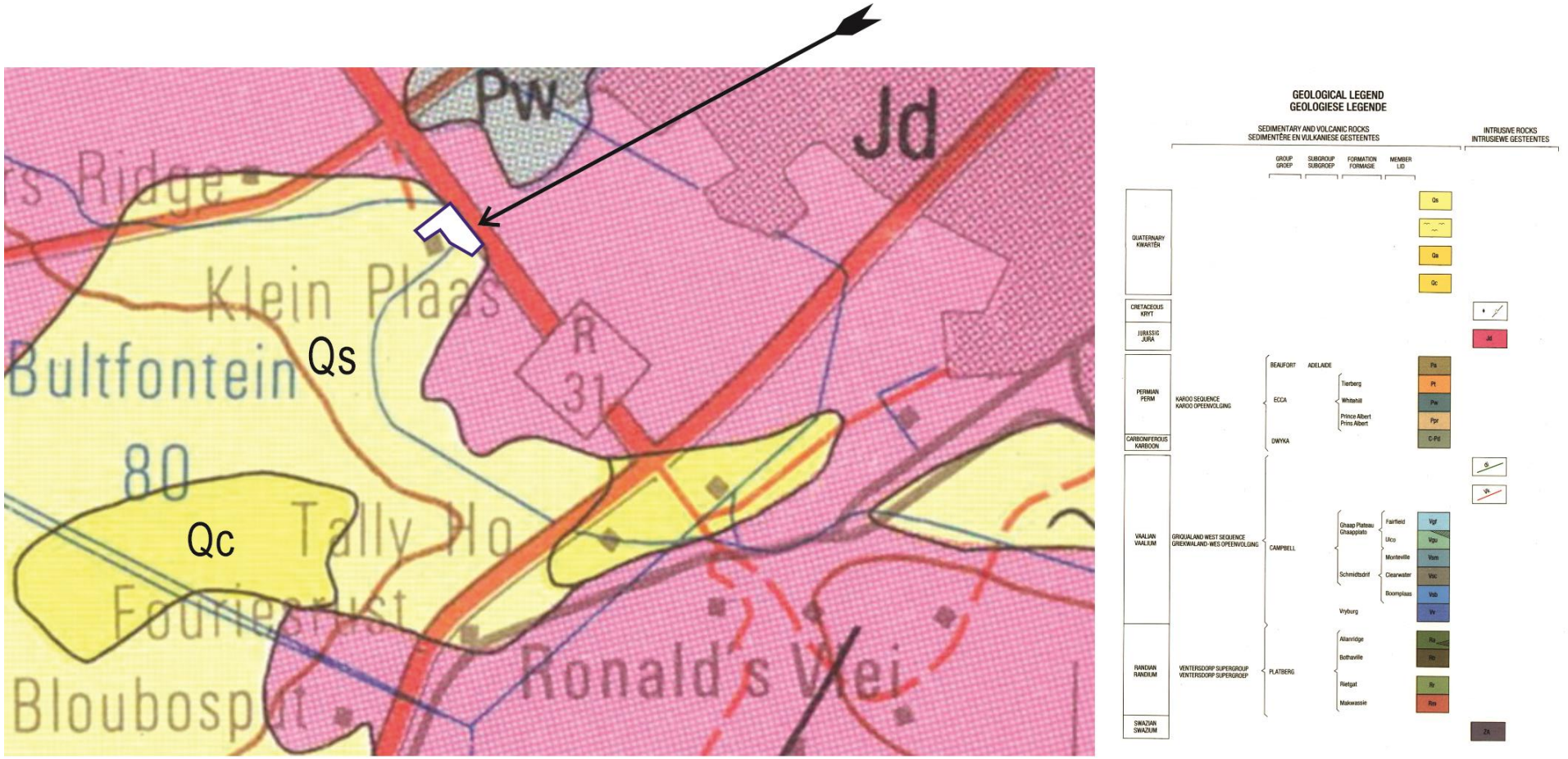

Figure 4. From oldest to youngest, the geology in and around the affected area is made up of Permian Ecca shales (*Pw*), Jurassic dolerite intrusions (*Jd,* Karoo Dolerite Suite), Quaternary calcretes, surface limestones (*Qc*) and aeolian sands (*Qs*) (Kalahari Group). Portion of 1:250 000 scale geological map of the area (2824 Kimberley) with the affected area indicated by white polygon.

1. Pniel, Nooitgedacht & Powers Site - ESA, MSA and LSA
2. Canteen Koppie - ESA
3. Rooidam - ESA
4. Biesiesput - MSA
5. Driekopseiland - Glacial striations, Rock engravings
6. Doornlaagte - ESA
7. Kareevloer - ESA, MSA
8. Alexandersfontein - 'palaeo-lake'
9. Liebensraum - ESA
10. Wildebeestkuil - Rock engravings
11. Witpan - Rock engravings
12. Orange River Station, Blockhouse & Concentration Camp - Anglo-Boer War
13. Battle of Magersfontein - Anglo-Boer War
14. Battle of Modder River - Anglo-Boer War
15. Graveyard - Anglo-Boer War
16. Fortifications - Anglo-Boer War
17. Beaconsfield historical landscape

Figure 5. Heritage sites in the vicinity of the study area.

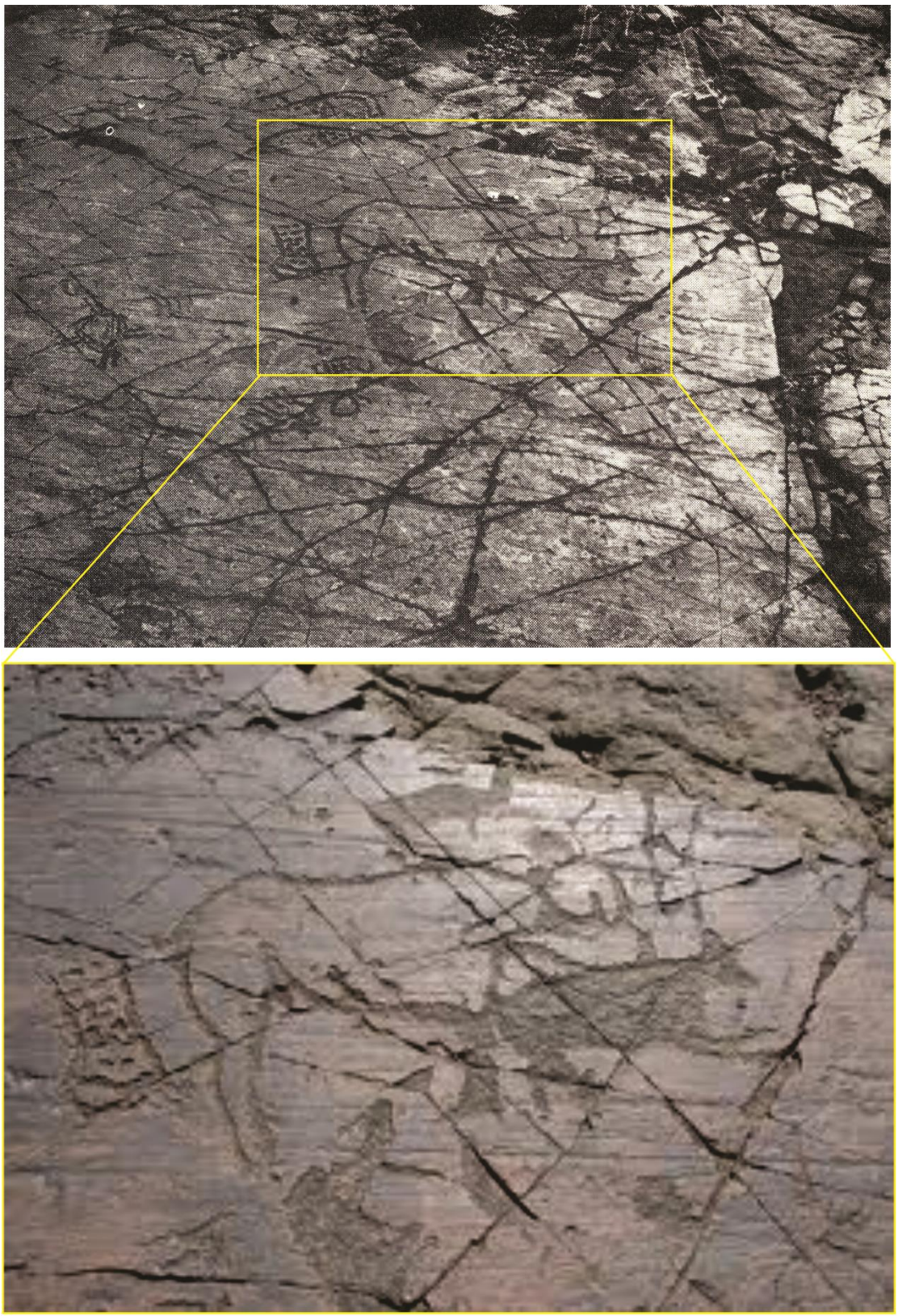

Figure 6. Example of rock engravings found on the glacial pavements at Nooitgedacht.

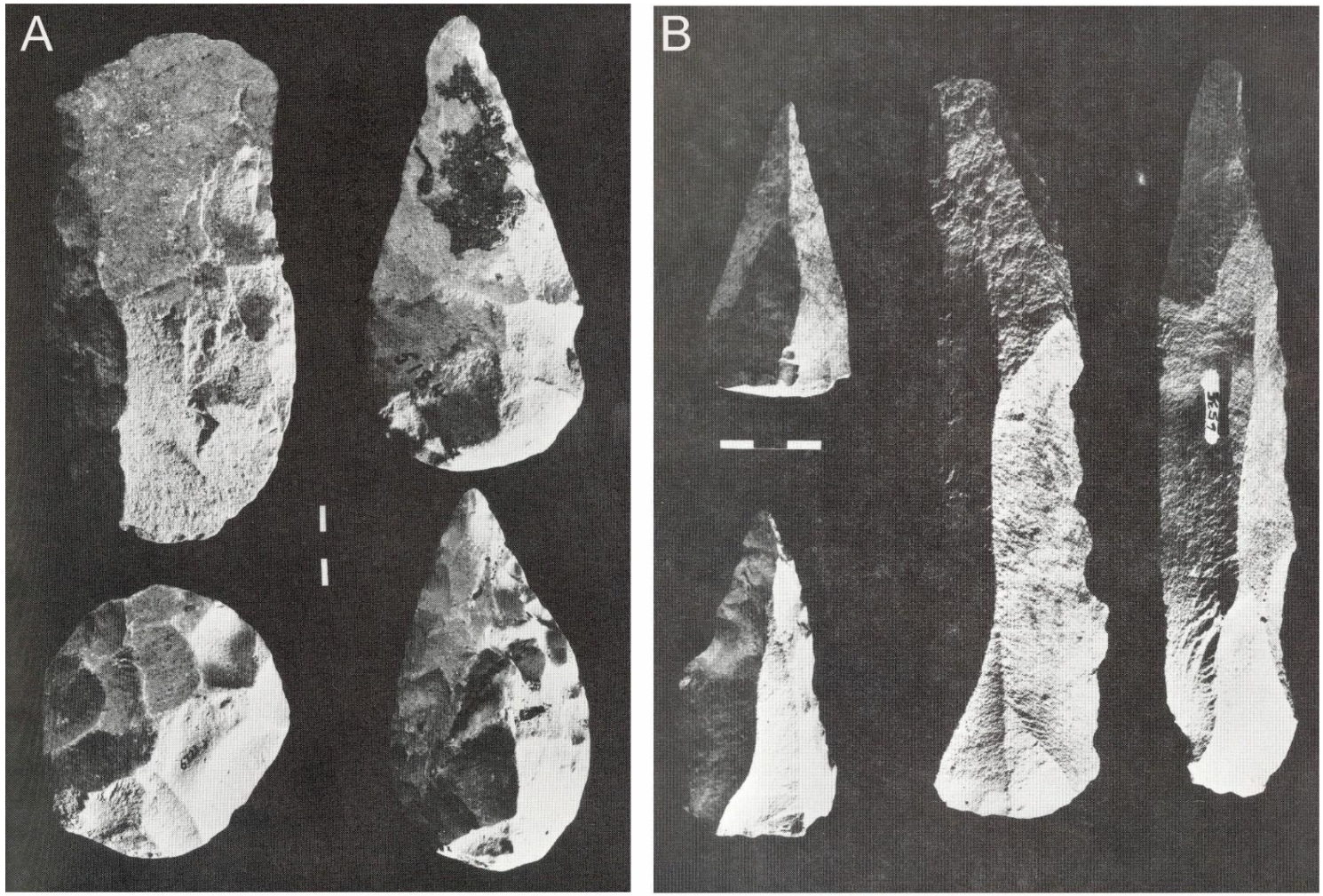

Figure 7. (A) Clockwise from left: a cleaver, 2 x handaxes and a prepared core; (B) Upper and lower left: convergent point; middle and right: parallel and convergent long blades. Raw material = andesite (after Beaumont & Morris 1990).

Figure 8. Surface scatters (left) and *in situ* ESA bifaces (right) at Kromrand, southwest of Boshof.

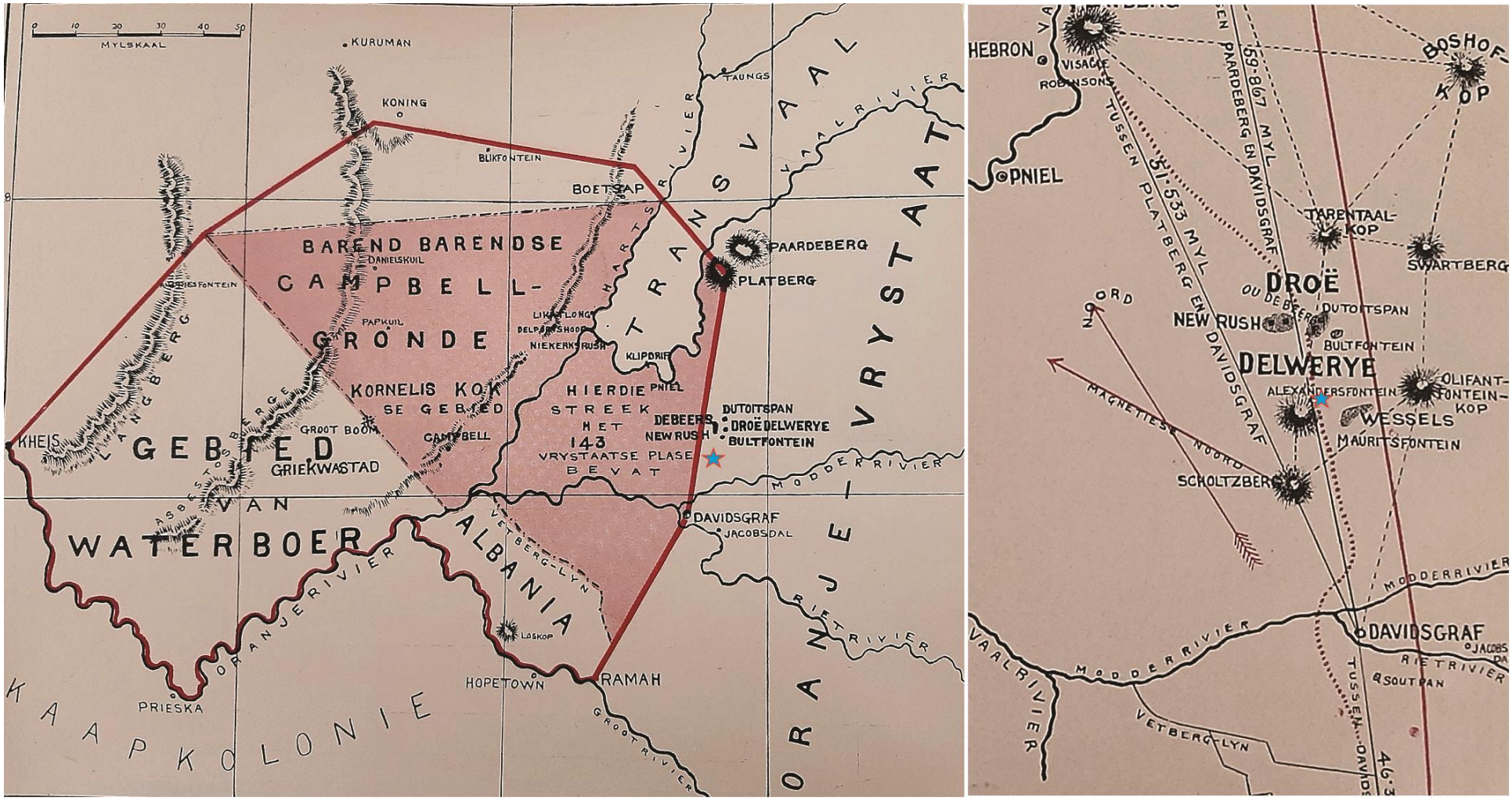

Figure 9. Colonial expansion, territorial fluidity and mining developments in the region during the 19th century. Proposed study area marked by blue star.

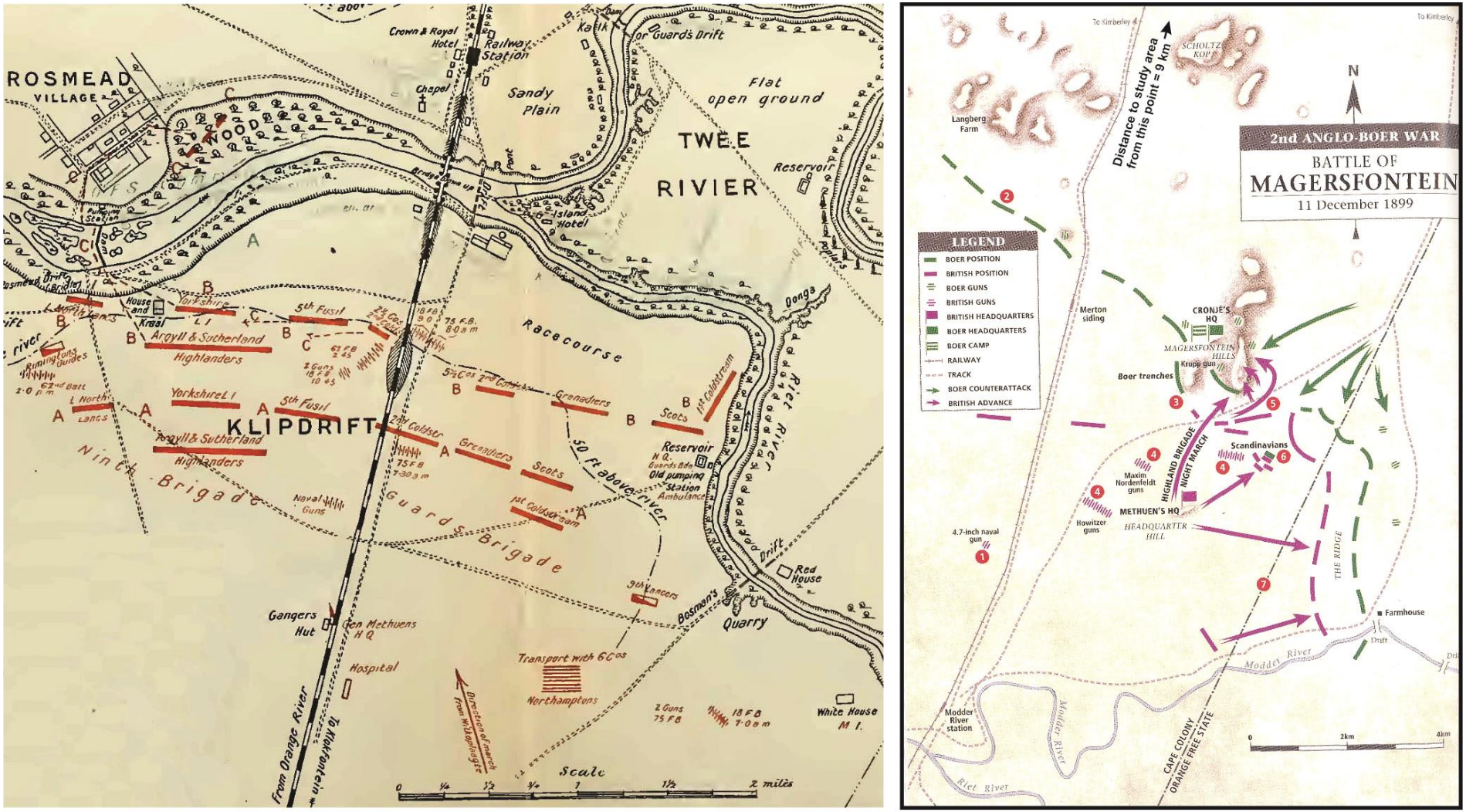

Figure 10. Battle plan of Modder River and Magersfontein (after Amery 1905 and Von der Heyde 2013)

Figure 11. The terrain is capped by thick deposits of late Quaternary, Kalahari Group aeolian sand and calcrete matrix (Scale 1 = 10 cm)