

Palaeontological desk top study for the
Construction of a power line from Foskor MTS
near Phalaborwa to Spencer MTS near Tzaneen
and the establishment of a transformation yard
at Spencer MTS

PALAEONTOLOGICAL DESK TOP STUDY

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1. Introduction

The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in i.a. the origin of dinosaurs and mammals. Fossils are also used to identify rock strata and determine the geological context of the subregion with other continents and played a crucial role in the discovery of Gondwanaland and the formulation of the theory of plate tectonics. South Africa is probably best known palaeontologically for having more than half of all the hominin specimens in the world, the greatest variety of hominins in a country and the longest record of continuous hominin occupation in the world.

The Heritage Act of South Africa stipulates that fossils and fossil sites may not be altered or destroyed. The purpose of this document is to detail the probability of finding fossils in the study area which may be impacted by the proposed development.

2. Terms of reference for the report

According to the South African Heritage Resources Act (Act 25 of 1999) (Republic of South Africa, 1999), certain clauses are relevant to palaeontological aspects for a terrain suitability assessment.

- **Subsection 35(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 with the detection or recovery of metals or archaeological material or objects, or use such equipment for the recovery of meteorites.
- **Subsection 35(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 procedures 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.

South Africa's unique and non-renewable palaeontological heritage is protected in terms of the NHRA. According to this act, heritage resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

As areas are developed and landscapes are modified, heritage resources, including palaeontological resources, are threatened. As such, both the

environmental and heritage legislation require that development activities must be preceded by an assessment of the impact undertaken by qualified professionals. Palaeontological Impact Assessments (PIAs) are specialist reports that form part of the wider heritage component of:

- Heritage Impact Assessments (HIAs) called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority.
- Environmental Impact Assessment process as required in terms of other legislation listed in s. 38(8) of NHRA;
- Environmental Management Plans (EMPs) required by the Department of Mineral Resources.

HIAs are intended to ensure that all heritage resources are protected, and where it is not possible to preserve them in situ, appropriate mitigation measures are applied. An HIA is a comprehensive study that comprises a palaeontological, archaeological, built environment, living heritage, etc specialist studies. Palaeontologists must acknowledge this and ensure that they collaborate with other heritage practitioners. Where palaeontologists are engaged for the entire HIA, they must refer heritage components for which they do not have expertise on to appropriate specialists. Where they are engaged specifically for the palaeontology, they must draw the attention of environmental consultants and developers to the need for assessment of other aspects of heritage. In this sense, Palaeontological Impact Assessments that are part of Heritage Impact Assessments are similar to specialist reports that form part of the EIA reports. The standards and procedures discussed here are therefore meant to guide the conduct of PIAs and specialists undertaking such studies must adhere to them. The process of assessment for the palaeontological (PIA) specialist components of heritage impact assessments, involves:

Scoping stage in line with regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involves an **initial assessment** where the specialist evaluates the scope of the project (based, for example, on NID/BIDs) and advises on the form and extent of the assessment process. At this stage the palaeontologist may also decide to compile a **Letter of Recommendation for Exemption from further Palaeontological Studies**. This letter will state that there is little or no likelihood that any significant fossil resources will be impacted by the development. This letter should present a reasoned case for exemption, supported by consultation of the relevant geological maps and key literature.

A Palaeontological Desktop Study – the palaeontologist will investigate available resources (geological maps, scientific literature, previous impact assessment reports, institutional fossil collections, satellite images or aerial photos , etc) to inform an assessment of fossil heritage and/or exposure of potentially fossiliferous rocks within the study area. A Desktop studies will conclude whether a further field assessment is warranted or not. Where further

studies are required, the desktop study would normally be an integral part of a field assessment of relevant palaeontological resources.

A **Phase 1 Palaeontological Impact Assessment** is generally warranted where rock units of high palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large-scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed project area is unknown. In the recommendations of Phase 1, the specialist will inform whether further monitoring and mitigation are necessary. The Phase 1 should identify the rock units and significant fossil heritage resources present, or by inference likely to be present, within the study area, assess the palaeontological significance of these rock units, fossil sites or other fossil heritage, comment on the impact of the development on palaeontological heritage resources and make recommendations for their mitigation or conservation, or for any further specialist studies that are required in order to adequately assess the nature, distribution and conservation value of palaeontological resources within the study area.

A **Phase 2 Palaeontological Mitigation** involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or the recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before Phase 2 may be implemented.

A **'Phase 3' Palaeontological Site Conservation and Management Plan** may be required in cases where the site is so important that development will not be allowed, or where development is to co-exist with the resource. Developers may be required to enhance the value of the sites retained on their properties with appropriate interpretive material or displays as a way of promoting access of such resources to the public.

The assessment reports will be assessed by the relevant heritage resources authority, and depending on which piece of legislation triggered the study, a response will be given in the form of a Review Comment or Record of Decision (ROD). In the case of PIAs that are part of EIAs or EMPs, the heritage resources authority will issue a comment or a record of decision that may be forwarded to the consultant or developer, relevant government department or heritage practitioner and where feasible to all three.

3. Details of study area and type of assessment:

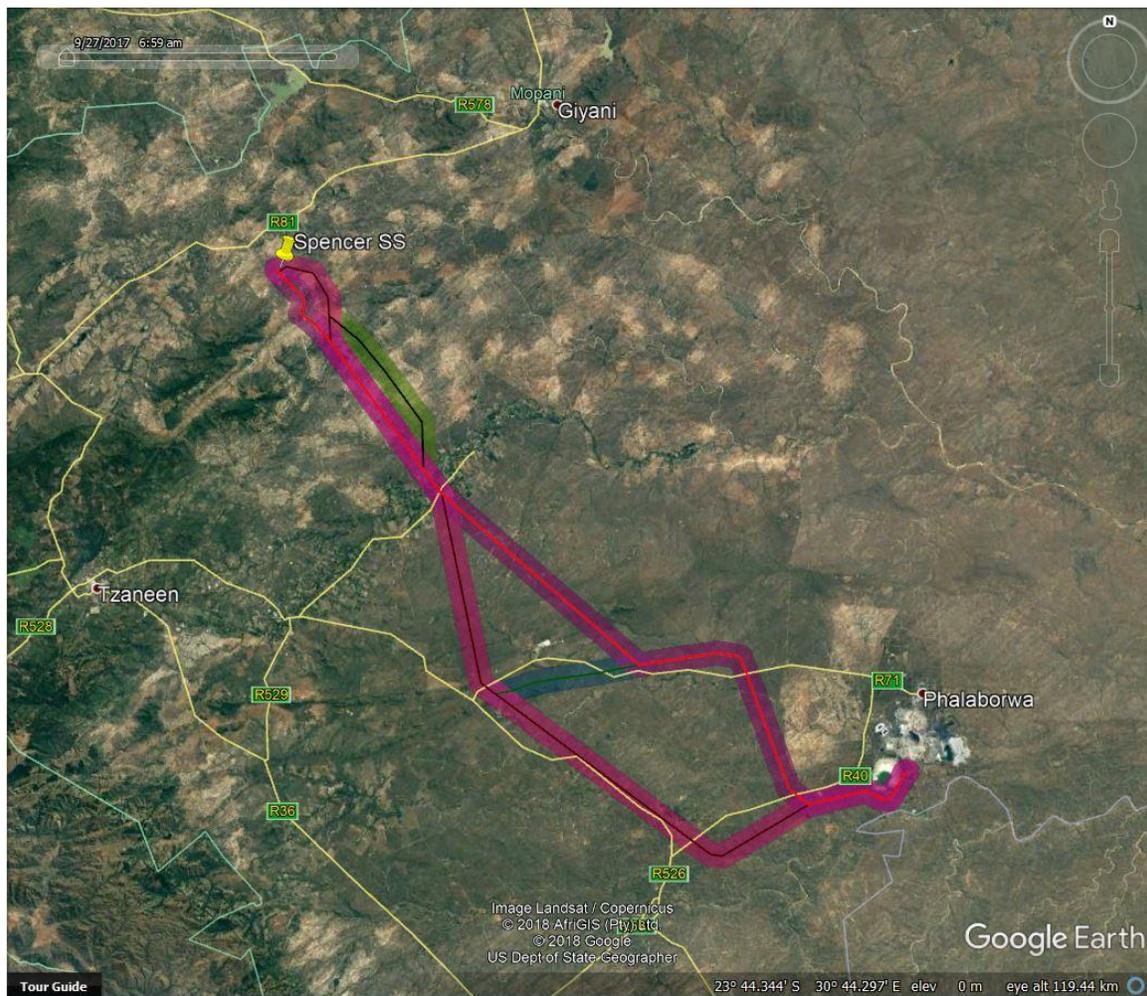
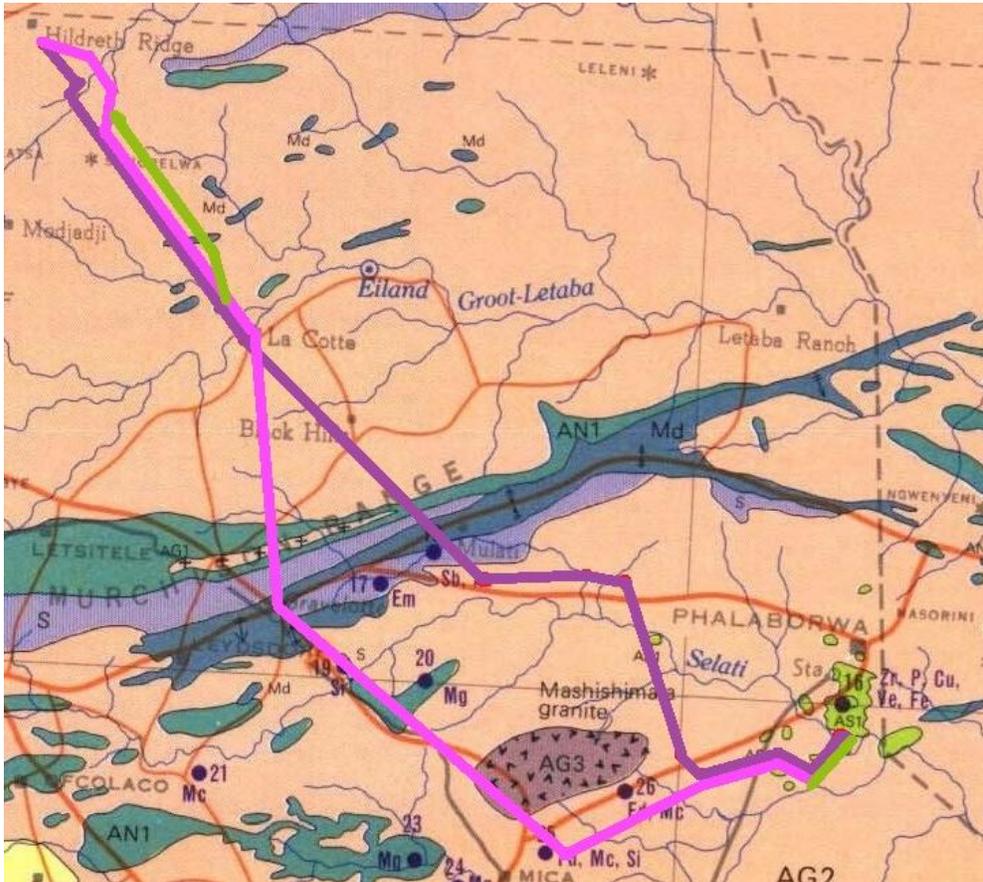


Figure 1: Google Earth photo indicating study site

Several mines occur in this mineral-rich region the largest of which is in Phalaborwa. The study area varies from No to Low Palaeontological Sensitivity according to SAHRA. The relevant literature and geological maps have been studied for a Desk Top Study.

4. Geological setting



The study area is indicated by the pink, purple, green and aquamarine lines

Figure 2: Geological map of the study area and surroundings (adapted from the 1: 1 000 000 Geology Map for South Africa, Lesotho and Swaziland, Geological Survey, 1970)

GEOLOGICAL MAP LEGEND (adapted from the 2330 Tzaneen 1: 250 000 geology map)

Lithology				Age
AS1	Carbonatite, pyroxenite, syenite, phoscorite	Phalaborwa Complex		Vaalian
AG3	Biotite granite	Mashishimale Suite		Randian
AN1	Ultrabasic and basic intrusive and their metamorphosed derivatives	Rubbervale Formation Weigel Formation Mac Kop Formation La France Formation Leydsdorp Formation Mulati Formation	Gravelotte Group	
Md	Conglomerate, quartz, shale, limestone, lava		Giyani Group	
S	Ultramafic, quartzitic and granetiferous schists, amphibolite, metamorphosed sediments			
AG2	Grey biotite gneiss and migmatite with anatectic mobilisates	Goudplaats Gneiss		Swazian

The Goudplaats Gneiss dominates the study area and is also the oldest lithostratigraphic unit in the study area (Brandl, 1987). The age of the Goudplaats-Hout River Gneiss is considered to be 3333 Ma old (Robb *et al.*, 2006). The gneiss is characterised by alternating bands of leucocratic and melanocratic material. The leucocratic melts were generated during several phases of mobilisation (Brandl, 1987).

The Murchinson Sequence comprises of the Giyani, Gravelotte and Pietersburg Groups. Rocks of the Giyani and Gravelotte Groups occur as elongated greenstone belts in the study area. The lithologies seemed to have developed in a rifting environment or in a back-arc basin (Brandl, 1987). The gneisses of the Gravelotte greenstone belt was dated between 2953 and 3180 Ma while the Giyani greenstone belt was emplaced approximately 2850 Ma ago (Brandl *et al.*, 2006).

The granite of the Mashishimale Suite is considered to be 2698 Ma old (Robb *et al.*, 2006).

The Phalaborwa Complex consists of ultramafic to peralkaline intrusive rocks which were emplaced in a series of successive pulses approximately 2060 Ma ago (Brandl, 1987).

5. Palaeontological assessment of the region

The rocks of the study consist of igneous and metamorphic rocks of between 3333 and 2060 Ma. These rocks are of no palaeontological concern.

The fossil record of the overlying Quaternary-aged sands is sparse, occurs sporadically and is low in diversity. Although no fossils have been reported for the study area, fossils such as root casts, burrows, termitaria, ostrich egg shells, mollusc shells and isolated bones have been discovered in the Quaternary sands elsewhere (Almond & Pether 2008).

References:

Almond, J.E. & Pether, J. (2008) Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

Brandl, G. (1987) The Geology of the Tzaneen Area. Geological Survey, Pretoria.

Brandl, G.; Cloete, M. & Anhaeusser, C.R. (2006) Archaean Greenstone Belts. In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), *The Geology of South Africa*. Geological Society of South Africa, Johannesburg & Council for Geoscience, Pretoria. Pp. 9-56.

Geological Survey (1970) 1: 1 000 000 Geology Map for South Africa, Lesotho and Swaziland.

Geological Survey (1985) Tzaneen 2330 1:250 000 Geology Map, Geological Survey, Pretoria.

Partridge, T.C., Botha, G.A. & Haddon, I.G. (2009). Cenozoic Deposits of the Interior. In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), *The Geology of South Africa*. Geological Society of South Africa, Johannesburg & Council for Geoscience, Pretoria. Pp. 585-604.

Robb, L.J.; Brandl, G.; Anhaeusser, C.R. & Poujol, M. (2006) Archaean Granitoid Intrusions. In: Johnson, M. R., Anhaeusser, C. R. and Thomas, R. J. (eds.), *The Geology of South Africa*. Geological Society of South Africa, Johannesburg & Council for Geoscience, Pretoria. Pp. 57-94.

6. Conclusion and recommendations:

The area is underlain by igneous and metamorphic rocks of Swazian to Vaalian aged igneous rocks (3.33 – 2.05 Ga). Due to the very low probability of fossils occurring in the study area it is recommended that the project should be exempted from further palaeontological studies.

In the unlikely event that fossils are found in the soil cover in the study area the CEO should take the following steps:

PROCEDURE FOR CHANCE PALAEOLOGICAL FINDS

Extracted and adapted from the National Heritage Resources Act, 1999 Regulations Reg No. 6820, GN: 548.

The following procedure must be considered in the event that previously unknown fossils or fossil sites are exposed or found during the life of the project:

1. Surface excavations should continuously be monitored by the ECO and any fossil material be unearthed the excavation must be halted.
2. If fossiliferous material has been disturbed during the excavation process it should be put aside to prevent it from being destroyed.
3. The ECO then has to take a GPS reading of the site and take digital pictures of the fossil material and the site from which it came.
4. The ECO then should contact a palaeontologist and supply the palaeontologist with the information (locality and pictures) so that the palaeontologist can assess the importance of the find and make recommendations.
5. If the palaeontologist is convinced that this is a major find an inspection of the site must be scheduled as soon as possible in order to minimise delays to the development.

From the photographs and/or the site visit the palaeontologist will make one of the following recommendations:

- a. The material is of no value so development can proceed, or:
- b. Fossil material is of some interest and a representative sample should be collected and put aside for further study and to be incorporated into a recognised fossil repository after a permit was obtained from SAHRA for the removal of the fossils, after which the development may proceed, or:
- c. The fossils are scientifically important and the palaeontologist must obtain a SAHRA permit to excavate the fossils and take them to a recognised fossil repository, after which the development may proceed.

7. If any fossils are found then a schedule of monitoring will be set up between the developer and palaeontologist in case of further discoveries.

7. Declaration of Independence:

I, Jacobus Francois Durand declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development, 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.



Palaeontological specialist:

Dr JF Durand (Sci. Nat.)

BSc Botany & Zoology (RAU), BSc Zoology (WITS), Museology Dipl. (UP), Higher Education Diploma (RAU), PhD Palaeontology (WITS)

Palaeontological assessments:

- Urban development in Cradle of Humankind World Heritage Site (Gauteng): Letamo, Honingklip, Windgat, Sundowners, Ekutheni
- Urban development at Goose Bay, Vereeniging, Gauteng
- Urban development on Portions 98, 99, 179, 236, 284 and 364 of the farm Waterkloof 306 JQ, Rustenburg, North West Province
- Upgrade of R21 between N12 and Hans Strydom Drive, Gauteng
- Vele Colliery, Limpopo Province
- De Wildt 50 MW Solar Power Station, Gauteng
- 10 MW PV Plant Potchefstroom, North West Province
- Omega 342 50MW Solar Power Station, Viljoenskroon, Free State
- Springfontein wind and solar energy facility, Free State
- Solar power plant, Bethal, Mpumalanga
- Diamond mine on Endora, Limpopo Province
- Development at Tubatse Ext.15, Limpopo Province
- Manganese mine south of Hotazel, Northern Cape
- Wind energy facility at Cookhouse, Eastern Cape
- Energy facility at Noupoot, Northern Cape
- Fluorspar mine near Wallmannsthal, Gauteng
- ESKOM power line, Dumo, KwaZulu-Natal

- ESKOM Gamma-Omega 765KV transmission line, Western Cape
- ESKOM 44KV power line at Elandspruit near Middelburg, Mpumalanga
- ESKOM Makopane Substation, Limpopo Province
- ESKOM Platreef Substation and power lines to Borutho MTS Substation, Limpopo Province
- Solar energy facility at Prieska, Northern Cape.
- Marang B - a 3 x 500MVA 400/132kV Main Transmission Substation east of Rustenburg, North West Province
- Upgrading of storm water infrastructure in Valencia, Addo, Eastern Cape
- Development of a 10 MW Solar Energy facility on the Farm Liverpool 543 KQ Portion 2 at Koedoeskop, Limpopo Province
- Development of a fluorspar mine at Wallmannsthal, North of Pretoria
- Extension of limestone mine on the farms Buffelskraal 554 KQ Portion1 and Krokodilkraal 545 KQ, Limpopo Province
- Lesego Platinum Mine, Sekhukhune Area, Steelpoort, Limpopo Province
- Mine at Hotazel, Northern Cape
- Pollution control dams at Transalloys in Clewer, Emalahleni, Mpumalanga
- Erection of spill points on the Farm Kwikstaart 431 KQ Portion 2, Thabazimbi, Limpopo Province
- Construction of dam at Ethemba, Swaziland
- Construction of bridge at Busingatha, KwaZulu Natal
- Water Reticulation System - Kei Road and Berlin General, Eastern Cape
- Development at Kromdraai, COHWHS (Portion 26 of the Farm Kromdraai, West Rand Municipality)
- Construction of Nhlezi Bridge, KwaZulu Natal
- Erection of spill point and dam on the Farm Faure 72 KQ Portion 8, Makoppa near Thabazimbi, Limpopo Province
- Colliery on the Farm Goedeheop near Piet Retief, Mpumalanga
- Erection of spill points on the Farm Diepwater 302 KQ Portions 4 -8 near Thabazimbi, Limpopo Province
- Construction of 2 MW photovoltaic power plant on the farm De Hoek 32, Pixley ka Seme District Municipality, Northern Cape Province
- Road upgrade near Magogo, KwaZulu/Natal
- Construction of haul road & waste dump: Lylyveld, Sishen, Northern Cape
- Construction of 4 weirs and a road culvert on Portion 3 of the Farm Roodekrans 133JT, Dullstroom Area, Mpumalanga
- Construction of a solar energy facility on Blaubospan near Groblershoop, Northern Cape
- Construction of road from Macengeni to Macijo, KwaZulu/Natal
- Construction of the John Taole Gaetsewe school and hostels in Dithakgong, Northern Cape
- Development at Duduza Township, Gauteng
- Construction of roads near Ndanyana KwaZulu/Natal
- Development of colliery on the farm Goedeheop near Piet Retief, Mpumalanga
- Development of orchards on the Farm Kromdraai, near Thabazimbi, Limpopo Province.

- Upgrade of Section 3 and Section 4 of the National Route R75, Eastern Cape.
- Construction of Concentrated Power Plants at Olyvenhout Drift, Upington, Northern Cape.
- Borrow pit at New Payne in Mthatha, Eastern Cape.
- Borrow pit for rural road to Centuli Clinic, Eastern Cape.
- Juno Gromis 400kV power line (West Cape and North Cape).
- Barberton IAPS Waste Water Treatment Works, Barberton, Mpumalanga.
- Development of orchards on the Farm Kromdraai, Thabazimbi, Limpopo Province.
- Erection of spill points on the farm Knoppieskop, Limpopo Province.
- Development at O.R. Tambo International Airport, Gauteng.
- Development on Portion 12 of the Farm Tregaron in the Sundays River Municipality, Eastern Cape
- Development of spill points and dam on the Farm Fairfield 306 KQ, Makoppa near Thabazimbi, Limpopo Province
- Development of 800 ha dry lands on Farm Hoylesdale 163 KQ portion 1, Makoppa, Thabazimbi Local municipality, Limpopo Province
- Construction of solar energy facility on Blauwpospan near Groblershoop, Northern Cape.
- Development of the Doornhoek Fluorspar Mine near Zeerust, Northwest.
- Development on the Farm Haakdoringdrift, 373 KQ Portion 3, Thabazimbi, Limpopo Province.
- Development of bulk sewer line, Motherwell, Eastern Cape.
- Erection of spill points on the Farm De Hoop, Koedoeskop, near Thabazimbi, Limpopo Province,
- Construction of Tiger Solar power plant near Windsorton, Northern Cape,
- Development of Amandelbult Open Cast Mine near Thabazimbi, Limpopo
- Development at The Shed in the Cradle of Humankind World Heritage Site
- Development of 800 ha dry lands on Farm Hoylesdale 163 KQ portion 1, Makoppa, Thabazimbi Local municipality, Limpopo Province,
- Construction of solar energy facility on Blauwpospan near Groblershoop, Northern Cape,
- Proposed development at Jeffreys Bay, Eastern Cape,
- Development of the Doornhoek Fluorspar Mine near Zeerust, Northwest,
- Development on the Farm Haakdoringdrift, Thabazimbi, Limpopo,
- Proposed improvement of National Route R510 Section 2 from Bierspruit Bridge to Thabazimbi, Limpopo Province,
- Development at O.R. Tambo International Airport, Gauteng.
- Development on Portion 12 of the Farm Tregaron in the Sundays River Municipality, Eastern Cape,
- Proposed development at Erasmus Park, Pretoria, Gauteng,
- Development of spill points and dam on the Farm Fairfield 306 KQ, Makoppa near Thabazimbi, Limpopo Province,
- Electrification project in the Taung Skull Site buffer zone in Buxton, North West Province,

- Erection of spill points on the Farm Faure near Thabazimbi, Limpopo Province,
- Development of Marang Solar Energy Facility on Blauwbospan near Groblershoop, Northern Cape.
- Construction of the Sorata-Witsieshoek 132kV Power Line, Free State.
- Development of remaining extent of Holding 22 Waterval Small Holdings JQ, Rustenburg, North West Province.
- Road upgrade at Matla Coal Mine near Kriel, Mphumalanga.
- Mining right (diamonds) on the Farm Palmietfontein 208JP, near Pilanesberg, Moses Kotane Local Municipality, Bojanala District, Northwest.

Palaeontological research:

- Gauteng: Wonder Cave
- KwaZulu/Natal: Newcastle, Mooi River, Rosetta, Impendle, Himeville Underberg, Polela & Howick Districts, Sani Pass
- Eastern Cape: Cradock District, Algoa Basin
- Western Cape: Clanwilliam District
- Free State: Memel & Warden Districts
- Limpopo Province: Nyalaland (KNP), Vhembe Reserve, Pont Drift
- Zimbabwe: Sentinel Ranch, Nottingham