Palaeontological Impact Assessment for the revised Beeshoek Iron Ore Mine TRF and railway siding, west of Postmasburg, Northwest Province

Desktop Study

For

HCAC

24 July 2021

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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 32 years research; 24 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Heritage Contracts and Archaeological Contracts, Modimolle, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A palaeontological Impact Assessment was requested for the proposed options of linking Beeshoek to the TFR Ore line, via the existing Kolomela Direct Link. This in turn would allow Beeshoek Mine greater flexibility to also export ore through Saldanha port. The project includes two rail lines, two borrow pits for bridges, bridge laydown areas and two roads linking with the airfield. The mine is approximately 5km west of Postmasberg, Northern Cape Province. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed railway line TFR and siding and infrastructure lies on Quaternary Kalahari sands, alluvium and calcrete. There is a very small chance that fossils may occur in palaeo-pans BUT no such feature is visible. Therefore, a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once surveyor and/or the environmental office walks the route, they should be photographed, position recorded, removed and stored. Photographs sent to the palaeontologist will enable him/her to assess the scientific importance of the fossils and act accordingly.

The Impact Significance:

Negative	**Low**	**Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged.**	**- 1 – 5**

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1. Background

Railway Line Link (TFR and Beeshoek Siding)

Beeshoek currently provides to external and internal markets via their rail load out facilities at Beeshoek. There are two rail load-out facilities at Beeshoek, with one handling Lumpy and DR, and one handling Fines. The railway siding is operated at a 24 hour, seven day a week process.

The Lumpy and DR stockpiles are reclaimed using feeders situated below the stockpile bed, which place the product on a reclaim conveyor, which then feeds the Lumpy/DR load-out conveyor system. Front-end loaders are utilized to draw material from the fines product stockpile and feed a hopper for the conveyance system feeding the Fines load-out.

The current siding allows for the following:

- 11 – 13 local trains per week, consisting out of 105 wagons loaded on average 63.5 tons per wagon
- 1 export train per week, consisting out of 114 wagons loaded on average 68.5 tons per wagon.
-

In 2010 / 2011 the rail facilities for Kolomela Mine and the corresponding direct link to the TFR Ore line were designed and constructed. The line was constructed to 30t axle load standards with an operational design allowing 342 wagon trains (3 rakes of 114 wagons) to be operated by Kolomela Mine via the use of a swingset rake (114 wagons).

The swingset principle allowed for a 4th rake to be preloaded and staged prior to the arrival of a train. With the arrival of an empty 342 wagon (3 rake) train, this meant that only 2 rakes (of 114 wagons) would have to be loaded before a recompiled 342 wagon (3 rake) train could depart thereby shortening the turnaround time of the train within the siding.

An option within the operational design was an allowance for Beeshoek Mine to make use of the swingset concept within the consist makeup. This would mean that Beeshoek could load one rake while Kolomela was loading the other 2 rakes and the required turnaround time could be met. It would also give Beeshoek mine direct access to the TFR Ore Line and export customers via Saldanha.

Proposed Project

The Beeshoek Link Line Feasibility Study aims to realise the above option and therefore the mine has investigated the options of linking Beeshoek to the TFR Ore line, via the existing Kolomela Direct Link. This in turn would allow Beeshoek Mine greater flexibility to also export ore through Saldanha port.

Negotiations with Transnet have not as of yet been concluded in terms of allocations, and for this reason the project is presented in this application as the best practical outcome. It is important to note that various discussions are being undertaken between Transnet and the Applicant. These discussions would define the direction the project moves in, i.e. immediate commissioning upon authorisation, potential delay in commissioning, or not commissioning the project. However, for the purposes of this EIA report, the assumption is made that this project will proceed, and for this reason should the project proceed the following is considered:

- The line (main western line) will comprise a 2.8km main link line of approximately 5.5m in width with a 5m bulk fill (varies along the alignment). The line will tie from the existing TFR Postmasburg line at the Beeshoek Iron Ore Mine, crossing over the road accessing Tommysfield Airport.
- The existing R385 road will be lifted into the road over rail system to allow for the railway line to cross under the R385 regional tar road before linking to the existing TFR Yard that services Kolomela Mine.
- Considering that one 4m access road will be constructed along the alignment with an 8m buffer on either side of the railway line, the approximate extent of the development is 9ha (85 400m2).
- A second line will be constructed (the northern link line), which will tie into the existing Orex line between Beeshoek and Khumani Iron Ore Mine. This line is approximately 1.3km in length with similar dimensions as the main western line. This latter line is about 2ha is extent.

The revised approach of TFR is to run trains with 3 rakes of 116 wagons, giving trains a total length of 348 wagons. For this reason the current operational concept is for Beeshoek to load a single train rake (116 wagons) to form part of a 3 rake train (348 wagons) which would be transported to Saldanha. The other 2 rakes of the train will be loaded by Kolomela. This concept is to be explored further as part of the study.

The project requirements will include:

- Overall Design:
  - Railway formation – 5.5m
  - Bulk fill – 5m
  - One service road – 4m
  - Buffer – 8m on each side
- TFR train design
  - 348 wagons (3 x 116 rakes)
  - 30t axle load
- Beeshoek Traffic
  - 1 x 116 rake (Saldanha traffic)
  - 30t axle loads

Two access roads will be constructed, one linking to Tommy's field and one to the northern link line and from there to Tommy's field airport. These will have a width less than 8m and respectively lengths of 550m and 420m.

A Rail Contractor Laydown area will be required (Laydown 1). This will be located in an existing disturbed area to the south of the mines' landfill site.

Two laydown areas will be required for the bridge construction, which will require clearance. The South laydown area is located to the east of the decommissioned R385 road, at an area of 0.8ha. The North laydown areas is located just north of this area, north of the existing R385 railway line, at an area of 1ha.

Borrow material will be required for the construction of the railway line and bridge. The borrow material will be sourced from within the mine boundary, at existing opencast pits, such as from the Village opencast pit, the existing quartzite stockpile and the existing manganese stockpiles. Two (2) other borrow pit areas have also been identified next to the bridge laydown areas (north and south). These two areas will require clearance of 1.1ha each. A last borrow pit area will be considered, which will not require clearance as this is an existing borrow pit area, previously utilized in the construction of the R385 deviation.

During the construction phase, currently planned for about 14 months, a temporary two-way deviation road (of less than 1km, will be provided for vehicles travelling on the R385 during the construction of the road bridge.

An updated Palaeontological Impact Assessment was requested for the Beeshoek Mine TRF and siding line project. In order to comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 2017).

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
ai	Details of the specialist who prepared the report	Appendix B
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4

g	An identification of any areas to be avoided, including buffers	N/A
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
j	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
k	Any mitigation measures for inclusion in the EMPr	Section 8
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A

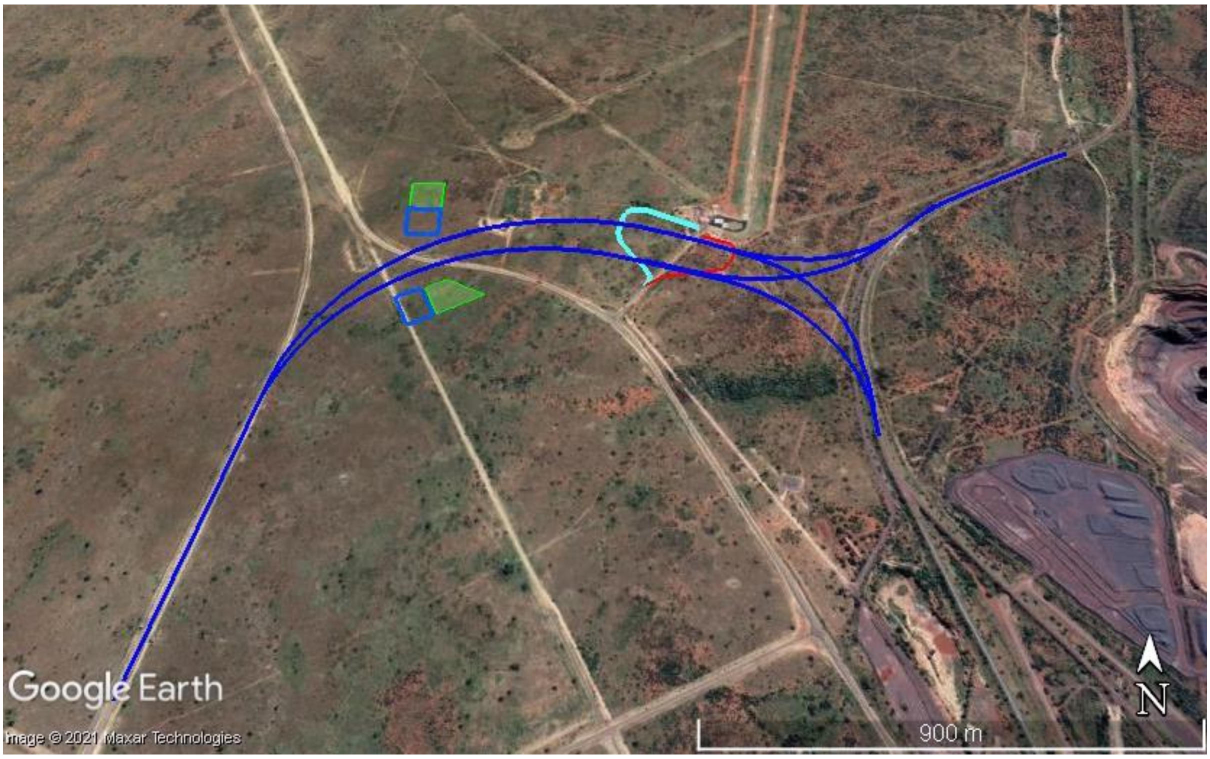

Figure 1: Google Earth map of the proposed TFR and siding development at Beeshoek Iron Ore Mine, west of Postmasburg, Northern Cape Province. Blues lines = railway lines; blue squares = bridge laydown areas north and south; green squares = borrow pit bridge north and south; turquoise loop = airfield access road; red loop = Tommy's LXing.

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

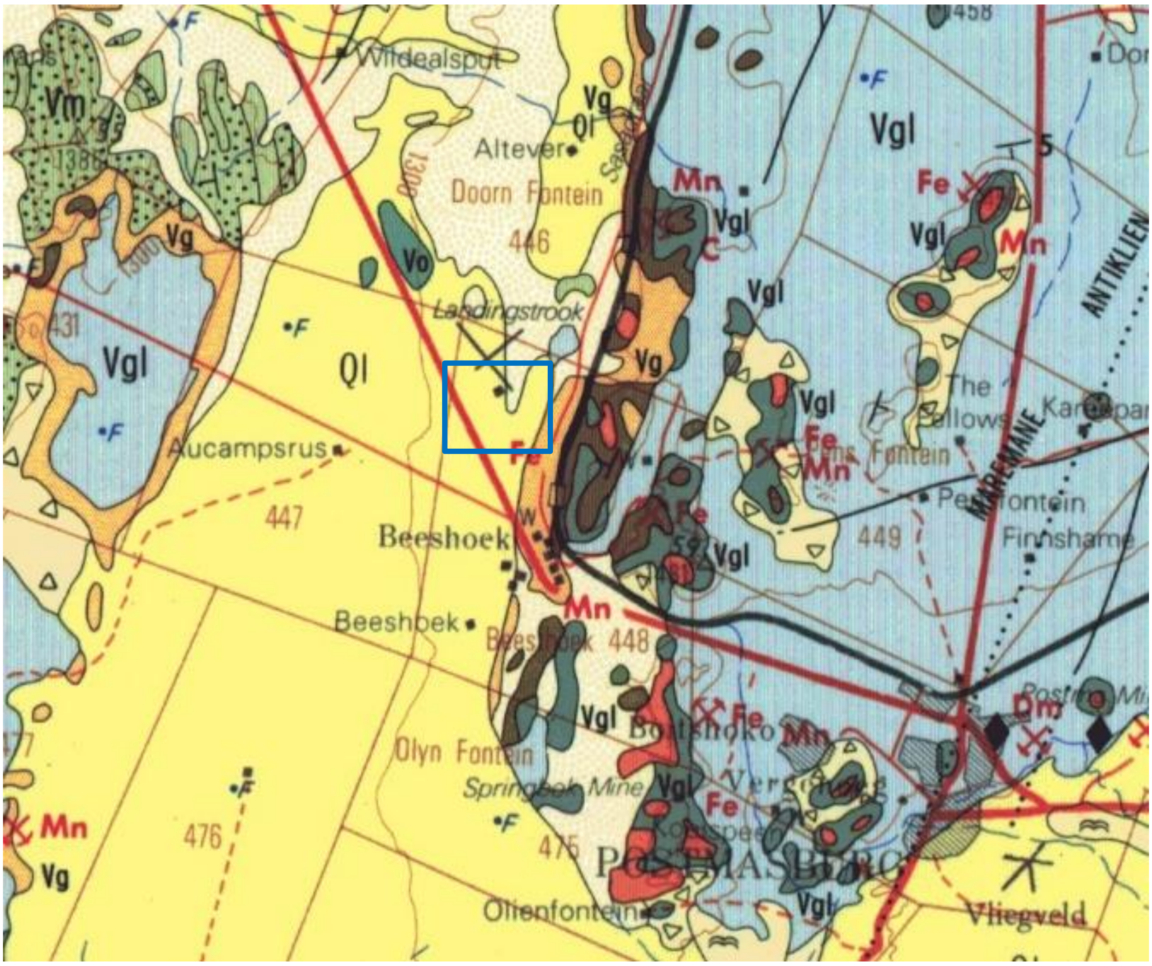

Figure 2: Geological map of the area around Beeshoek and Postmasburg. The location of the proposed project is indicated with the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1:250 000 map 2822 Postmastburg.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. Johnson et al., 2006; Moen, 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Qs	Kalahari Group	Alluvial and aeolian sands	Last ca 2.5 Ma
Ql	Kalahari Group	Calcrete, limestone, alluvium	Last ca 2.5 Ma
T-Qk	Sands overlying Tertiary rocks	Alluvial and aeolian sands	Last 65 Ma
Vha	Hartley Fm, Olifantshoek SG (and Mapedi Fm).	Andesite, tuff, conglomerate	Ca 1893 Ma

Symbol	Group/Formation	Lithology	Approximate Age
Vlu	Lucknow Fm, Olifantshoek Sequence	Quartzitic limestone	>1893 Ma
Vga	Gamagara Fm, Griqualand West Sequence	Shale, quartzite, conglomerate	>1893 Ma
Vo	Ongeluk Fm, Postmasburg Group, Transvaal SG	Andesite, lava	2222 Ma
Vk	Koegas Subgroup, Postmasburg Group, Transvaal SG.	Mudstone, iron formation, riebeckitite	2420 Ma
Vgl	Lime Acres Fm, Campbell Rand Subgroup, Ghaap Group, Transvaal SG	Dolomite, limestone, chert	>2420 Ma

In the Griqualand West Basin, the Ghaap Group of the Transvaal Supergroup, is divided into four subgroups, from the oldest, Schmidtsdrift, Campbell Rand, Asbestos Hills and Koegas Subgroups (Eriksson et al., 2006, p. 244). The Koegas Subgroup is overlain by the Postmasburg Group and the latter is divided into the lower Makganyene Formation and the Ongeluk Formation (ibid). There are three formations in the Asbestos Subgroup, from the base, the Kliphuis, Kuruman and Danielskuil Formations, with all three composed of iron-formation. The Asbestos Hills Subgroup is dated at about 2500 Ma.

The Campbell Rand Subgroup has nine Formations (Eriksson et al., 2006; Beukes et al., 2016) and they form a stromatolitic carbonate platform. The Campbell Rand Subgroup occurs around the basin margin on the craton. Platform margin and lagoonal dolomites are manganese-rich, whereas basinal dolomites are iron-rich, and intertidal to supratidal deposits are virtually free of iron and manganese (Beukes, 1987). Beeshoek is on iron-rich and lies partly on the Manganore iron formation (Figures 2, 3).

Quaternary Kalahari sands cover large parts of the rocks in this region, especially to the west. This is the largest and most extensive palaeo-erg in the world (Partridge et al., 2006) and is composed of extensive aeolian and fluvial sands, sand dunes, calcrete, scree and colluvium. Periods of aridity have overprinted the sands, and calcrete and silcrete are common.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. The site is on alluvium and on aeolian Kalahari sands that were derived from farther to the northwest (Goudie and Wells, 1995) and finally deposited in this region during the Quaternary. Since they are windblown the sands are not in primary context, nor do they preserve any fossils.

Fossils can only be preserved if there are spring or palaeopan deposits where wood, plants or bones can be entrapped and preserved in the calcrete or silcrete that occasionally forms in such settings. No such deposits have been recorded from this site, and the Google Earth imagery does not show any pan or spring deposits. According to Goudie and Wells (1995) three factors are required for the formation of pans, namely a setting where the fluvial system is not fully integrated, salt weathering and aeolian deflation occur. The latter two conditions apply to this environmental setting, but the first does not as the site is on a slope. Therefore, it is extremely unlikely that there are any pans in the site or any fossils in the sands.

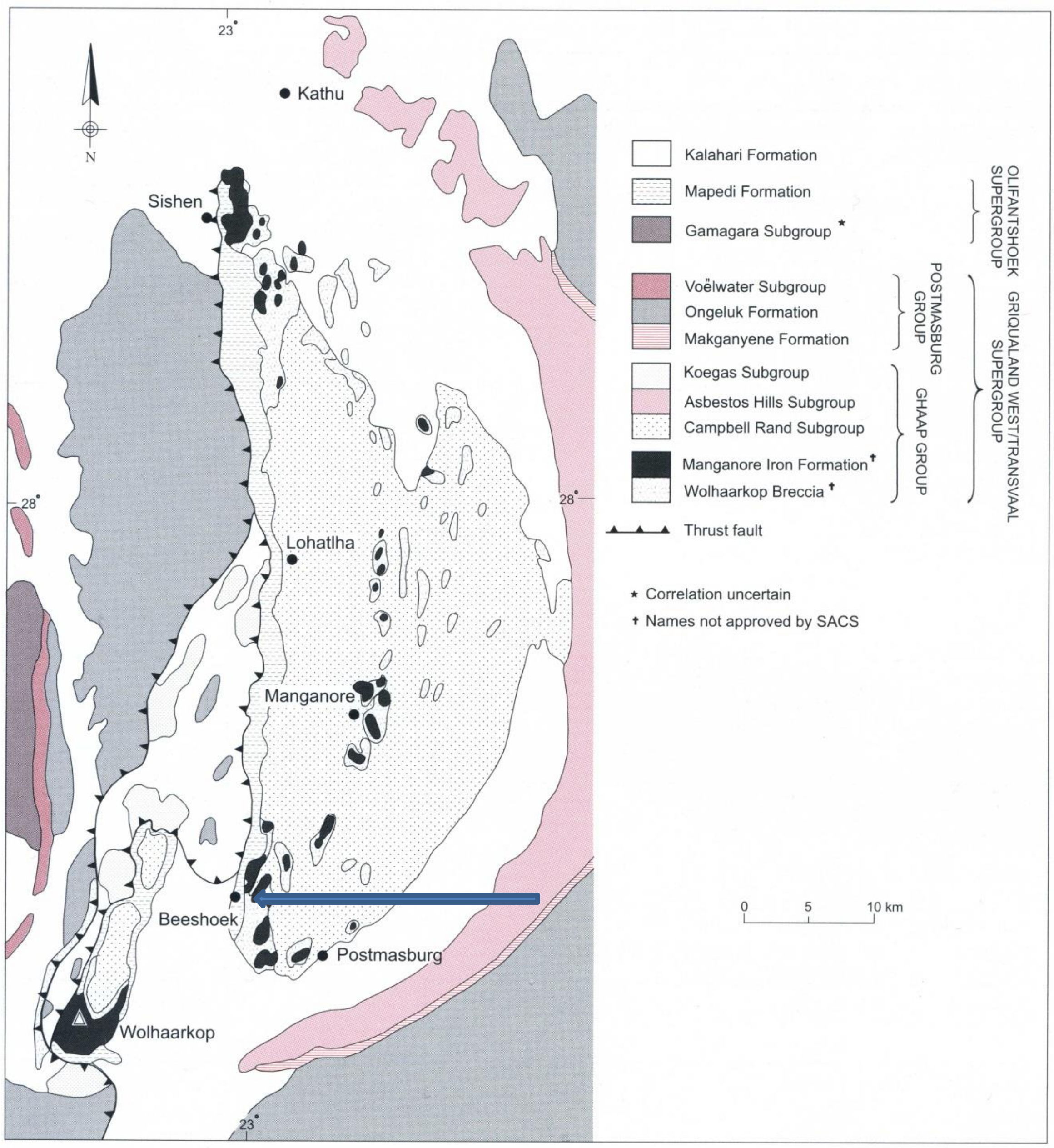

Fig. 1 – Geology of the Maremane dome (simplified from Van Schalkwyk and Beukes 1986).

Figure 3: Detailed map of the Postmasburg-Sishen iron deposits from Astrup et al., 1998.

Plio-Pleistocene fossils have been recovered from palaeo-pans in the region, for example Kathu Pan and Townlands (Walker et al., 2017,) but there are no pans evident in the project footprint. There are palaeontological and archaeological sites in the Kuruman hills, Ghaap Group, but not in the project footprint.

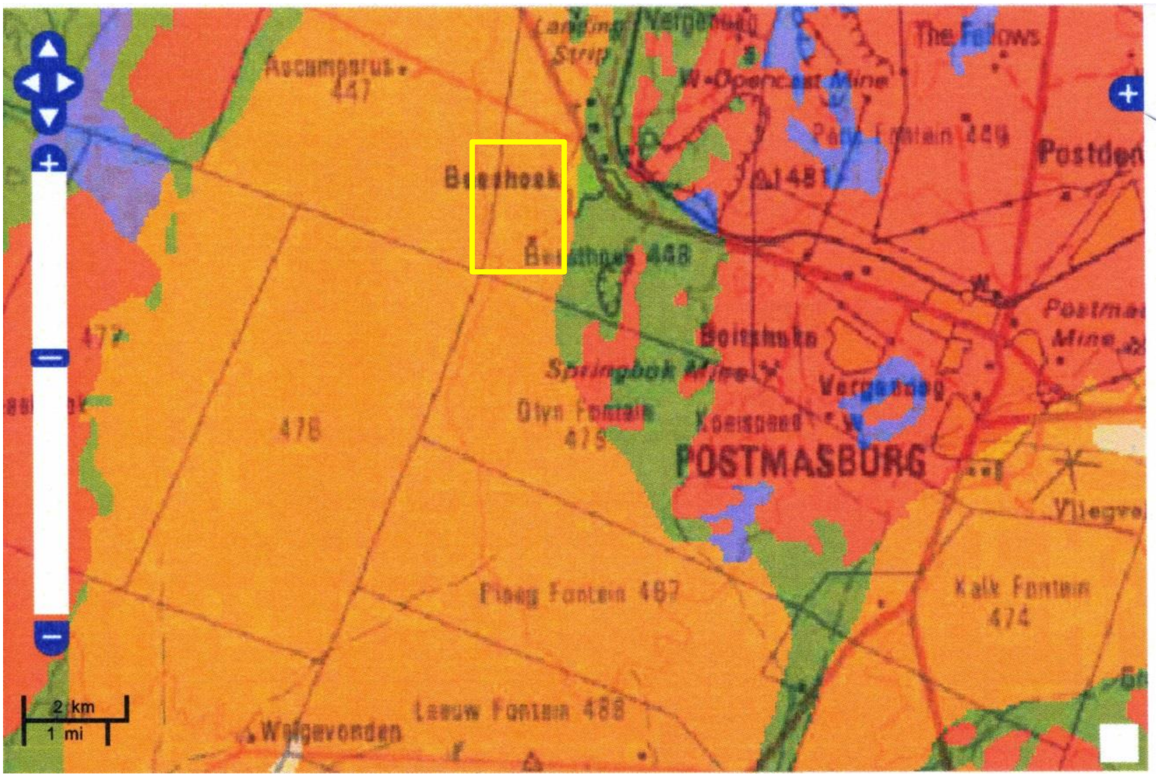

Figure 4: SAHRIS palaeosensitivity maps for the site for the proposed Beeshoek project shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as highly sensitive (orange) or moderately sensitive (green) so a desktop study is presented here.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in the table provided by the EIA company. NOTE not reproduced here because it is the same for all the specialists

Table 3: impacts for four stages 1 = planning; 2 = construction; 3= operation; 4 = closure.

Assessments for Palaeontology	1	2	3	4
Status of Impact	N	P	0	0
Impact Extent	low	low		
Impact Duration	3	1		
Impact Probability	1	1		
Impact Intensity	-1	+1		
Impact Significance	-1-5	-1-5		
MITIGATION = removal of any fossils found in the planning stage. If the surveyor or environmental officer sees any fossils along the rail line route, borrow pits, bridge or road construction that could be damaged, the position of the fossils should be marked with GPS points, the fossils photographed and then removed to a safe storage site until a palaeontologist can assess their scientific worth. Fossils should be given to a recognised repository (e.g. the McGregor Museum in Kimberley) with the relevant site data.	Mitigation during this phase			

Negative	**Low**	**Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts, mitigation is either easily achieved or little will be required, or both. Social, cultural, and economic activities of communities can continue unchanged.**	**- 1 – 5**

There will be no impact for the operational and closure (decommissioning) phases.
No monitoring is required if there are no fossils or if the fossils have been rescued.

The status of the impact during the planning phase and before mitigation (removal of fossils) will be negative; it becomes positive if fossils are absent or have been removed.
The extent of the impact is low because only fossils in the railway route could be affected.
The duration of the impact would be permanent if fossils are not removed, but is low if they are removed.
The probability of any fossils occurring along the route is very low because there are no palaeo-pans or palaeo-springs visible on the satellite imagery.
The intensity of the impact is only local.
Significance of the impact is low.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the aeolian sands, sandstones and calcrete are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material. No palaeo-pans or palaeo-springs that could entrap fossil, are visible in the satellite imagery, therefore it is extremely unlikely that they occur along the proposed railway route.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils in the loose sands or calcretes of the Quaternary. There is a very small chance that fossils may occur in palaeo-pans BUT no such feature is visible. Therefore, a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once surveyor and/or the environmental office walks the route, they should be photographed, position recorded, removed and stored. Photographs sent to the palaeontologist will enable him/her to assess the scientific importance of the fossils and act accordingly.

7. References

Astrup, J., Tsikos, H., 1998. Manganese. In: M.G.C. Wilson and C.R. Anhaeusser (Eds). The Mineral Resources of South Africa: Handbook. Council for Geosciences 16, p. 450-460.

Beukes, N.J., 1987. Facies relations, depositional environments, and diagenesis in a major early Proterozoic stromatolitic carbonate platform to basinal sequence, Campbell Rand Subgroup, Transvaal Supergroup, southern Africa. Sedimentary Geology 54, 1-46.

Eriksson, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. 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 237-260.

Goudie, A.S., Wells, G.L., 1995. The nature, distribution and formation of pans in arid zones. Earth Science Reviews 38, 1–69.

Porat, N., Chazan, m., Grün, R., Aubert, M., Eisenmann, V., Kolska Horwitz, L., 2010. New radiometric ages for the Fauresmith industry from Kathu Pan, southern Africa: Implications for the Earlier to Middle Stone Age transition, Journal of Archaeological Science 37, 269–283.

Walker, S.J.H., Lukich, V., Chazan, M., 2014. Kathu Townlands: A High Density Earlier Stone Age Locality in the Interior of South Africa. PLoS ONE 9(7): e103436. doi:10.1371/journal.pone.0103436

8. Chance Find Protocol

Programme for Palaeontology – to commence once the excavations commence and the route is surveyed by the surveyor or environmental officer. Planning/pre-construction phase

1. The following procedure is only required if fossils are seen on the surface when surveyed and any palaeo-pan or palaeo-spring feature is recognised.
2. If any fossiliferous material (plants, insects, bone) is seen it should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
3. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 1.5). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any scientifically important fossil material as assessed from the submitte photographs, then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the site and excavate (having obtained a SAHRA permit).
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study.
7. Annual reports must be submitted to SAHRA as required by the relevant permits.
8. If no good fossil material is recovered then the site inspection by the palaeontologist will not be necessary.
9. If no fossils are found during the survey then no further palaeontological impact assessment is required.

Appendix A – Examples of a palaeo-pan and fossils

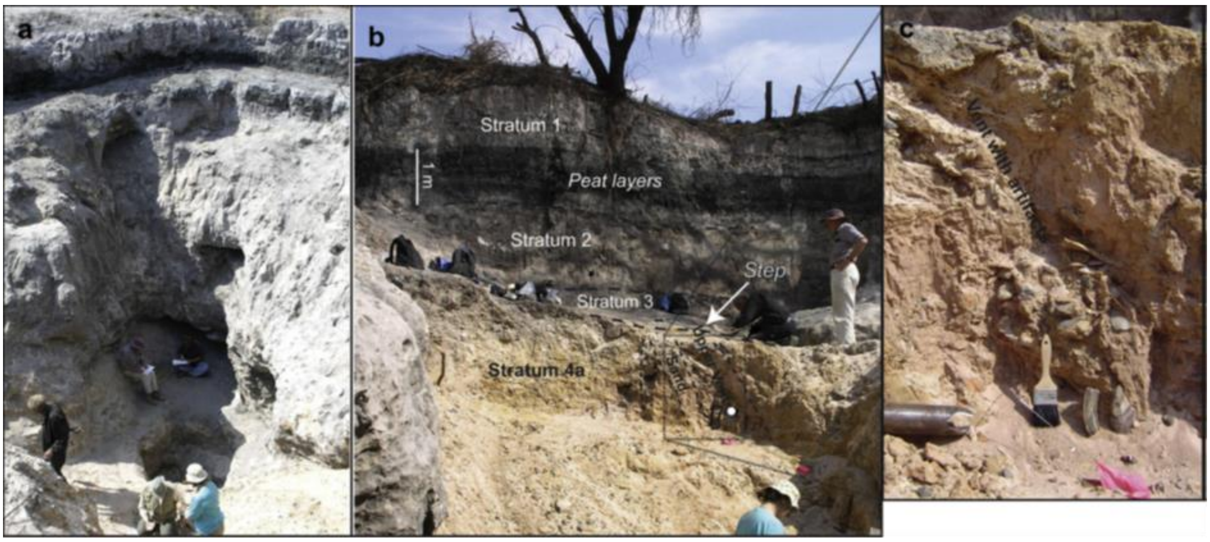

Figure 6: Example of a palaeo-pan deposit, Kathu Pan, near Kuruman and Kathu. From Porat et al., (2010).

Figure 7: Examples of bone fragments from quaternary sediments and could be found associated with pans.

Figure 8: Examples of silicified wood from Pleistocene sediments

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
January 2021

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
Present employment	:	Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-
Telephone	:	+27 11 717 6690
Fax	:	+27 11 717 6694
Cell	:	082 555 6937
E-mail	:	marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+

Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	11	0
Masters	10	4
PhD	11	4
Postdoctoral fellows	10	5

viii) Undergraduate teaching
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 2-8 students per year.

ix) Editing and reviewing
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –

Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources

- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for Enviropro

xi) Research Output

Publications by M K Bamford up to December 2019 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 10 book chapters.
Scopus h-index = 29; Google scholar h-index = 36; -i10-index = 80
Conferences: numerous presentations at local and international conferences.

xii) NRF Rating

NRF Rating: B-2 (2016-2020)
NRF Rating: B-3 (2010-2015)
NRF Rating: B-3 (2005-2009)
NRF Rating: C-2 (1999-2004)