# Palaeontological Impact Assessment for the proposed new underground Khwara Manganese mine near Hotazel, Northern Cape Province

**Desktop Study**

**For**

**SLR Consulting (South Africa) (Pty) Ltd**

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## Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 20 year PIA studies

## Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by, SLR Consulting (South Africa) (Pty) Ltd, Johannesburg. The views expressed in this report are entirely those of the author and SLR Consulting and no other interest was displayed during the decision making process for the project.

Specialist: …….. Prof Marion Bamford……..

Signature: …….

## Executive Summary

The desktop Palaeontological Impact Assessment for the mining rights for the proposed mine on farms Wessels 227 and Dibiaghomo 226 near Hotazel, Northern Cape Province, by Khwara Manganese (Pty) Ltd has been completed. The rocks in the area are mostly ancient volcanic and sedimentary rocks of the Ventersdorp and Olifantshoek Supergroups. There is only a small chance of finding stromatolites in the Mooidraai Formation. The overlying Cenozoic Kalahari group sands, alluvium and calcrete could possibly contain fossil, but none has been reported from either the ancient or the younger rocks in this region. Since there is a very small chance of finding fossils a chance find protocol and monitoring programme are included. It is the opinion of the palaeontologist that the project may proceed as far as the palaeontology is concerned.

# Palaeontological Impact Assessment for the proposed new underground Khwara Manganese mine near Hotazel, Northern Cape Province

## 1. Background

Khwara Manganese (Pty) Ltd (Khwara) is proposing to apply for a mining right on the farms Wessels 227 and Dibiaghomo 226 near Hotazel. SLR has been appointed by Khwara to conduct an EIA for the new underground Khwara Manganese mine as part of the mining right application on the same properties that were assessed in the palaeontological assessment in 2013 by Dr Gideon Groenewald. Since the property is under new ownership an updated palaeontological assessment has been done as required by SAHRA.

The National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) requires that the proposed development must be preceded by the relevant impact assessment, in this case for palaeontology.

This report complies with the requirements of the NEMA and environmental impact assessment (EIA) regulations (GNR 982 of 2014). The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

| **A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:** | **Relevant section in report** |
|---|---|
| Details of the specialist who prepared the report | Prof Marion Bamford |
| The expertise of that person to compile a specialist report including a curriculum vitae | Palaeontologist (PhD Wits 1990) CV attached |
| A declaration that the person is independent in a form as may be specified by the competent authority | Page 2 |
| An indication of the scope of, and the purpose for which, the report was prepared | Section 1, page 3 |
| The date and season of the site investigation and the relevance of the season to the outcome of the assessment | n/a Seasons make no difference to fossils |
| A description of the methodology adopted in preparing the report or carrying out the specialised process | Section 2, page 4 |
| The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure | See table 2 |
| An identification of any areas to be avoided, including buffers | n/a |
| 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 |
| A description of any assumptions made and any uncertainties or gaps in knowledge; | Section 6, page 9 |
| A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment | n/a |

| A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain: | Relevant section in report |
|---|---|
| Any mitigation measures for inclusion in the EMPr | n/a |
| Any conditions for inclusion in the environmental authorisation | n/a |
| Any monitoring requirements for inclusion in the EMPr or environmental authorisation | Section 8, page 10 |
| A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and | n/a |
| 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 |
| A description of any consultation process that was undertaken during the course of carrying out the study | Section 3 page5 |
| A summary and copies if any comments that were received during any consultation process | n/a |
| Any other information requested by the competent authority. | n/a |

## 2. Methods and Terms of Reference

1. In order to determine the likelihood of fossils occurring in the affected area geological maps, literature, palaeontological databases and published and unpublished records must be consulted.

2. If fossils are likely to occur then a site visit must be made by a qualified palaeontologist to locate and assess the fossils and their importance.

3. Unique or rare fossils should either be collected (with the relevant South African Heritage Resources Agency (SAHRA) permit) and removed to a suitable storage and curation facility, for example a Museum or University palaeontology department or protected on site.

4. Common fossils can be sacrificed if they are of minimal or no scientific importance but a representative collection could be made if deemed necessary.

The published geological and palaeontological literature, unpublished records of fossil sites, catalogues and reports housed in the Evolutionary Studies Institute, University of the Witwatersrand, and SAHRA databases were consulted to determine if there are any records of fossils from the sites and the likelihood of any fossils occurring there.


**FIGURE 1: GOOGLE MAP OF AREA AROUND HOTAZEL.**

## 3. Consultation Process

No consultations were carried out during the desktop study. Apart from reviewing interested and/or affected party (IAP) comments received by the EIA consultant during the EIA process, no other consultation took place as part of the paleontological study.

## 4. Geology and Palaeontology

Project location and geological setting

The proposed Manganese mine near Hotazel is on the Farms Wessels 227 and Dibiaghomo 226 and this is on ancient rocks of the Ventersdorp and Olifantshoek Supergroups and also Cenozoic Kalahari Group rocks as shown in the geological map in Figure 2.

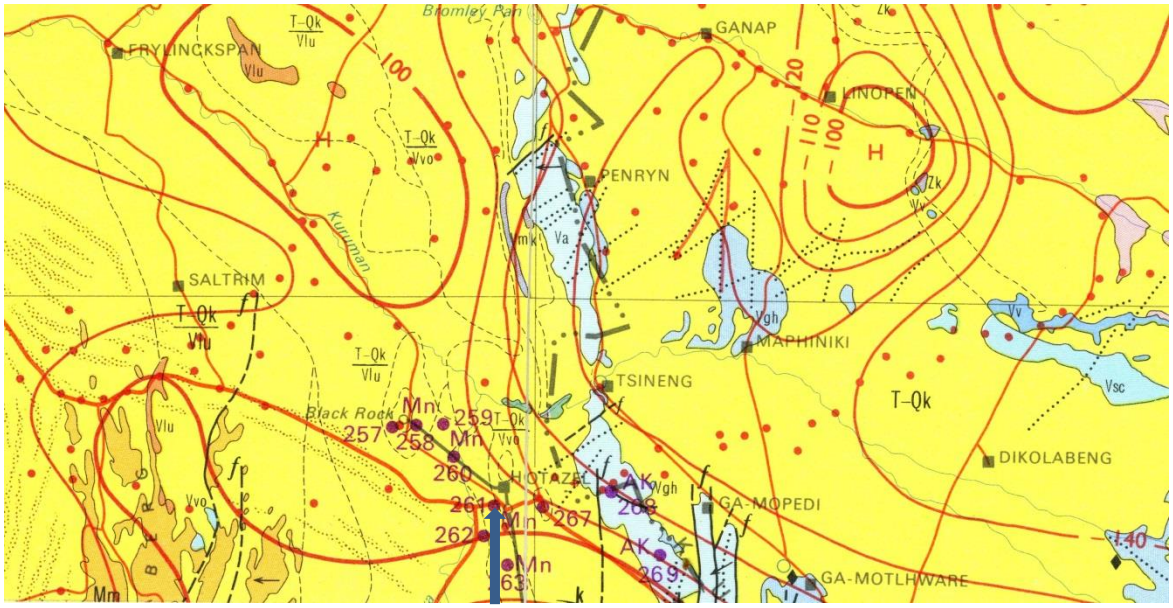


**FIGURE 2: GEOLOGICAL MAP OF THE AREA AROUND HOTAZEL, NORTHERN CAPE PROVINCE. THE APPROXIMATE LOCATION OF THE PROPOSED PROJECT IS INDICATED WITH THE ARROW. ABBREVIATIONS OF THE ROCK TYPES ARE EXPLAINED IN TABLE 2. MAP ENLARGED FROM THE GEOLOGICAL SURVEY 1: 1 000 000 MAP 1984.**

**TABLE 2: EXPLANATION OF SYMBOLS FOR THE GEOLOGICAL MAP AND APPROXIMATE AGES (ERIKSSEN ET AL., 2006; MOEN, 2006; PARTRIDGE ET AL., 2006). SG = SUPERGROUP; FM = FORMATION.**

| Symbol | Group/Formation | Lithology | Approximate Age |
|---|---|---|---|
| Q | Quaternary | Aeolian sands | Last 2.5 Ma |
| T-Qk | Kalahari Group | Sand, limestone | Ca 65 – 2.5 Ma |
| Mm | Matsap subgroup, Volop Group, Olifantshoek Supergroup | Subgreywacke, Quartzite, conglomerate | Ca 2000 – 1800 Ma |
| Vlu | Lucknow Fm, Olifantshoek Supergroup | White quartzite, shale, dolomite, conglomerate | Ca 2000 – 1800 Ma |
| Vho | Hotazel Fm, Postmasburg Group | Jaspillites, manganese | |
| Vo | Ongeluk Fm, Postmasburg Group, Ventersdorp Supergroup | Andesite | Ca 2222 Ma |
| Vmk | Makganyene Fm, Postmasburg Group | Diamictite, jaspilite, sandstone | |
| Va | Asbestos Hills subgroup, Ghaap Group, Ventersdorp Supergroup | Iron formation, Jaspilite | 2500 – 2425 Ma |
| Vgh | Ghaap Group, Ventersdorp Supergroup | Dolomite, limestone, chert | 2640 – 2425 Ma |

| Symbol | Group/Formation | Lithology | Approximate Age |
|---|---|---|---|
| Vsc | Schmidtsdrif subgroup, Ghaap Group, Ventersdorp Supergroup | Dolomite, shale | 2640 – 2620 Ma |

Geology

Hotazel is in the Griqualand West Basin, Northern Cape Province with underlying ancient rocks, some volcanic and some sedimentary deposits. The oldest are the Schmidtsdrift Subgroup, Ghaap Group, comprising a lower Boomplaas Formation which consists of stromatolitic and oolitic platform carbonates (Erikssen at al., 2006) and overlying Clearwater Formation shales, tuffites and BIF-like cherts (banded iron formation). There are also Asbestos Hills Subgroup BIFs and diamictites of the Postmasburg Group. Manganese deposits occur in the slightly younger Hotazel Formation which is in in the upper Postmasburg Group.

Overlying much of the ancient rocks are the extensive Cenozoic sands and calcretes of the Kalahari Group which range in thickness from a few metres to more than 180m (Partridge et al., 2006). The depth is controlled by the north-south palaeovalleys formed by ridges of Olifantshoek and Transvaal Supergroup ridges and valleys associated with the Dwyka Group as well as the Late Cretaceous drainage system (Partridge et al., 2006). Currently the palaeodunes in the Prieska area are being re-mapped using satellite imagery and ground truthing and a more complex picture is emerging (Dr Greg Botha, CGS, pers. com.).

Palaeontology
(Refer to Figure 4 for SAHRIS palaeosensitivity)

The ancient rocks in this area do not contain fossils because of their age and their origin which is a mix of volcanism, diamictites and banded iron formation. There may be stromatolites in the cores that penetrate the Mooidraai Formation which overlies the Hotazel Formation but these are microstromatolites and difficult to recognize.

The Kalahari Group sediments could preserve Cenozoic fossils but most of it is Aeolian, however there are some pans and springs that trap and preserve fossils, for example Kathu Pan. None has been reported from the Hotazel area but this could be because the area has not been surveyed thoroughly.

According to the SAHRIS palaeosensitivity map (Fig. 4) there is very little chance of finding fossils in this area.

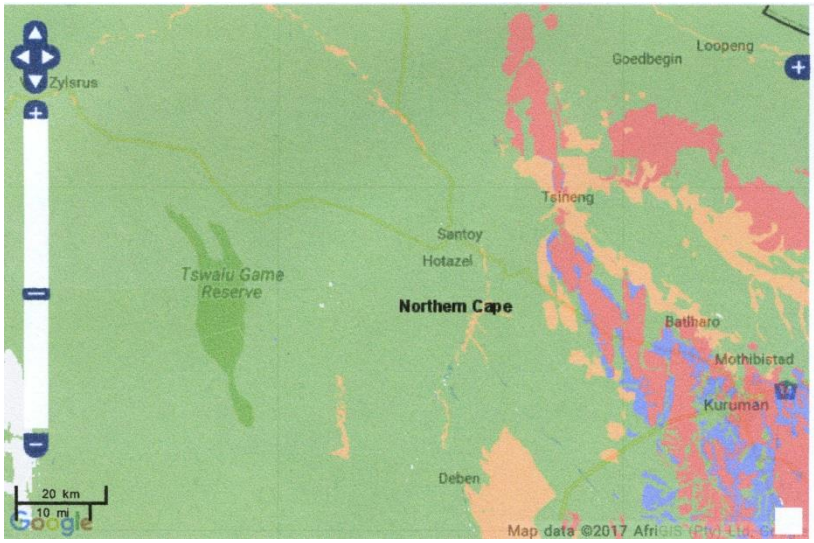


**FIGURE 4: SAHRIS PALAEOSENSITIVITY MAP. COLOURS INDICATE THE FOLLOWING DEGREES OF SENSITIVITY: RED = VERY HIGHLY SENSITIVE; ORANGE/YELLOW = HIGH; GREEN = MODERATE; BLUE = LOW; GREY = INSIGNIFICANT/ZERO.**

## 5. Impact assessment

Using the criteria in the table below, the impact of the mining operation on the two farms has been assessed.

**TABLE 3: CRITERIA FOR ASSESSING IMPACTS**

| **PART A: DEFINITION AND CRITERIA** | | |
|---|---|---|
| **Criteria for ranking of the SEVERITY/NATURE of environmental impacts** | **H** | Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. |
| | **M** | Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. |
| | **L** | Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. |
| | **L+** | Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. |
| | **M+** | Moderate improvement. Will be within or better than the recommended level. No observed reaction. |
| | **H+** | Substantial improvement. Will be within or better than the recommended level. Favourable publicity. |
| **Criteria for ranking the DURATION of impacts** | **L** | Quickly reversible. Less than the project life. Short term |
| | **M** | Reversible over time. Life of the project. Medium term |
| | **H** | Permanent. Beyond closure. Long term. |
| **Criteria for ranking the SPATIAL SCALE of impacts** | **L** | Localised - Within the site boundary. |
| | **M** | Fairly widespread – Beyond the site boundary. Local |
| | **H** | Widespread – Far beyond site boundary. Regional/ national |
| **PROBABILITY (of exposure to impacts)** | **H** | Definite/ Continuous |
| | **M** | Possible/ frequent |
| | **L** | Unlikely/ seldom |

No surface activities will take place as part of the proposed project therefore there will be no impact on surface fossil heritage resources. The IMPACT is nil (according to the scheme in Table 3).

Borehole cores and mining operations would penetrate deep into the ancient rocks where there are no fossils except for a very small chance of finding stromatolites. Therefore the SEVERITY/NATURE of the environmental impact would be L.

DURATION of the impact would be permanent: H.

Since only the possible fossils within the area would be visibly associated with surface pan or spring features these could be removed, the SPATIAL SCALE will be localised within the site boundary: L.

There is a very small chance of finding Cenozoic fossils on the surface or stromatolites far below the surface as these have been reported from similar aged sites, but none has been reported for the area around Hotazel. However, the PROBABILITY of affecting any fossils is unlikely or seldom: L

## 6. 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 basement rocks, dolomites, sandstones, shales, quartzites, basalts and sands and diamictites are typical for the country and do not contain any body fossil material. The sediments the Mooidraai Formation could contain microstromatolites, however, they have yet to be recorded from the proposed site for prospecting and mining.

## 7. Recommendation

It is unlikely that any fossils occur in the sites for the proposed mine because mostly the rocks are much too old and volcanic in origin. Cenozoic rocks may contain fossils but these have not been reported from the area. As there is a small chance of finding fossils a chance find and monitoring protocol is recommended.

As far as the palaeontology is concerned the proposed development can go ahead. Any further palaeontological assessment would only be required if fossils are found by the geologist or environmental personnel. The procedure can be added to the EMPr.

## 8. Monitoring Programme for Palaeontology – to commence once mining begins.

1. The following procedure is only required if fossils are seen during mining.

2. Any fossiliferous material (trace fossils, stromatolites, plants, insects, bone, coal) should be put aside in a suitably protected place. This way the mining 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 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 any fossils are found and the palaeontologist deems them important (based on the photographs) then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible. However, if the onsite designated person is diligent and extracts the fossil material then inspections can be less frequent.
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. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then further site inspections by the palaeontologist can be terminated. A final report by the palaeontologist must be sent to SAHRA.
8. If no fossils are found then no further monitoring is required.

## 9. References


Erikssen, 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.

MacRae, C.S., 1999. Life Etched in Stone. Fossils of South Africa. Geological Society of South Africa, Johannesburg. 350 pp.

Moen, H.F.G., 2006. The Olifantshoek Supergroup. 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 319-324.

Partridge, T.C., Botha, G.A., Haddon, I.G., 2006. 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.


Figure 5: Examples of stromatolites from the Transvaal Supergroup . A = view from side. B = view from the top. C = vertical section through a stromatolite. Photographs from McRae (1999).