RECOMMENDED EXEMPTION FROM FURTHER PALAEONTOLOGICAL STUDIES:

Proposed Wet Gas Sulfuric Acid Plant at the Mortimer Smelting Complex on Farms Zwartklip 405 KQ, Spitskop 410 KQ, Haardoorn 6 JQ and Turfbult 404 KQ, Bojanala Platinum District Municipality, near Rustenburg, Northwest Province

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EXECUTIVE SUMMARY

The ancient Precambrian gabbroic bedrocks underlying the Mortimer Smelting Complex study area near Rustenburg Platinum Mines, Northwest Province, are entirely unfossiliferous. Any overlying Late Caenozoic superficial sediments (*e.g.* stream alluvium) are of low palaeontological sensitivity. Furthermore the footprint of the development is very small and already highly-disturbed. It is concluded that the proposed wet gas sulphuric acid (WSA) plant is of VERY LOW impact significance in terms of palaeontological heritage resources.

It is recommended that, pending the discovery of significant new fossils remains before or during construction, exemption from further specialist palaeontological studies and mitigation be granted for the proposed WSA plant development.

Should significant new fossils - such as vertebrate bones and teeth - be exposed during development, the responsible Environmental Control Officer should alert SAHRA (*i.e.* The South African Heritage Resources Authority. Contact details: Dr Ragna Redelstorff, SAHRA, P.O. Box 4637, Cape Town 8000. Tel: 021 202 8651. Email: rredelstorff@sahra.org.za or Ms Natasha Higgitt. Tel: 021 462 4502. Email: nhiggitt@sahra.org.za) as soon as possible so that appropriate action can be taken in good time by a professional palaeontologist. Palaeontological mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as of associated geological data (*e.g.* stratigraphy, sedimentology, taphonomy). The ECO should be guided by the tabulated Chance Fossil Finds Procedure that is appended to this report.

1. OUTLINE OF THE PROPOSED DEVELOPMENT

In order to reduce SO_2 emissions, the company Anglo American Platinum Limited (AAP) is proposing to construct a wet gas sulphuric acid (WSA) plant adjacent to their existing Mortimer Smelting Complex located near Rustenburg Platinum Mines, Northwest Province. The smelting complex is located some 75 km north of Rustenburg on Farms Zwartklip 405 KQ, Spitskop 410 KQ, Haardoorn 6 JQ and Turfbult 404 KQ, Bojanala Platinum District Municipality, Northwest Province, South Africa (Figs. 1 & 2).

The following project background has been provided by WSP, Environment & Energy, Africa:

> Anglo American Platinum Limited (AAP) owns and operates three smelting complexes, namely Polokwane, Mortimer and Waterval. This project relates to the Mortimer Smelter, which is located at the Union Section (RPM-US), straddling the Limpopo and North-West Provinces of South Africa. The Mortimer Smelter is situated in the North-West Province.
>
> The Mortimer Smelter is an existing metallurgical industrial furnace where sulphide ores are smelted. Wet concentrate from the Concentrator is received and dried in flash dryers. The dry concentrate is smelted in an electric furnace, resulting in the recovery of platinum group metals (PGMs) and other base metals. The product of the smelting process (referred to as 'matte') is then tapped from the furnace, cast and crushed. The resulting furnace slag is currently stockpiled.
>
> The Mortimer Smelter has been upgraded, with 'Phase One' of the upgrade occurring in 2008/2009 and 'Phase Two' in 2011, resulting in an increase in the furnace power from 19 MW to 38 MW. The off-gas is currently being treated *via* an electrostatic precipitator (ESP); exhaust from the ESP is vented into the atmosphere *via* a stack at 80m above the ground. The constituents in the emissions include particulate matter (PM), Sulphur Dioxide (SO_2) and nitrogen oxide (NO_x).
>
> The National Environmental Management Air Quality Act (No. 39 of 2004) (NEM:AQA) requires that furnaces at metallurgical industries be operated with efficient SO_2 abatement systems by 2015; however, Mortimer Smelter was given an extension until 2020. In order to comply with new South African legislation and associated more stringent emission standards, an SO_2 abatement system must be installed at the Mortimer Smelter.
>
> The proposed strategy to reduce SO_2 to achieve the Minimum Emission Standards (MES) is the installation of a Wet Gas Sulphuric Acid (WSA) Plant that will convert the SO_2 contained in the off-gas into commercial-grade concentrated sulphuric acid (H_2SO_4). The exhaust from the WSA plant (containing reduced SO_2 concentrations) will be vented into the atmosphere *via* a 60/80 m high stack, and the commercial grade sulphuric acid will be temporarily stored before being dispatched into the commercial market.

The area upon which the WSA Plant and associated SO_2 abatement equipment (development) will be located is within the Mortimer Smelter Complex (Fig. 2). The proposed development will include the construction of a wet gas sulphuric acid (WSA) plant, gas cooling tower, effluent treatment plant, acid storage and load out, lime storage and preparation silo, potable water storage tank, laydown area, as well as the resurfacing of existing and additional roads.

A Palaeontological Impact Assessment (PIA) has been requested for proposed Mortimer Smelter SO_2 Abatement Project by SAHRA (Case ID: 10904, Interim Comment of 25 July 2017). The present palaeontological heritage comment has accordingly been commissioned as part of the EIA for the WSA project by WSP Environmental (Pty) Ltd, Bryanston (Contact details: Ms Anri Scheepers. WSP, Environment & Energy, Africa. WSP House, Bryanston Place, 199 Bryanston Drive , Bryanston 2191 South Africa. T +27 11 300 6089; F +27 11 361 1381; M +27 82 701 7690).

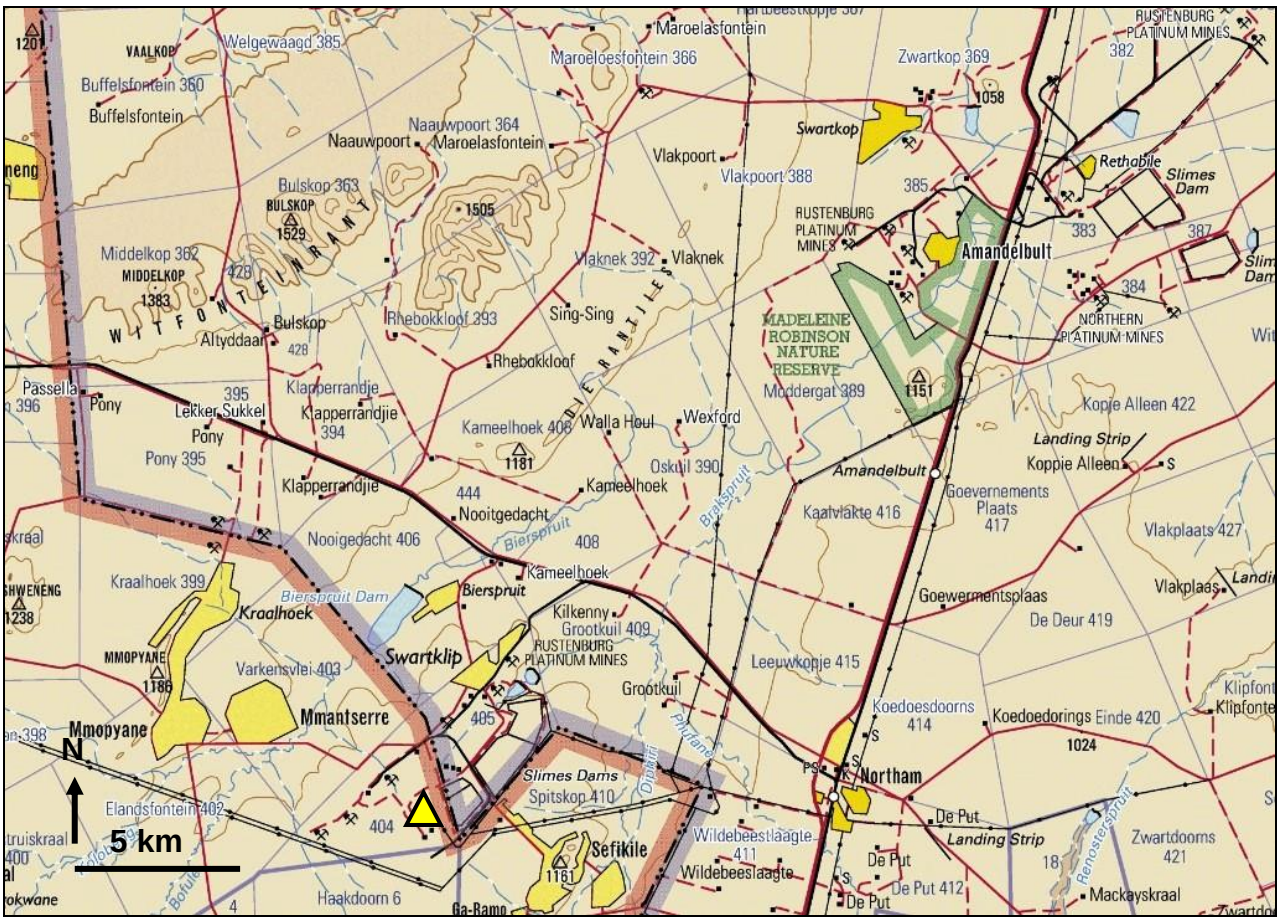

Figure 1. Extract from 1: 250 000 topographical map 2426 Thabazimbi (Courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the location of the Mortimer Smelting Complex study area near Rustenburg Platinum Mines, *c*. 75 km north of Rustenburg, Northwest Province (yellow triangle).

1.1. Legislative Framework

The present palaeontological heritage assessment report contributes to the EIA for the proposed development and falls under the South African Heritage Resources Act (Act No. 25 of 1999). It will also inform the Environmental Management Programme (EMPr) for this project.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites; and
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.

(2) All archaeological objects, palaeontological material and meteorites are the property of the State.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority—

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

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

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

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—

(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;

(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;

(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph *(a)* to apply for a permit as required in subsection (4); and

(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by the South African Heritage Resources Agency, SAHRA (2013).

1.2. Study approach and methodology

The footprint of the proposed development is small, while the inferred palaeontological sensitivity of the study area based on geological maps and the SAHRIS palaaeosensitivity map is LOW. A desktop-level palaeontological impact assessment is therefore appropriate here.

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations *etc.*) represented within the study area are determined from geological maps and satellite images. The known fossil heritage within each rock unit is inventoried from the published

scientific literature, previous palaeontological impact studies in the same region, and the author's field experience (Consultation with professional colleagues as well as examination of institutional fossil collections may play a role here, or later following field assessment during the compilation of the final report). This data is then used to assess the palaeontological sensitivity of each rock unit to development (provisional tabulations of palaeontological sensitivity of all formations in Limpopo Province have already been compiled by the author); see also the palaeosensitivity maps provided on the SAHRIS website). The likely impacts of the proposed development on local fossil heritage are then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned and (2) the nature and scale of the development itself, most significantly the extent of fresh bedrock excavation envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a Phase 1 field-based assessment study by a professional palaeontologist is usually warranted to identify any palaeontological hotspots and make specific recommendations for any mitigation or monitoring required before or during the construction phase of the development.

1.3. Limitations of this study

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil *etc*), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (*e.g*. of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist.

In the case of the present study area near Rustenburg Platinum Mines, Northwest Province, confidence levels for this palaeontological impact assessment are moderately high, based on the local geology, despite the lack of previous field-based palaeontological assessments in the region.

2. GEOLOGICAL BACKGROUND

The Mortimer Smelting Complex study area is located near Rustenburg Platinum Mines and close to the Limpopo / Northwest Province border, some 75 km north of Rustenburg and 50 km SW of Thabazimbi (Fig. 1). The footprint of the proposed WSA plant and associated infrastructure lies in highly disturbed, in part vegetated terrain at 1000-1050 m amsl within the Mortimer Smelter Complex and just south of a large mine dump (Fig. 2).

The geology of the study region to the north of Rustenburg and the Pilanesberg is shown on 1: 250 000 sheet 2426 Thabazimbi (Fig. 3) which has a short geological explanation printed on the map itself. The proposed development overlies gabbros (coarse-grained basic igneous rocks) of the world-famous Rustenburg Layered Suite This is a vast layered intrusion of mafic magma that was injected into the Kaapvaal Craton crust around 2060 Ma, *i.e.* in Early Proterozoic or Vaalian times (Walraven 1981, McCarthy & Rubidge 2005, Cawthorn *et al.* 2006). The Bushveld Complex has been described as "One of the great geological wonders of the world" – the largest layered igneous complex in the world with the richest reserves of platinum group metals known anywhere. The bedrocks in the lower-lying, western and central portions of the study area belong to the Rustenburg Layered Suite succession and have been mined there for a wide range of metals (red symbols in Fig. 3).

The Precambrian bedrocks in the study area are likely to be extensively mantled by a range of **Late Caenozoic superficial sediments** that are not mapped at 1: 250 000 scale. These may include stream alluvium, scree and downwasted rock rubble, surface gravels, sands and soils. No major water courses are seen in the study area on satellite images, so substantial alluvial deposits are not anticipated here.

Figure 2. Google Earth© satellite image of the footprint (yellow polygon) of the proposed WSA plant at the existing Mortimer Smelting Complex showing the terrain in the study area. Scale bar = 400 m. N towards top of image.

3. PALAEONTOLOGICAL HERITAGE

Precambrian igneous bedrocks of the Rustenburg Layered Suite (Bushveld Complex) are completely unfossiliferous. The Late Caenozoic superficial deposits might contain very sparse fossil or subfossil remains, such as vertebrate bones, teeth and horn cores or plant material such as subfossil wood, but in general they are of very low palaeontological sensitivity. To the author's knowledge, there are no fossil records from the study area.

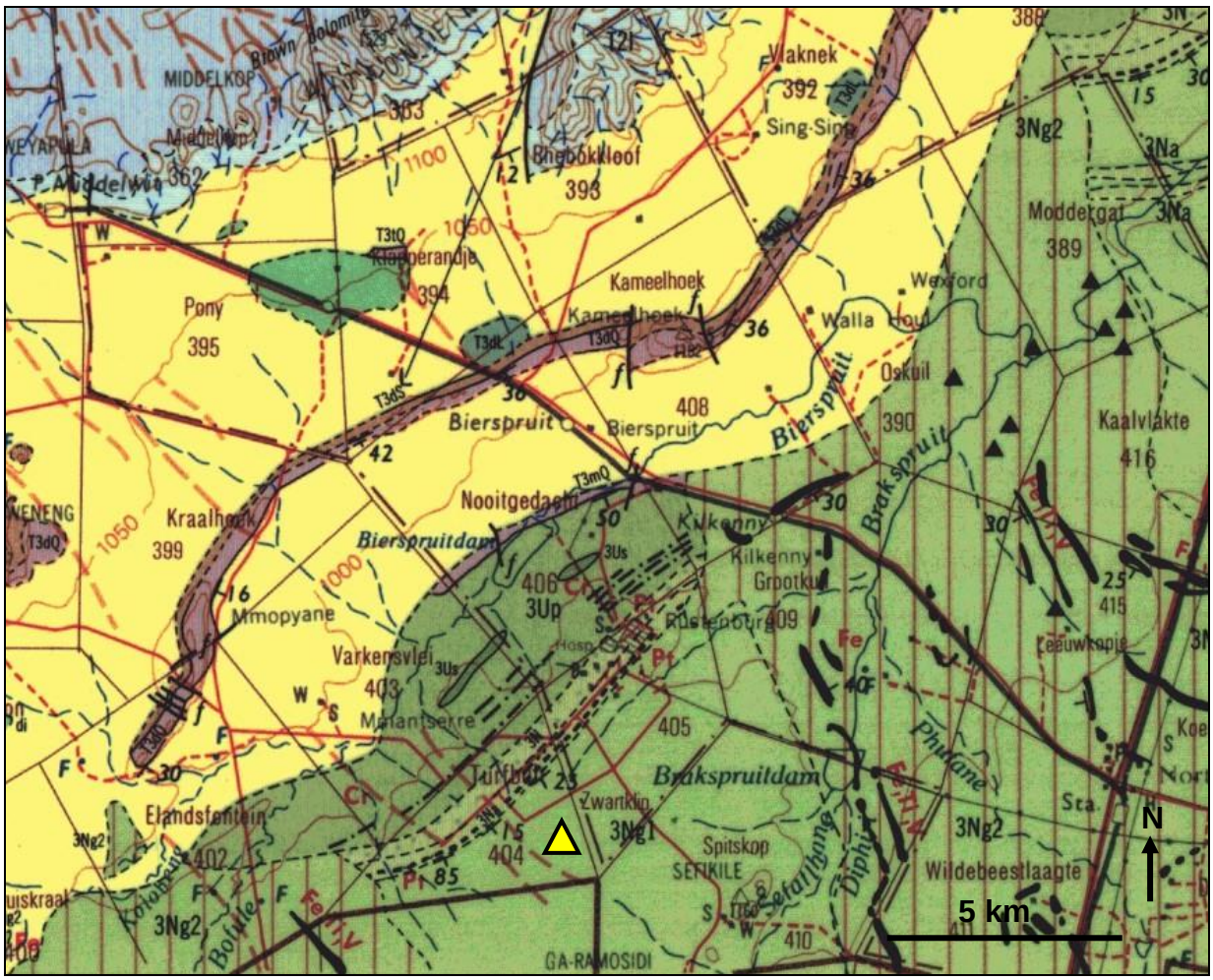

Figure 3. Extract from 1:250 000 geological map 2426 Thabazimbi (Council for Geoscience, Pretoria) showing the approximate location of the Mortimer Smelting Complex near Rustenburg Platinum Mines, *c*. 75 km north of Rustenburg, Northwest Province (yellow triangle). The development area of the proposed WSA plant overlies unfossiliferous Precambrian gabbros of the Rustenburg Layered Suite within the Bushveld Igneous Complex (3Ng1, green). There are no major drainage lines in the area that might be associated with substantial alluvial deposits. Red symbols refer to metallic ores within the Precambrian bedrocks.

4. CONCLUSIONS & RECOMMENDATIONS

The ancient Precambrian gabbroic bedrocks underlying the Mortimer Smelting Complex study area near Rustenburg Platinum Mines, Northwest Province, are entirely unfossiliferous. Any overlying Late Caenozoic superficial sediments (*e.g.* stream alluvium) are of low palaeontological sensitivity. Furthermore the footprint of the development is very small and already highly-disturbed. It is concluded that the proposed wet gas sulphuric acid (WSA) plant is of VERY LOW impact significance in terms of palaeontological heritage resources.

It is recommended that, pending the discovery of significant new fossils remains before or during construction, exemption from further specialist palaeontological studies and mitigation be granted for the proposed WSA plant development.

Should significant new fossils - such as vertebrate bones and teeth - be exposed during development, the responsible Environmental Control Officer should alert SAHRA (*i.e.* The South African Heritage Resources Authority. Contact details: Dr Ragna Redelstorff, SAHRA, P.O. Box 4637, Cape Town 8000. Tel: 021 202 8651. Email: rredelstorff@sahra.org.za or Ms Natasha Higgitt. Tel: 021 462 4502. Email: nhiggitt@sahra.org.za) as soon as possible so that appropriate action can be taken in good time by a professional palaeontologist. Palaeontological mitigation would normally involve the scientific recording and judicious sampling or collection of fossil material as well as of associated geological data (*e.g.* stratigraphy, sedimentology, taphonomy). The ECO should be guided by the tabulated Chance Fossil Finds Procedure that is appended to this report.

The palaeontologist concerned with mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies recently developed by SAHRA (2013). These recommendations should be incorporated into the Environmental Management Programme (EMPr) for the development.

Please note that all South African fossil heritage is protected by law (South African Heritage Resources Act, 1999) and fossils cannot be collected, damaged or disturbed without a permit from SAHRA or the relevant Provincial Heritage Resources Agency (in this case SAHRA).

5. ACKNOWLEDGEMENTS

Ms Anri Scheepers of WSP, Environment & Energy, Africa, Bryanston is thanked for commissioning this study and for providing the necessary background documentation.

6. KEY REFERENCES

CAWTHORNE, R.G., EALES, H.V., WALRAVEN, F., UKEN, R. & WATKEYS, M.K. 2006. The Bushveld Complex. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 261-281. Geological Society of South Africa, Marshalltown.

McCARTHY, T. & RUBIDGE, B. 2005. The story of Earth and life: a southern African perspective on a 4.6-billion-year journey. 334pp. Struik, Cape Town.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

WALRAVEN, F. 1981. The geology of the Rustenburg area. Explanation to 1: 250 000 geology sheet 2526 Rustenburg, 37 pp. Council for Geoscience, Pretoria.

7. QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Gauteng, KwaZulu-Natal, Mpumalanga, Limpopo, Northwest and Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has been a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

Dr John E. Almond,
Palaeontologist, *Natura Viva* cc

<table>
<tr><td colspan="3">CHANCE FOSSIL FINDS PROCEDURE: Proposed WSA Plant, Mortimer Smelting Complex near Rustenburg</td></tr>
<tr><td>Province & region:</td><td colspan="2">NORTHWEST PROVINCE, Bojanala Platinum District Municipality</td></tr>
<tr><td>Responsible Heritage Resources Authority</td><td colspan="2">SAHRA, P.O. Box 4637, Cape Town 8000.
Contact: Dr Ragna Redelstorff. Tel: 021 202 8651. Email: rredelstorff@sahra.org.za
or Ms Natasha Higgitt. Tel: 021 462 4502. Email: nhiggitt@sahra.org.za</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Late Caenozoic superficial sediments (alluvium / colluvium / soils / pedocretes/ surface gravels etc)</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Vertebrate bones, teeth and horn cores or plant material such as subfossil wood</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
Context – describe position of fossils within stratigraphy (rock layering), depth below surface
Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation
Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
Photograph fossils against a plain, level background, with scale
Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Authority</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Authority minimum standards.</td></tr>
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