DESKTOP PALAEONTOLOGICAL HERITAGE IMPACT ASSESSMENT REPORT IN RESPECT OF A PROPOSED ACCESS ROAD AND BRIDGE TO BE CONSTRUCTED ON PORTIONS 26, 35 AND 44 OF THE FARM TWEEFONTEIN 541, NEAR BRONKHORSTSPRUIT, GAUTENG PROVINCE

5 August 2018

Prepared for:

Heritage Contracts and Archaeological Consulting CC

On behalf of:

City of Tshwane Roads and Transport Department

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Prepared By:

Dr B.D. Millsteed

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EXECUTIVE SUMMARY

City of Tshwane Roads and Transport Department proposes to construct an access road (an upgrade of an existing road) and an associated bridge on Portions 26, 35 and 44 of the farm Tweefontein 541, approximately 11 km south-west of Bronkhorstspruit, in the Bronkhorstspruit Magisterial District, Metsweding District Municipality, Kungwini Local Municipality, Gauteng Province. The project area can be located within the confines of 1:50 000 topographic map 2528DC. The site of the area to be developed is approximately 900 m in length and will consist of an upgrade of an existing road and the construction of a bridge.

City of Tshwane Roads and Transport Department has appointed Heritage Contracts and Archaeological Consulting CC, as independent consultants, to conduct the Heritage Impact Assessment component of the reporting process for this construction project. Heritage Contracts and Archaeological Consulting CC has retained BM Geological Services to provide a desktop Palaeontological Heritage Impact Assessment Report in respect of the proposed project that will form part of the final Heritage Impact Assessment Report.

The entire extent of the project area is underlain by unfossiliferous strata of the Pretoria Group (Silverton and Magaliesberg Formations). It is anticipated, herein, that the road infrastructure will directly affect the land surface overlying the Silverton Formation and its associated regolith to a maximum depth of < 1 m while excavations occurring over the Magaliesberg Formation are expected to negatively impact upon the bedrock to a slightly deeper maximum depth (< 2 m). The concrete bases required for the construction of the bridge will require the emplacement of excavation of a maximum depth of 5 m.

Despite the impacts, discussed above, upon the bed rock underlying the project area both the Silverton and Magaliesberg Formations are considered to be unfossiliferous. The potential for a negative impact upon the palaeontological heritage of these strata has been assessed as negligible, and the scientific and cultural significance of any fossils contained is negligible to nil. Accordingly, no damage mitigation protocols are required within the area occupied by the bedrock underlying the project infrastructure.

The presence of a pervasive Cainozoic regolith horizon underlying the southern-most portions of the route of the proposed road upgrade has been interpreted. The fossiliferous potential of this unit is assessed as being negligible to nil. Accordingly, no damage mitigation protocols are required within the area occupied by the regolith.

This desktop study has not identified any palaeontological reason to prejudice the progression of this project. No damage mitigation protocols are recommended.

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2 TERMS OF REFERENCE AND SCOPE OF THE STUDY

The terms of reference for this study were as follow: -

- Conduct a desktop assessment of the potential impact of the proposed project on the palaeontological heritage of the project area.
- Describe the possible impact of the proposed development on the palaeontological heritage of the site, according to a standard set of conventions.
- Quantify the possible impact of the proposed development on the palaeontological heritage of the site, according to a standard set of conventions.
- Provide an overview of the applicable legislative framework.
- Make recommendations concerning future work programs as, and if, necessary.

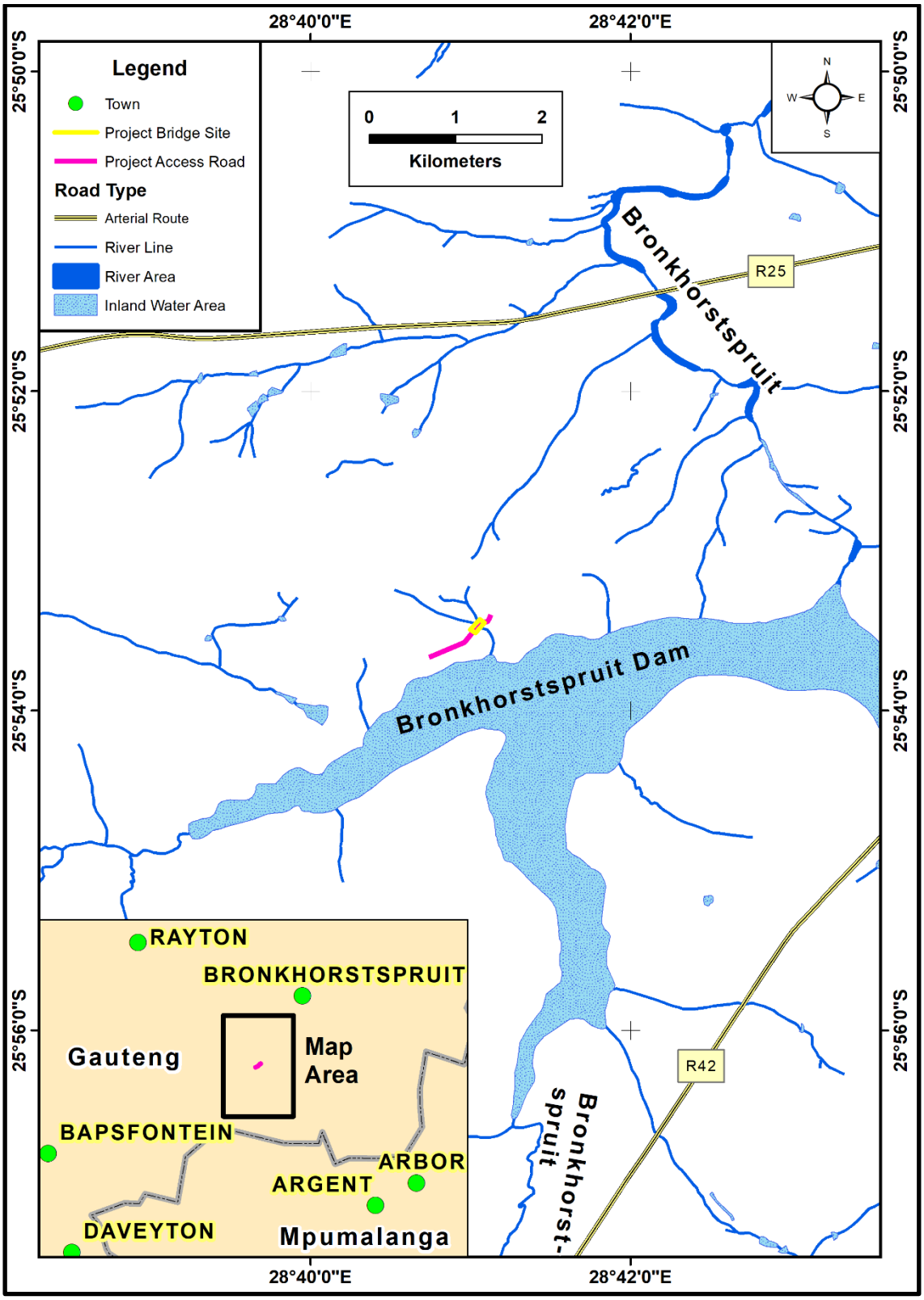

Figure 1: The locations of the proposed road and bridge infrastructure elements of the project.

3 LEGISLATIVE REQUIREMENTS

South Africa's cultural resources are primarily dealt with in two Acts. These are the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998).

3.1 The National Heritage Resources Act

The following are protected as cultural heritage resources by the National Heritage Resources Act:

- Archaeological artefacts, structures and sites older than 100 years.
- Ethnographic art objects (e.g. prehistoric rock art) and ethnography.
- Objects of decorative and visual arts.
- Military objects, structures and sites older than 75 years.
- Historical objects, structures and sites older than 60 years.
- Proclaimed heritage sites.
- Grave yards and graves older than 60 years.
- Meteorites and fossils.
- Objects, structures and sites or scientific or technological value

The Act also states that those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities. The national estate includes the following:

- Places, buildings, structures and equipment of cultural significance.
- Places to which oral traditions are attached or which are associated with living heritage.
- Historical settlements and townscapes.
- Landscapes and features of cultural significance.
- Geological sites of scientific or cultural importance.
- Sites of Archaeological and palaeontological importance.
- Graves and burial grounds.
- Sites of significance relating to the history of slavery.
- Movable objects (e.g. archaeological, palaeontological, meteorites, geological specimens, military, ethnographic, books etc.).

3.2 Need for Impact Assessment Reports

Section 38 of the Act stipulates that any person who intends to undertake an activity that falls within the following:

- The construction of a linear development (road, wall, power line, canal etc.) exceeding 300 m in length.
- The construction of a bridge or similar structure exceeding 50 m in length.
- Any development or other activity that will change the character of a site and exceed 5 000 m^2 or involve three or more existing erven or subdivisions thereof.
- Re-zoning of a site exceeding 10 000 $m^{2.}$
- Any other category provided for in the regulations of SAHRA or a provincial heritage authority.

must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development. If there is reason to believe that heritage resources will be affected by such development, the developer may be notified to submit an impact assessment report. A Palaeontological Impact Assessment (PIA) only looks at the potential impact of the development palaeontological resources of the proposed area to be affected.

3.3 Legislation Specifically Pertinent to Palaeontology*

*****Note: Section 2 of the Act defines "palaeontological" material as "any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains".

Section 35(4) of this Act specifically deals with archaeology, palaeontology and meteorites. The Act states that no person may, without a permit issued by the responsible heritage resources authority (national or provincial):

- Destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite.
- Destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite.
- 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
- Bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment that assists in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

- Alter or demolish any structure or part of a structure which is older than 60 years as protected.

The above mentioned palaeontological objects may only be disturbed or moved by a palaeontologist, after receiving a permit from the South African Heritage Resources Agency (SAHRA). In order to demolish such a site or structure, a destruction permit from SAHRA will also be needed.

Further to the above point, Section 35(3) of this Act indicates that "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". Thus, regardless of the granting of any official clearance to proceed with any development based on an earlier assessment of its impact on the Palaeontological Heritage of an area, the development should be halted and the relevant authorities informed should fossil objects be uncovered during the progress of the development.

3.4 The National Environmental Management Act [as amended]

The National Environmental Management Act does not provide the detailed protections and administrative procedures for the protection and management of the nation's Palaeontological Heritage as are detailed in the National Heritage Resources Act, but this act is more general in is application. In particular Section 2(2) of the Act states that environmental management must place people and their needs at the forefront of its concerns and, amongst other issues, serve their cultural interests equitably. Further to this point section 2(4)(a)(iii) states that disturbances of sites that constitute the nation's cultural heritage should be avoided, and where it cannot be avoided should be minimised and remedied.

Section 23(1) indicates that a general objective of integrated environmental management is to identify, predict and evaluate the actual and potential impact of activities upon the cultural heritage. This section also highlights the need to identify options for mitigating of negative effects of activities with a view to minimising negative impacts.

In order to give effect to the general objectives of integrated environmental management outlined in the Act the potential impact on cultural heritage of activities that require authorisation or permission by law must be investigated and assessed prior to their implementation and reported to the relevant organ of state. Thus, a survey and evaluation of cultural resources must be done in areas where development projects that will potentially negatively affect the cultural heritage will be performed. During this

process the impact on the cultural heritage will be determined and proposals for the mitigation of the negative effects made.

4 RELEVENT EXPERIENCE

Dr Millsteed holds a PhD in palaeontology and has previously been employed as a professional palaeontologist with the Council for Geoscience in South Africa. He is currently the principle of BM Geological Services and has sufficient knowledge of palaeontology and the relevant legislation required to produce this Palaeontological Impact Assessment Report. Dr Millsteed is registered with the South African Council for Natural Scientific Professions (SACNASP), is a member of the Palaeontological Society of South African and the Association of Australasian Palaeontologists and is also a Fellow of the Geological Society of South Africa.

5 INDEPENDENCE

Dr Millsteed was contracted as an independent consultant to conduct this desktop Palaeontological Heritage Impact Assessment study and shall receive fair remuneration for these professional services. Neither Dr Millsteed nor BM Geological Services has any financial interest in either the City of Tshwane Roads and Transport Department, the proposed access road and associated bridge, nor any companies or individuals associated with the project.

6 GEOLOGY AND FOSSIL POTENTIAL

Figure 2 shows that the project area is completely underlain by Eoproterozoic rocks of the Silverton Formation (Pretoria Group, Transvaal Supergroup). However, examination of Table 1 in conjunction with Figures 1 and 3 suggests that the published geological data is inaccurate (given the scale of the map this should not be unexpected) and that while the southern portions of the project are underlain by the Silverton Formation the central and northern portions of the project are in fact underlain by Eoproterozoic sediments of the Magaliesberg Formation (Pretoria Group, Transvaal Supergroup). Both The Silverton and Magaliesberg Formations form part of the basin-fill succession of the Transvaal Basin. A pervasive layer of Cainozoic regolith is interpreted to overlie the rocks of the Silverton Formation in the southern portion of the project area. A brief description of the geology of the area Pretoria Group and the Cainozoic regolith and their potential palaeontological contents is provided below.

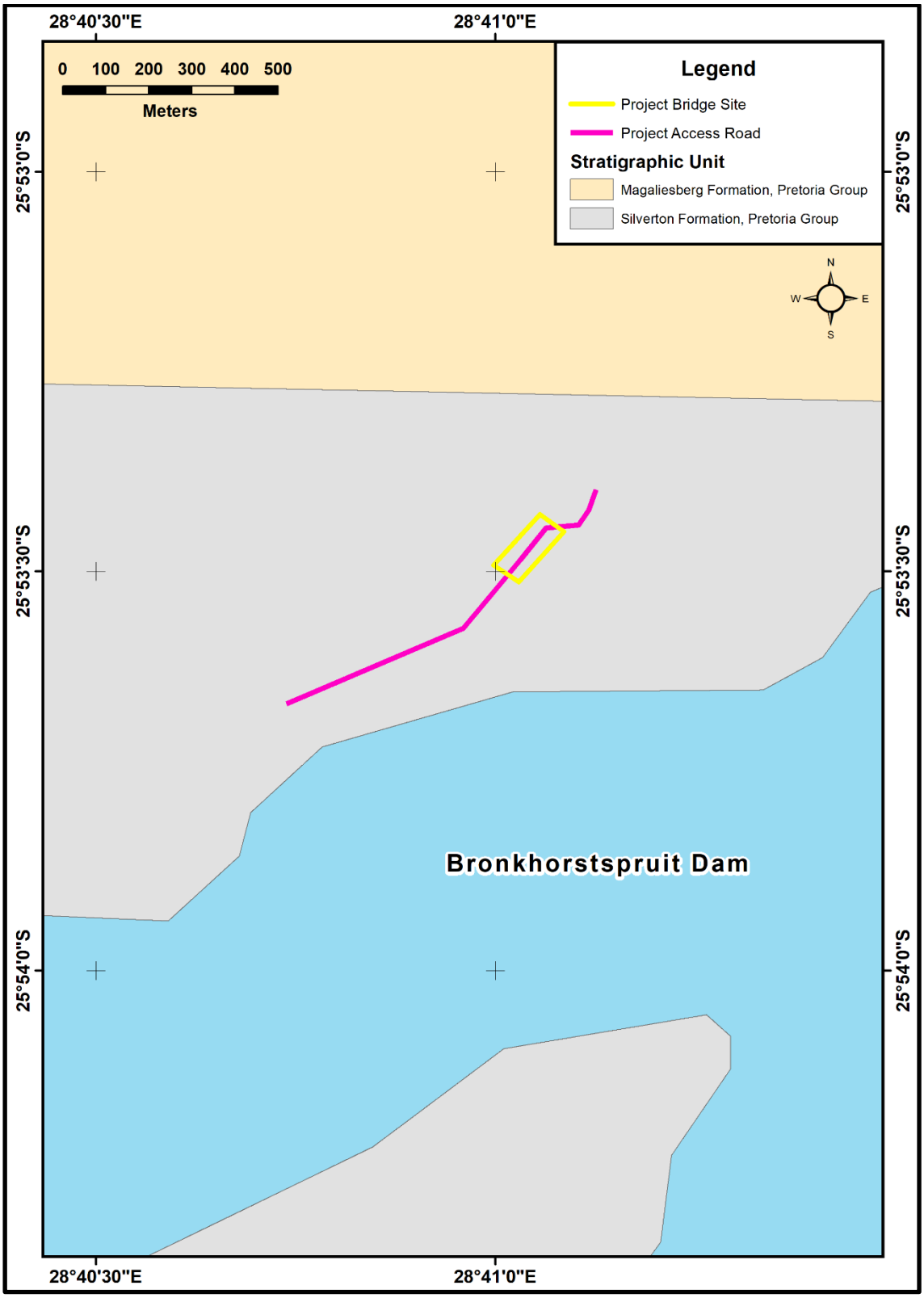

Figure 2: Map of the bed rock geology of the project area and its surrounding environs based on historical data. The location of the boundary between the two geological units is located further to the north than it is interpreted to be herein (see Figure 3).

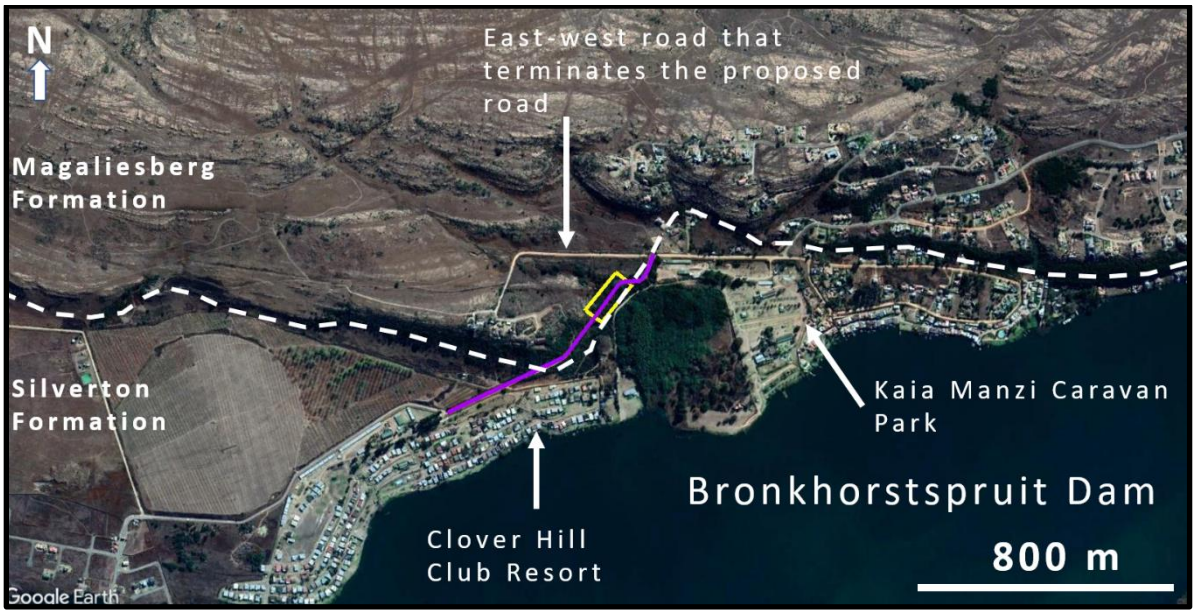

Figure 3: Google earth image of the project area and the wider region. The location of the proposed road (purple line) and the proposed bridge (yellow polygon) are shown. The approximate position of the outcrop of the boundary between the Silverton and Magaliesberg Formations (as interpreted herein) relative to the project area is shown using the dashed, white line.

6.1 Cainozoic regolith

6.1.1 Geology

The land surface overlying the Silverton Formation is topographically flat and featureless (Figure 3). It is evident that the land surface is being extensively utilised for agriculture with circular wheel irrigation areas and associated ploughed areas being present near the southern termination of the project area in Figure 3. The stratigraphic relationship between the Silverton and Magaliesberg Formations in this region indicates that both stratigraphic units dip to the north, with the stratigraphically older Silverton Formation occurring beneath the Magaliesberg Formation. The author has made extensive observations of the land surface associated with this stratigraphic boundary throughout the wider region. These observations indicate that much of the regolith cover overlying the Silverton Formation, in the immediate vicinity of the stratigraphic boundary between the two formations, consists of a talus wedge (thinning away from the Magaliesberg Formation) formed by the erosional of the Magaliesberg Formation and the retreat of the stratigraphic boundary towards the current outcrop of the Magaliesberg Formation (i.e., the regolith is

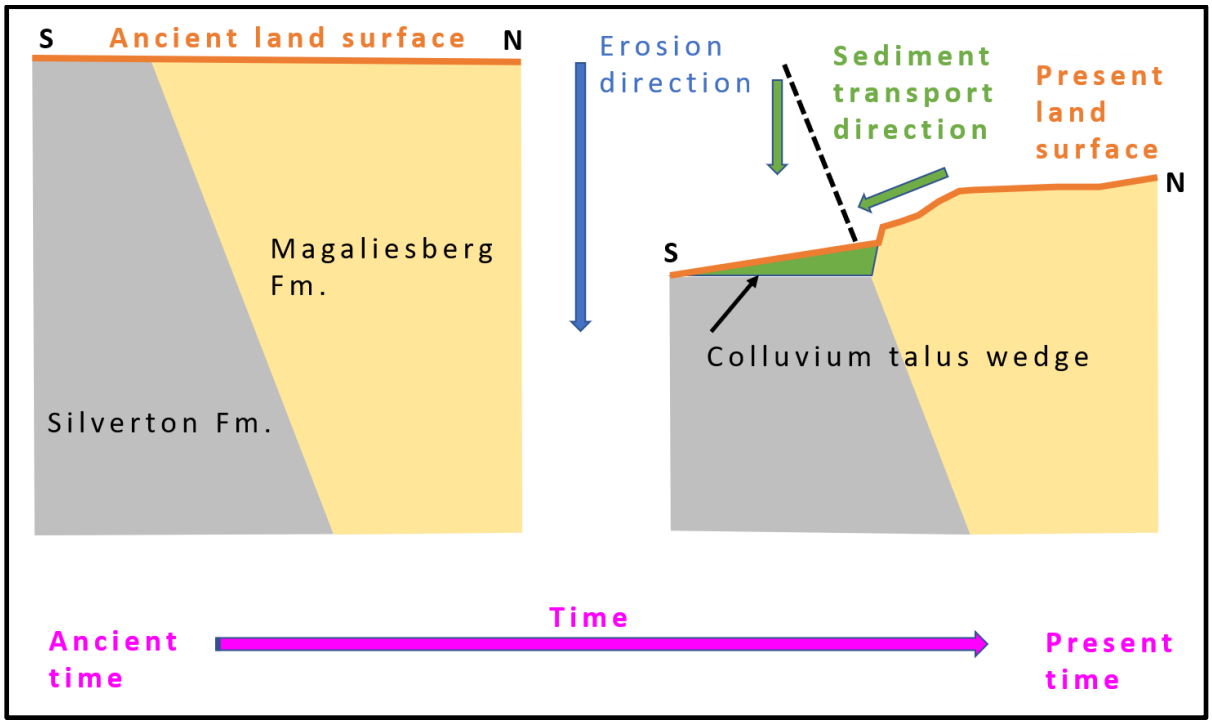

Figure 4: Schematic diagram showing the evolution of the present land surface from the ancient past to the present day. The downward and northern migration of the outcrop of the contact between the soft, easily eroded Silverton Formation and the harder, more erosion resistant Magaliesberg Formation creates higher topographic relief to the north. Sediment transport is in a southern and downward direction resulting in the formation of a southerly thinning colluvium talus wedge to the immediate south of the contact.

colluvium; Figure 4). It is also possible that some of the regolith layer may be derived from *in situ* weathering of the rocks of the Silverton Formation (i.e., they are soils).

Given the proximity of the location of the inferred regolith horizon to the margins of the Bronkhorstspruit Dam as well as the channel of the perennial Bronkhorstspruit and other significant drainage lines (Figure 3) consideration should be given to the origin of the regolith being fluvial in origin. However, the location of the margins of the dam waters are simply the result of modern flooding caused by the dam construction. The original fluvial channels would have been located to the south and well down the slope of the valley walls. It is these original channels that would have any chance of preserving potentially fossiliferous alluvial sediments but they are now drowned by the dam waters and are unobservable.

6.1.2 Palaeontological potential

The rocks of both the Silverton and Magaliesberg Formations are unfossiliferous. Thus, regardless of whether the regolith overlying the Silverton Formation is derived from *in situ* decomposition of the underlying Silverton Formation or by weathering and downhill transport of the unfossiliferous Magaliesberg Formation the regolith unit would be unfossiliferous.

6.2 Silverton Formation

6.2.1 Geology

Figure 2 shows that the project area is completely underlain by Eoproterozoic rocks of the Silverton Formation (Pretoria Group, Transvaal Supergroup) with the stratigraphically overlying Magaliesberg Formation rocks cropping out to the north. Examination of Table 1 indicates that in the central portions of the Transvaal Basin the upper-most portion of the Silverton Formation is predominantly composed of easily eroded mudstones (some tuffaceous) and occasional carbonates. The Magaliesberg Formation is comprised of 225 - 550 m of more erosion resistant sandstone with minor mudrock lenses (Table 1). The author's experience of the region indicates that the quartzites of the Magaliesberg Formation weather to produce a prominent rocky ridge. It is evident from Figure 3 that the rocks underlying the central and northern-most sections of the project form part of an extensive, rocky, topographically raised landform reminiscent of the Magaliesberg Formation elsewhere. Given the indicated proximity of the Magaliesberg Formation to the project area in Figure 2 it is considered, herein, that the most parsimonious interpretation is that these rocky exposures are actually outcrops of the Magaliesberg Formation. It appears that the location of the boundary between the Silverton and Magaliesberg Formations has been placed inaccurately too far to the north in the historical map data.

Radiometric dates from the unit are not common within the rocks of the Pretoria Group, but lavas of the Hekpoort Formation have been dated at 2224 ± 21 Ma (Eriksson *et al*., 2006). It is evident from Table 1 that the Hekpoort Formation is stratigraphically older than the Silverton Tectonic and, the radiometric age of 2224 ± 21 Ma represents an oldest possible age for the Silverton Formation.

The setting proposed for the Transvaal Basin (containing the Pretoria Group strata) lies within the rift-to-intracratonic-sag-type group of basins. The developments of the group within the basin is interpreted as documenting a series of transgressive/regressive sea movements in a shallow seaway (Eriksson *et al*., 2006).

Table 1: List of formations comprising the Pretoria Group (listed in order from youngest at the top to oldest at the bottom). The list provided details of the various rock types that comprise each formation as well as details of the stratigraphic thickness of the unit within the central area of the Transvaal Basin (modified from Eriksson *et al*., 2006).

FORMATION NAME	LITHOLOGY
Rayton	Ca. 200 m of mudrock, sandstones, and andesite with some carbonates near the top of the unit
Magaliesberg	225 - 550 m of sandstone with mudrock lenses
Silverton	40 - 110 m of predominantly mudstones (some tuffaceous) with pyroclastic rocks of the Machadodorp Member near the middle of the unit and carbonates near the top
Daspoort	40 - 110 m of sandstones with lesser mudrock, common pebbly conglomerate
Strubenkop	100 -150m of mudrock with subordinate sandstone and minor tuff
Dwaalheuvel	Sandstone, conglomerate with subordinate mudrock
Hekpoort	340 – 650 m of basaltic andersite composition air-fall tuffs and reworked pyroclastics
Boshoek	< 2 m of mostly abundant sandstone, conglomerate and diamictite
Timeball Hill	Mudrocks dominant (130-350 m at top; and at base (220-350 m) with diamictites. Some thin quartzites in the middle of the unit (< 40 m total) and the Bushy Bend Lava member at the base
Rooihoogte	10 – 50 m of breccia and conglomerate

6.2.2 Palaeontological potential

No macrofossil materials are known to occur with the rocks of either the Silverton or Magaliesberg Formations. The Silverton and Magaliesberg Formations unit are, therefore, considered to be unfossiliferous.

7 ENVIRONMENT OF THE PROPOSED PROJECT SITE

The project area lies approximately 11 km southwest from Bronkhorstspruit (Figure 1). Topographically, the region is divided into a flat, featureless terrane to the south which is extensively utilised for agriculture and which also hosts the Bronkhorstspruit Dam. In the north of the project area lies a hilly, rocky terrane which is not cultivated (Figure 3). The divide between the flat south and the hilly, rocky north is comprised of a prominent erosional scarp (Figure 3).

The southern-most extent of the proposed access road is located immediately north of the Clover Hill Club Resort. The road will extend to the north-east where it climbs up, and parallel to, the prominent erosional scarp mentioned above. The northern-most termination of the road lies on a small, flat plateau where the proposed road will intersect a pre-existing east-west oriented road; this road extends to the east where it joins up with the Kaia Manzi Caravan Park and then on to the more easterly Kungwini Country Estate (Figure 5). Examination of Google earth imagery (Figure 6) reveals that the proposed bridge, located in the northern portions of the route of the proposed road, will span a pronounced north-west to south-east oriented, heavily wooded, erosional valley formed by two streams that coalesce and then that traverse the route of the road (Figure 5).

The southern-most extent of the project area was originally underlain by vegetation cover of the Rand Highveld Grassland type, while the central and northern portions are underlain by the Gold Reef Mountain Bushveld vegetation type (Mucina and Rutherford, 2006; Figure 7). Mucina and Rutherford (2006) describe the conservation status of the Rand Highveld Grassland veld type as being endangered while the Gold Reef Mountain Bushveld vegetation type is described as being least threatened. It is apparent from Figure 3 that very little, if any, of the original vegetation cover of the area remains in the flat, southern portions of the project area (Figures 3 and 5). The central and northern portions retain more of the original plant cover (Figure 3).

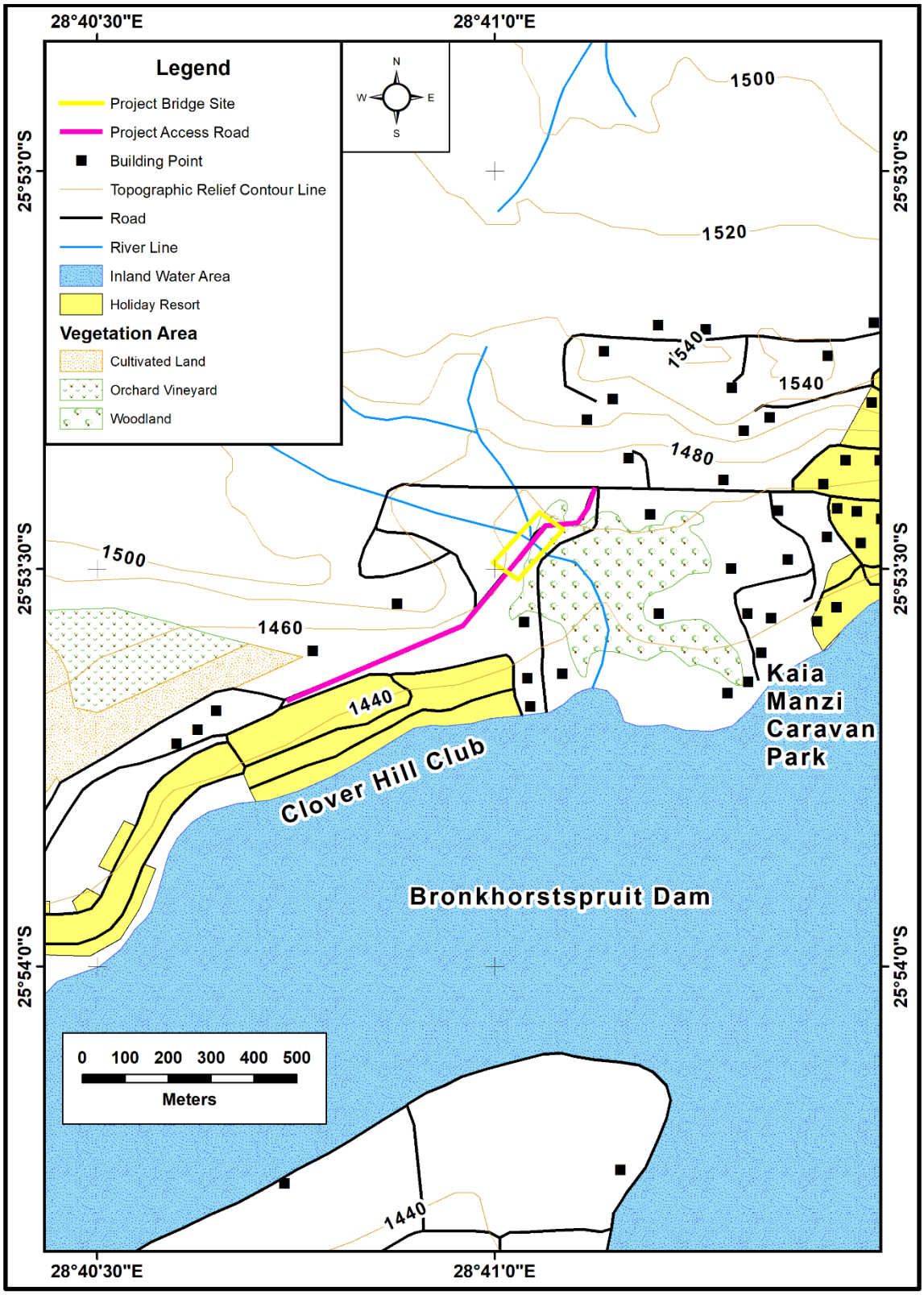

Figure 5: The environment of the area underlying the route of the proposed road (purple line) and bridge (yellow rectangle) and the surrounding environs. The topographic relief contour interval for the map is 20 m.

Figure 6: Google earth image centred on the area of the proposed bridge construction (tallow rectangle). The heavily wooded area represents an erosional valley that traverses the route of the proposed road at the site of bridge.

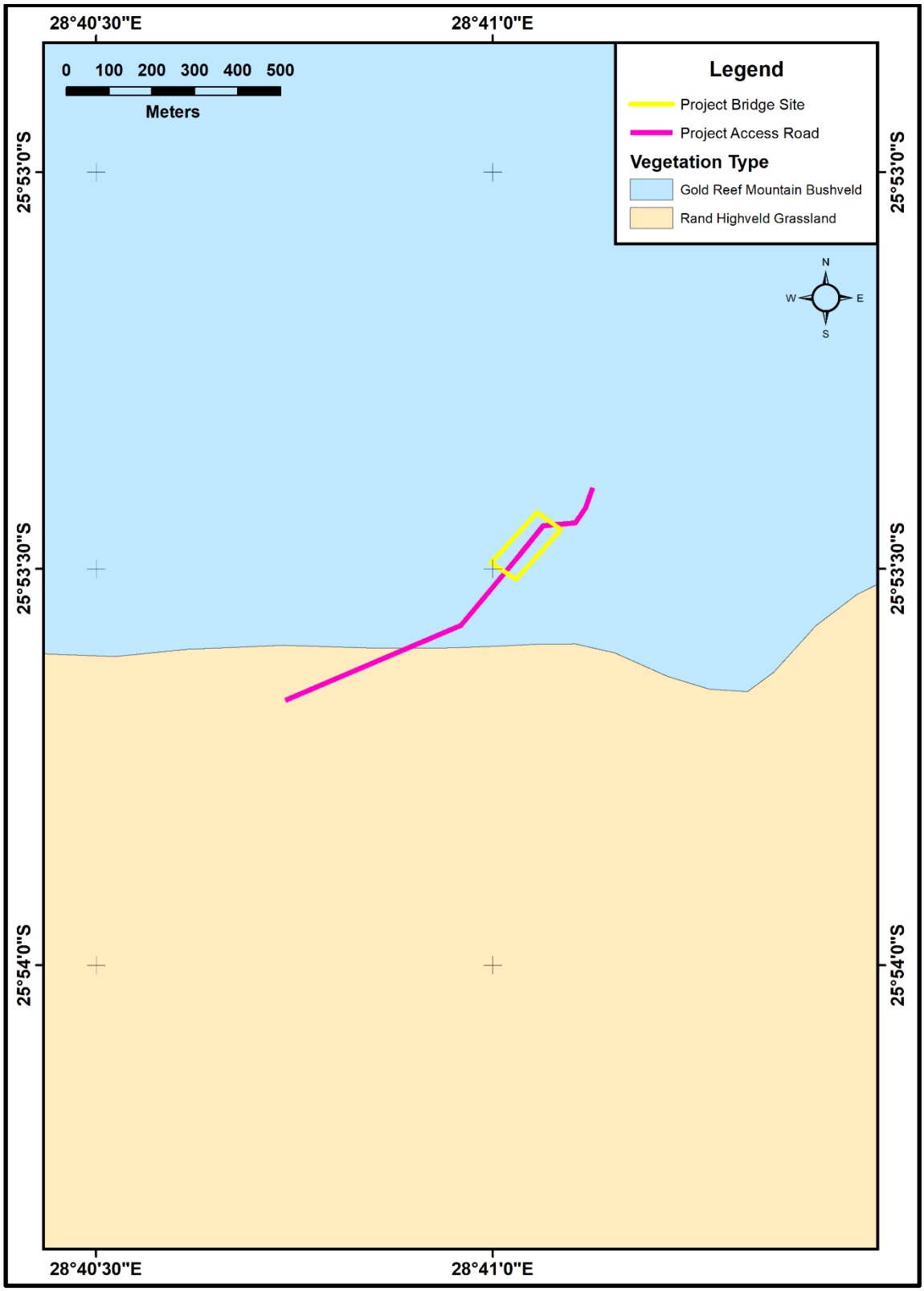

Figure 7: Vegetation types underlying the project area and the surrounding environs (modified from Mucina and Rutherford, 2006).

8 OVERVIEW OF SCOPE OF THE PROJECT

The nature of the built and other infrastructure elements proposed for the road and associated bridge are as follow:

Road

The proposed road is an upgrade of a pre-existing road. The exact details of the proposed road's width dimensions and construction techniques are unknown to the author; a guide to the dimensions may be gained as the existing road appears on Google earth imagery to be a dirt road approximately 8 m wide. However, for the purposes of discussion within this report, and to represent a worst-case scenario, it is considered most likely that the road will consist of a sealed, two lane road at least 8 m wide; the two road lanes will carry traffic travelling in opposite directions. The road will extend for approximately 900 m from the northern margin of the Clover Hill Club Resort and will extend in a north-easterly direction climbing up (and parallel to) an erosional scarp. The proposed road will terminate at a junction with an existing east-west oriented road that extends to the east and provides access to both the Kaia Manzi Caravan Park (Figure 3) and the more easterly Kungwini Country Estate.

It is anticipated that the bedrock will need to be excavated and levelled across much of the outcrop of the Magaliesberg Formation and a layer of road base put into place. The maximum depth of the excavations into the Magaliesberg Formation rocks is anticipated, herein, to be <2 m. In the southern-most portions of the project the road will be constructed upon the flat, featureless topography that overlies the Silverton Formation. It is anticipated that in these areas excavation will be required into the bedrock of the Silverton formation and/or the regolith layer. It is expected that the maximum depth of these excavations (to allow for levelling and emplacement of road base) will be < 1 m.

Bridge

The bridge will consist of an integral design with a voided concrete deck resting upon spread footing. The bridge will span a heavily wooded, erosional valley located in the northern portions of the project area and which cuts down through the erosional scarp that forms the boundary between the Silverton and Magaliesberg Formations. The concrete deck will be 10 m wide and will be set upon twin concrete bases 4 m in width (the centre point of each will lie 15 m apart). The depth of the voids to be excavated for the concrete bases will be approximately 5 m deep. It is evident from Figure 3 that these excavations will occur within the Magaliesberg Formation and/or any overlying regolith. The bridge appears to be approximately 150 m in length.

The following impact assessment (Section 9) is made in the light of these assumptions.

9 IMPACT ASSESSMENT

The potential impact of the City of Tshwane Roads and Transport Department's construction project is categorised below according to the following criteria:-

9.1 Nature of Impact

The potential negative impacts of the proposed project on the palaeontological heritage of the area are:

- Damage or destruction of fossil materials during the construction of project infrastructural elements to a maximum depth of those excavations. Many fossil taxa (particularly vertebrate taxa) are known from only a single fossil and, thus, any fossil material is potentially highly significant. Accordingly, the loss or damage to any single fossil can be potentially significant to the understanding of the fossil heritage of South Africa and to the understanding of the evolution of life on Earth in general. Where fossil material is present and will be directly affected by the building or construction of the projects infrastructural elements the result will potentially be the irreversible damage or destruction of the fossil(s).
- Movement of fossil materials during the construction phase, such that they are no longer *in situ* when discovered. The fact that the fossils are not *in situ* would either significantly reduce or completely destroy their scientific significance.
- The loss of access for scientific study to any fossil materials present beneath infrastructural elements for the life span of the existence of those constructions and facilities.

9.2 Extent of impact

The possible extent of the impact of the proposed project on the palaeontological heritage of South Africa is restricted to the damage, destruction or accidental relocation of fossil material caused by the excavations and construction of the necessary infrastructure elements forming part of the project. The **extent of the area of potential impact is, accordingly, categorised as local** (i.e., restricted to the project site).

9.3 Duration of impact

The anticipated duration of the identified impact is assessed as potentially **long term to permanent**. This is assessment is based on the fact that, in the absence of mitigation procedures (should fossil material be present within the area to be affected) the damage or destruction of any palaeontological materials will be permanent. Similarly, any fossil materials that exist below the structures and infrastructural elements that will constitute

the school and orphanage complex will be unavailable for scientific study for the life of the existence of those features.

9.4 Probability of impact

It is pertinent to realise that fossils are generally scarce and sporadic in their occurrence and, as such, the probability of any development affecting a fossil at any particular point on the land surface in relatively low. However, the strata of the Silverton and Magaliesberg Formations are known to be unfossiliferous. Accordingly, the probability of any fossils contained within either of these stratigraphic units being negatively affected is assessed as **negligible**.

The presence of a Cainozoic regolith cover underlying the project area is interpreted herein (see Section 6.1.1 above). It is anticipated that this regolith is derived from either *in situ* decomposition of the underlying Silverton Formation rocks or is colluvium derived from erosion and down-hill transportation of Magaliesberg Formation rocks. As both the Silverton and Magaliesberg Formation strata are considered to be unfossiliferous it is not probable that the regolith horizon will have inherited fossil material from either of the possible bed rock protoliths. The probability of any fossil materials being originally present within the regolith is **negligible**.

9.5 Significance

Should the project progress without due care to the possibility of fossils being present within either the bedrock or regolith the resultant damage, destruction or inadvertent relocation any affected fossils will be permanent and irreversible. However, both the bedrock and regolith cover underlying the project area are considered to be unfossiliferous, herein. As a result, the significance of the proposed project on the palaeontological heritage of the area is categorised as **negligible to nil**.

10 DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSABLE LOSS

The degree to which the possible negative effects of the proposed project can be mitigated, reversed or will result in irreversible loss of the palaeontological heritage can be determined as discussed below.

10.1 Mitigation

No damage mitigation protocols are required.

10.2 Reversal of damage

Any damage to, or the destruction of, palaeontological materials or the reduction of their scientific value due to a loss of their original location is **irreversible**.

10.3 Degree of irreversible loss

Once a fossil is damaged, destroyed or moved from its original position without its geographical position and stratigraphic location being recorded the **damage is irreversible**.

By their nature fossils are usually scarce and sporadic in their occurrence and the chances of negatively impacting on a fossil in any particular area are low. However, any fossil material may be of the greatest scientific importance; this is particularly true of vertebrate fossils in which many taxa are known from only one fossil. Thus, the potential always exists during construction and excavation within potentially fossiliferous rocks for the permanent and irreversible loss of extremely significant or irreplaceable fossil material. This said, many fossils are incomplete in their state of preservation or are examples of relatively common taxa. As such, just because a fossil is present it is not necessarily of great scientific value. Accordingly, not all fossils are necessary significant culturally of scientifically significant and the potential degree of irreversible loss will vary from case to case. The judgement on the significance of the fossil must be made by an experienced palaeontologist.

11 ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

The information provided within this report was derived from a desktop study of available maps and scientific literature; no direct observation was made of the area as the result of a site visit. In particular, the discussion of the geological units occurring beneath the project area infrastructure (and as such the basis of understanding the fossiliferous potential of the area and the extent of any negative impact upon the palaeontological heritage of the area) was derived from the published 1:250 000 geological maps of the area. The accuracy of 1:250 000 geological maps is often variable; some areas being compiled from air photo interpretation or remote sensing procedures. It is apparent that there may be such an error in the area of the project and a number of logical assumptions have been made to reinterpret the geology of the project area. The possibility of the presence of additional geological units being present within the project area cannot be disregarded.

The presence and mode of formation of the Cainozoic regolith interpreted to be underlying the project area has been hypothesised from available evidence and the authors knowledge of the area and not by direct observation.

12 ENVIRONMENTAL IMPACT STATEMENT

A desktop study has been conducted on the site of the proposed road upgrade and bridge construction on Portions 26, 35 and 44 of the farm Tweefontein 541, approximately 11 km south-west of Bronkhorstspruit, in the Bronkhorstspruit Magisterial District, Metsweding District Municipality, Kungwini Local Municipality, Gauteng Province. The project area can be located within the confines of 1:50 000 topographic map 2528DC. The site of the area to be developed is approximately 900 m in length, with the proposed bridge occupying ca. 150 m of that extent.

The entire extent of the project area is underlain by unfossiliferous strata of the Pretoria Group (Silverton and Magaliesberg Formations). It is anticipated, herein, that the road infrastructure will directly affect the land surface overlying the Silverton Formation and its associated regolith to a maximum depth of < 1 m while similar excavations occurring over the Magaliesberg Formation are expected to negatively impact upon the bedrock to a slightly deeper maximum depth (< 2 m). The concrete bases required for the construction of the bridge will require the emplacement of excavation of a maximum depth of 5 m.

Despite the impacts discussed above upon the bed rock underlying the project area both the Silverton and Magaliesberg formations are considered to be unfossiliferous. The potential for a negative impact upon the palaeontological heritage of these strata has been assessed as negligible, and the scientific and cultural significance of any fossils contained is negligible to nil. Accordingly, no damage mitigation protocols are required within the area occupied by the bedrock underlying the project infrastructure.

The presence of a pervasive Cainozoic regolith horizon underlying the southern-most portions of the route of the proposed road upgrade has been interpreted. The fossiliferous potential of this unit is assessed as being negligible to nil. Accordingly, no damage mitigation protocols are required within the area occupied by the regolith.

This desktop study has not identified any palaeontological reason to prejudice the progression of this project. No damage mitigation protocols are recommended.

13 REFERENCES

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