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PHASE 1 PALAEOLOGICAL IMPACT ASSESSMENT

Libode Borrow Pits

(Nqeleni District, Eastern Cape)

Specialist report by:

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Mining Permit Application: EC30/5/1/3/2/10135MP

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1. EXECUTIVE SUMMARY

Rose Prevec was appointed by Site Plan Consulting (on behalf of Great Karoo Prospecting) to assess the site of a series of proposed borrow pits in Libode, 30 km East of Mthatha, Eastern Cape, on the R61. The borrow pits will extend laterally across an area approximately 6.5 km long with a maximum width of about 1.5 km.

The borrow pits will primarily impact on dolerites and possibly on peripheral rocks of the Adelaide Subgroup (Beaufort Group). The dolerites have no palaeontological value, and although the Adelaide Subgroup is renowned for its plant, animal and trace fossil heritage, the existing excavations on site indicate that the limited exposures of these rocks have been very heavily metamorphosed and intruded by the adjacent dolerites, with much of their primary structure having been destroyed. It is highly unlikely that any fossils are present, and if they are present, they would probably be highly degraded and of limited value.

SIGNIFICANCE RATING							
Rock Unit	Temporal Scale	Spatial Scale	Probability	Impact severity		Overall Significance	
				with mitigation	without mitigation	with mitigation	without mitigation
Dolerite	N/A	N/A	nil	nil	nil	nil	nil
Adelaide Subgroup	permanent	International	Highly unlikely	beneficial	Low	Low	Low

Recommendation: it is highly unlikely that fossils will be exposed during the course of this development as the target rock for mining is non-fossiliferous dolerite, but the Environmental Control Officer should monitor new peripheral exposures of sedimentary bedrock for fossil occurrences, particularly in pits BP2b and BP2c, and should any fossils be exposed, they should be left in situ, and the Eastern Cape Provincial Heritage Resources Agency (ECPHRA) should be contacted immediately (Mr Sello Mokhanya, Tel: 043 745 0888; smokhanya@ecphra.org.za) to arrange for implementation of appropriate mitigation measures by a palaeontologist.

2. INTRODUCTION AND BRIEF

A Palaeontological Impact Assessment was requested by Site Plan Consulting (on behalf of the developers, Great Karoo Prospecting) for a series of existing and proposed borrow pits in Libode, east of Mthatha in the Eastern Cape.

The commodity to be mined is aggregate (doleritic), to be used as fill in the construction / upgrade of the Libode interchange on the R61 which passes just south of the town (as described in the EMP document provided by Site Plan Consulting).

Preliminary examination of a 1:250 000 geological map of the area indicated that the borrow pits would impact on non-fossiliferous dolerite and potentially on rocks of the Upper Permian Adelaide Subgroup, which is known to be of high palaeontological sensitivity (Almond *et al.*, 2008; SAHRA palaeontological sensitivity map; <http://www.sahra.org.za/map/palaeo>), thereby necessitating a field assessment and production of a Palaeontological Impact Assessment Report (as per the SAHRA Minimum Standards for Palaeontological Components of Heritage Impact Assessment Reports, 2012).

2. LEGISLATIVE FRAMEWORK

South African National Heritage Resources Act No. 25/1999

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

This report represents the palaeontological component of the HIA, conducted as part of an Environmental Management Plan under the Mineral and Petroleum Resources Development Act (MPRDA), mining permit application number EC30/5/1/3/2/10135MP.

3. DETAILS OF THE STUDY AREA

The development area is situated on the southern outskirts of the town Libode, approximately 30 km east of Mthatha along the R61 tar road, in the Nqeleni District, Eastern Cape (Fig. 1; 1:50 000 topographic map 3129CA Libode; Fig. 2). The development site is on a portion of Farm Masamini 63 (Remainder).

Within the 4.84 Ha application area, three excavation areas have been identified (2a, 2b and 2c; Fig. 3). The excavation 2a already exists, whereas 2b and 2c have yet to be mined.

The borrow pits will extend laterally across an area approximately 6.5 km long with a maximum width of about 1.5 km, along a series of adjacent, east-facing slopes.

4. GEOLOGICAL SETTING

As indicated by the 1:250 000 geological map of the Mthatha (Umtata) region (3128 Umtata; 1977; Fig. 4), the underlying rocks in the area fall within the palaeontologically highly significant **Beaufort Group**, of the Karoo Supergroup, in the south-eastern reaches of the main Karoo Basin. The entire area was heavily intruded by dolerite dykes and sills of the **Karoo Dolerite Suite (Jd)** during Jurassic times (scattered pink areas in Fig. 4; Duncan & Marsh, 2006). Because of the igneous nature of the dolerites, they have no potential to yield palaeontological heritage.

The Beaufort Group, underlain conformably by the predominantly deep-water mudrock of the Ecca Group, is characterized as a fluvial succession comprising upward-fining sequences of mudrock and sandstones, the latter mostly representing river channel fills (see Hancox & Rubidge, 2001 for overview). The Beaufort Group (see Fig. 4) is divided into two subgroups, viz. the Upper Permian, Adelaide Subgroup and the overlying, Lower to Mid-Triassic, Tarkastad Subgroup. Mthatha lies just east of the boundary between Tarkastad Subgroup exposures to the west, and Adelaide Subgroup to the East. The **Adelaide Subgroup** comprises (oldest to youngest) the Koonap, Middleton and Balfour Formations. Difficulties in mapping the geology of the Mthatha region because of the dense vegetation cover, deep weathering and acute lack of outcrop, has precluded delimitation of the formations in this area.

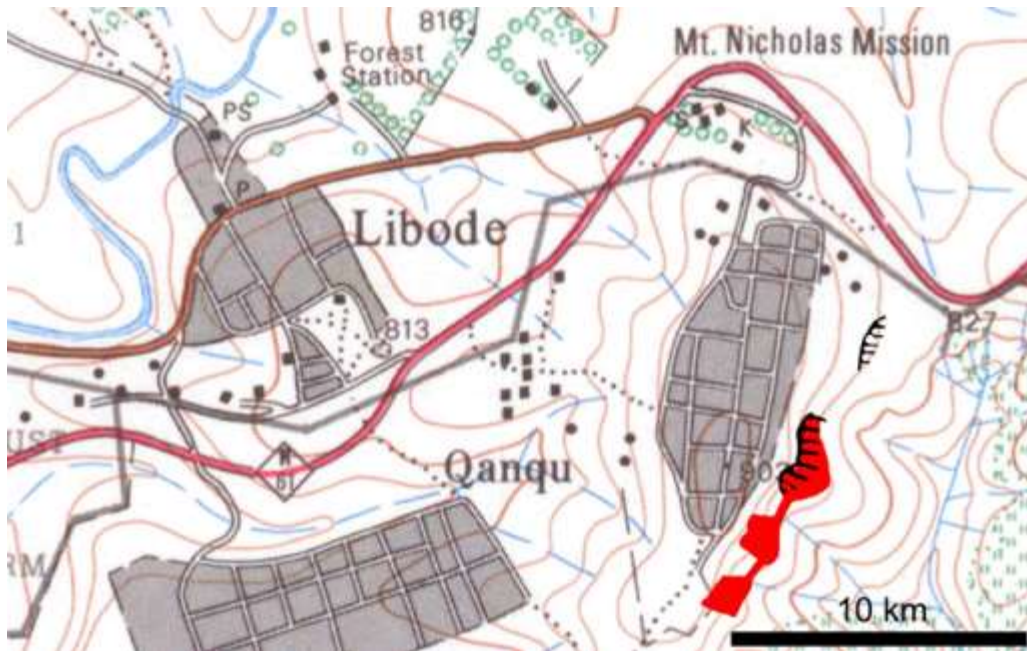


Figure 1. Topographical map indicating the position of the development area (in red) in the small town of Libode, 30 km to the east of Mthatha on the R61 (1:50 000 Topographical map 3129CA Libode).



Figure 2. Google Earth image indicating location of existing and planned borrow pits near Libode, Eastern Cape.

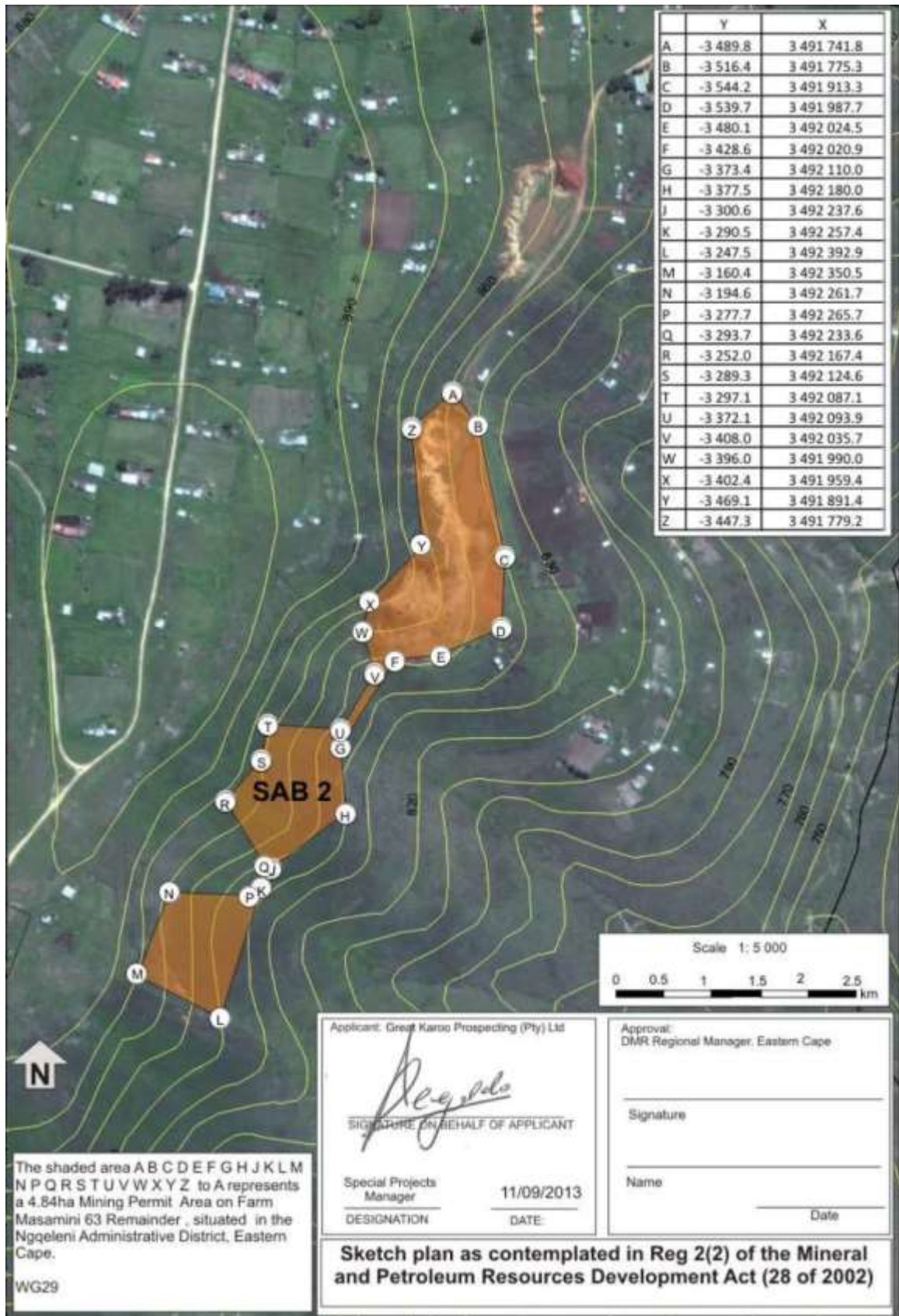


Figure 3. Proposed mine plan for the Libode borrow pits, provided by Site Plan Consulting (EMP document).

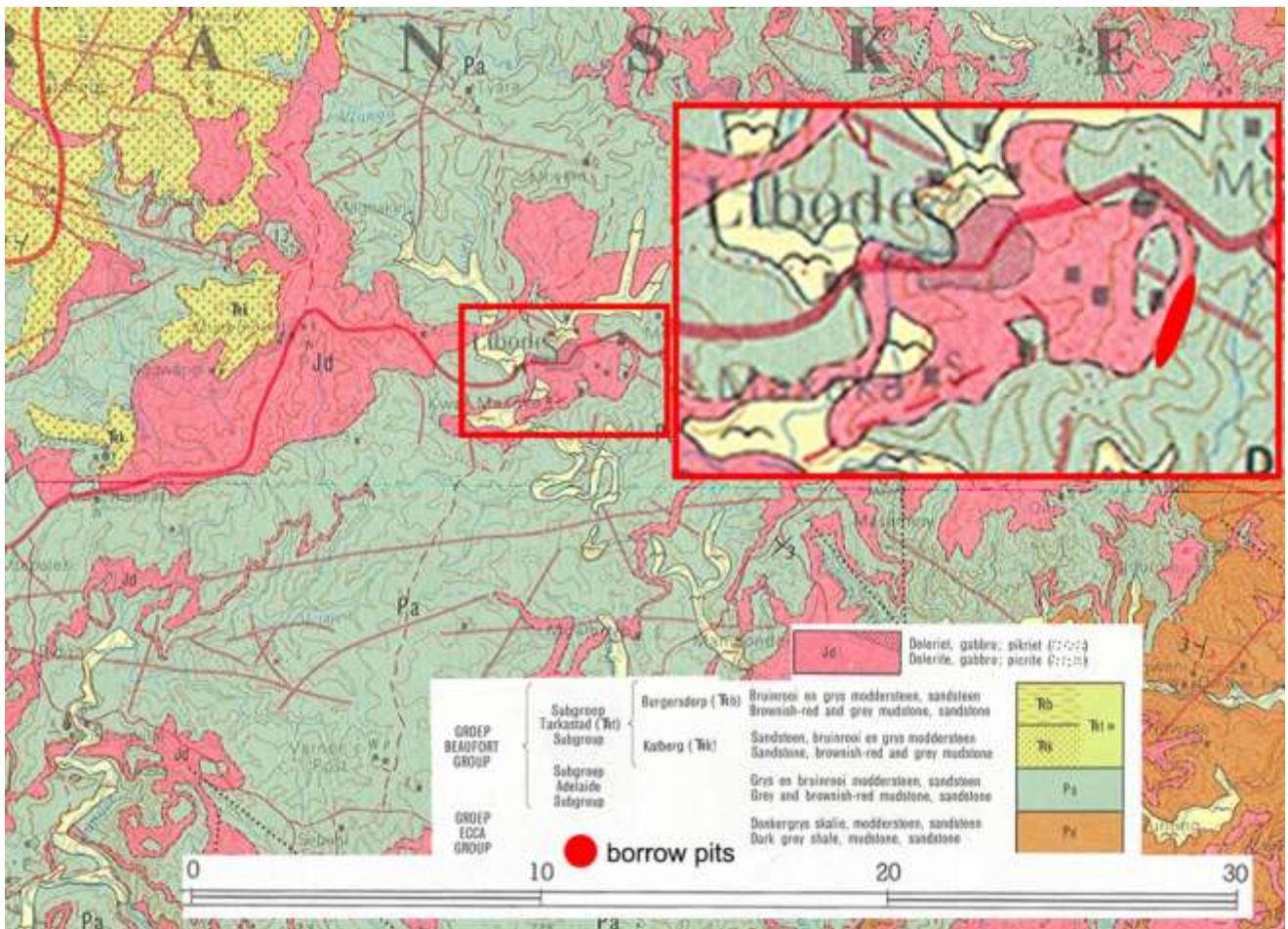


Figure 4. Geological map of the Libode area (extracted from 1:250 000 3128 Umtata) indicating dolerites (Jd) in pink and Adelaide Subgroup in green, and Libode area enlarged within inset.

5. PALAEOONTOLOGICAL POTENTIAL

The dolerites in the area, and that are specifically to be mined at Libode, are igneous in nature, and by definition are **non-fossiliferous**.

The Adelaide Subgroup, however, is renowned for its Permian fossil heritage in the form of plants of the *Glossopteris* flora including *Glossopteris* leaves and associated fertile organs, ferns, sphenophytes/horsetails, silicified wood (eg. Anderson & Anderson, 1985; Bamford, 2004; Gastaldo *et al.*, 2005; Prevec *et al.*, 2010), trace fossils (Bordy *et al.*, 2011), fish (eg. *Atherstonia*) and vertebrate faunas, including the so-called ‘mammal-like reptiles’ or therapsids for which South Africa is internationally recognised (eg. Rubidge *et al.*, 1995; MacRae, 1999; McCarthy and Rubidge, 2005). The therapsid fossil record of South Africa provides the most complete record of the evolutionary transition from reptiles to mammals, and the nearly continuous record of this group through the Permian and into the Triassic

provides unparalleled opportunity to understand the greatest extinction event in Earth's history, at the close of the Permian Period 251 Ma (Gastaldo *et al.*, 2005; Smith and Ward, 2001; Smith and Botha-Brink, 2014). The vertebrate biozones are not well-defined in the former Transkei area, for historical reasons (poor collecting record) and because of the dense vegetation regionally and general paucity of outcrop. However, it is likely that the Permian rocks in the Libode area fall within the *Dicynodon* Assemblage Zone, or possibly within the uppermost *Cistecephalus* Assemblage Zone (Rubidge, 2013). Comprehensive details of the diverse vertebrate fauna that has been found in this biozone are provided in Rubidge *et al.* (1995).

6. METHODOLOGY

In light of the possible impact on rocks of the palaeontologically sensitive Adelaide Subgroup, a field inspection was conducted on 02 February 2014. A dirt road leading from the R61 allowed for rapid and easy access to the existing pit BP2a.

A visual assessment was conducted on foot. The entire area is densely vegetated, with well-developed soils. The rolling grassland revealed no outcrop (Fig. 7), so inspections were based on the existing quarries in the development area.

7. FIELD OBSERVATIONS

The site inspection was brief, as it immediately became apparent that the quarries will primarily affect non-fossiliferous dolerites. Minor exposures of sandstone in the upper reaches of quarries BP01 and BP02 reflected a high degree of alteration from close proximity to the dolerite intrusions. The highly metamorphosed nature of the deposits almost certainly precludes any possibility of fossils being found in this localised area. There was no outcrop apparent in the footprint apart from the two existing quarries at the development site (BP2a, Figs 5-7; and a smaller quarry to the north-east that is presumably the BP1 mentioned in the Proposed Mine Plan in Fig. 2). Specifically, the adjacent area representing the south-eastern parts of the development area, where pits BP2b and BP2c are to be excavated, are covered in soil and grassy vegetation, with no rock exposed at surface (Fig. 7). These pits are at the same elevation as BP2a, and are closely adjacent. It is reasonable to assume the continuation of similar subsurface lithologies at these sites.



Figure 5. Existing exposures in Borrow Pit 2a, the site of prior dolerite aggregate mining.



Figure 6. Deeply weathered dolerite towards the base of the exposure in BP2a.



Figure 7. View of BP2a, and to the left, the slopes that mark the location of planned borrow pits BP2b and BP2c.

8. IMPACT SIGNIFICANCE

SIGNIFICANCE RATING							
Rock Unit	Temporal Scale	Spatial Scale	Probability	Impact severity		Overall Significance	
				with mitigation	without mitigation	with mitigation	without mitigation
Dolerite	N/A	N/A	impossible	N/A	No impact	N/A	insignificant
Adelaide Subgroup	permanent	International	Highly unlikely	beneficial	Low	Low	Low

There will be no impact on palaeontological heritage during mining of the dolerites in the quarries, which appear to be the primary target of the developers. Some marginal, highly metamorphosed deposits of the Adelaide Subgroup may be impacted, but due to the high level of alteration, it is unlikely that these rocks will contain fossils.

Overall impact to fossil heritage is predicted to be very low.

9. RECOMMENDATIONS

No further action on the part of a palaeontologist is required in terms of monitoring. However, the Environmental Control Officer on site should be made aware of the small possibility for fossils to be unearthed during excavation of rocks of the Adelaide Subgroup. If any fossil are observed during excavation, the ECO must immediately inform the Eastern Cape Heritage Resource Agency (ECPHRA; Mr Sello Mokhanya, Tel: 043 745 0888; smokhanya@ecphra.org.za) and a qualified palaeontologist must evaluate, and if necessary, excavate the material.

10. CONCLUSIONS

This development is very unlikely to have an impact on any fossil heritage. There is a remote possibility that fossil heritage could be unearthed during mining of the dolerites, as mining activity may impact peripherally on the Adelaide Subgroup host rocks. However these have been significantly altered by the intrusion of the dolerites, which probably destroyed any fossil heritage present.

11. REFERENCES

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