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PHASE 1 PALAEONTOLOGICAL IMPACT ASSESSMENT

Great Kei Wind Energy Facility

(Komga, Eastern Cape Province)

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On behalf of developer:

Great Kei Wind Power (Pty) Limited

25 April 2014

1. EXECUTIVE SUMMARY

Rose Prevec was appointed by Coastal and Environmental Services (on behalf of InnoWind) to perform a Palaeontological Impact Assessment (PIA) on the site of a proposed wind energy development (43 wind turbines) near Komga in the Amatole District Municipality, Eastern Cape. The development area overlies strata of the highly palaeontologically sensitive Balfour Formation, Adelaide Subgroup, Beaufort Group, Karoo Supergroup. The purpose of the PIA (forming part of a Heritage Impact Assessment), is to identify and assess exposed palaeontological heritage, as well as potential heritage that may be impacted by the development, and to make recommendations as to how these impacts could be mitigated.

Regionally, the topography and vegetation in the Komga area conspire to limit the amount of rock exposure for inspection to a very few road cuttings and abandoned borrow pits. Although no fossils were found at surface within any of the wind turbine construction sites, it was impossible to adequately assess the actual palaeontological potential of the area., because each and every one of these sites was well vegetated, with no bedrock exposed for inspection. A high potential for fossil occurrences can however, be inferred from contemporaneous deposits in areas with more exposure further to the west.

The South African Heritage Resources Agency (SAHRA) lists the Permian-Triassic Balfour Formation as being of 'very high' palaeontological significance. Damage to or destruction of any fossil during mining or construction activities would be a highly negative, permanent impact of international significance.

SIGNIFICANCE RATING							
Rock Unit	Duration	Spatial Scale	Degree of confidence	Impact severity		Overall Significance	
				with mitigation	without mitigation	with mitigation	without mitigation
Balfour Formation	permanent	International	possible	beneficial	High negative	beneficial	High negative

Recommendation: Considering the palaeontological wealth of the Balfour Formation elsewhere in the Eastern Cape, regular monitoring of all bedrock disturbances during the course of this development must be carried out by an Environmental Control Officer who has received appropriate training (i.e. by a qualified palaeontologist). Should any fossils be exposed during construction activities, 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 qualified palaeontologist.

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3. INTRODUCTION AND BRIEF

A Palaeontological Impact Assessment was requested by Coastal and Environmental Services (on behalf of the developers, Great Kei Wind Power) for the site of a proposed wind energy generation facility near Komga in the Amatole District Municipality, Eastern Cape (Figs 1, 2, 3).

The construction of wind turbines will impact on bedrock of Jurassic Karoo dolerites (which, as igneous rocks, are devoid of palaeontological heritage), and also on rocks of the Balfour Formation, Adelaide Subgroup, Beaufort Group. The Balfour Formation is known to be of high palaeontological sensitivity in the Eastern Cape (SAHRA palaeontological sensitivity map; http://www.sahra.org.za/map/palaeo; Figs 4-6), 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, 2013), as part of a Heritage Impact Assessment.

4. LEGISLATIVE FRAMEWORK

Protection of South Africa's environmental resources is regulated by the Department of Environmental Affairs (DEA), in part through the National Environmental Management Act ("NEMA" Act 107 of 1998). In accordance with the Act, developers must apply to the competent authority for approval of their plans, which, depending on the nature of the development, are subject to an assessment of the anticipated impacts these activities will have on the environment. The primary piece of legislation protecting national heritage in South Africa, is the South African Heritage Resources Act (Act No. 25) of 1999. In accordance with Section 38 (Heritage Resources Management) of the act, developers must apply to the relevant authority (ECPHRA in the Eastern Cape) for authorisation to proceed with their planned activities. This application must be accompanied by documentation detailing the expected impact this will have on national heritage in particular.
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 among others:

- 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.

To address concerns relating to the protection of these particular heritage resources, a Heritage Impact Assessment (HIA) may be required to assess any potential impacts to archaeological and palaeontological heritage within the footprint of the proposed development. This report represents the palaeontological component of the HIA.

5. DETAILS OF THE STUDY AREA

The study area extends across a region about 10 km long (North-South) and 6.5 km wide (East-West), 6 km east south-east from the town of Komga in the Amatole District Municipality, Eastern Cape Province. The wind turbine sites, totalling 43 in number, are mostly situated on low ridges and hills in the area (figs 1-4).

The regional landscape is one of rolling hills, pastures and agricultural land, with indigenous bush limited mostly to steep slopes, gullies and rivers. The vegetation is dense, with rock exposure limited almost exclusively to road cuttings and occasional borrow pits. Rivers in the area were difficult to access due to thick vegetation, and those gullies inspected tended to yield loose bedload and scree, rather than bedrock exposures.

6. GEOLOGICAL SETTING

As indicated by the 1:250 000 geological map of the region (3226 King Williams Town; 1974; Fig. 5), 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. 5; Duncan & Marsh, 2006).

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. 6) is divided into two subgroups, viz. the Upper Permian, Adelaide Subgroup and the overlying, Lower to Mid-Triassic, Tarkastad Subgroup. The Adelaide Subgroup comprises (oldest to youngest) the Koonap, Middleton and Balfour Formations. It is the Balfour Formation that is at surface in the development area.

The Balfour Formation is Late Permian in age, with the well-studied and internationally high profile Permian-Triassic Boundary represented in its uppermost unit, the Palingkloof Member (Prevec *et al.*, 2010; Smith & Ward, 2001).

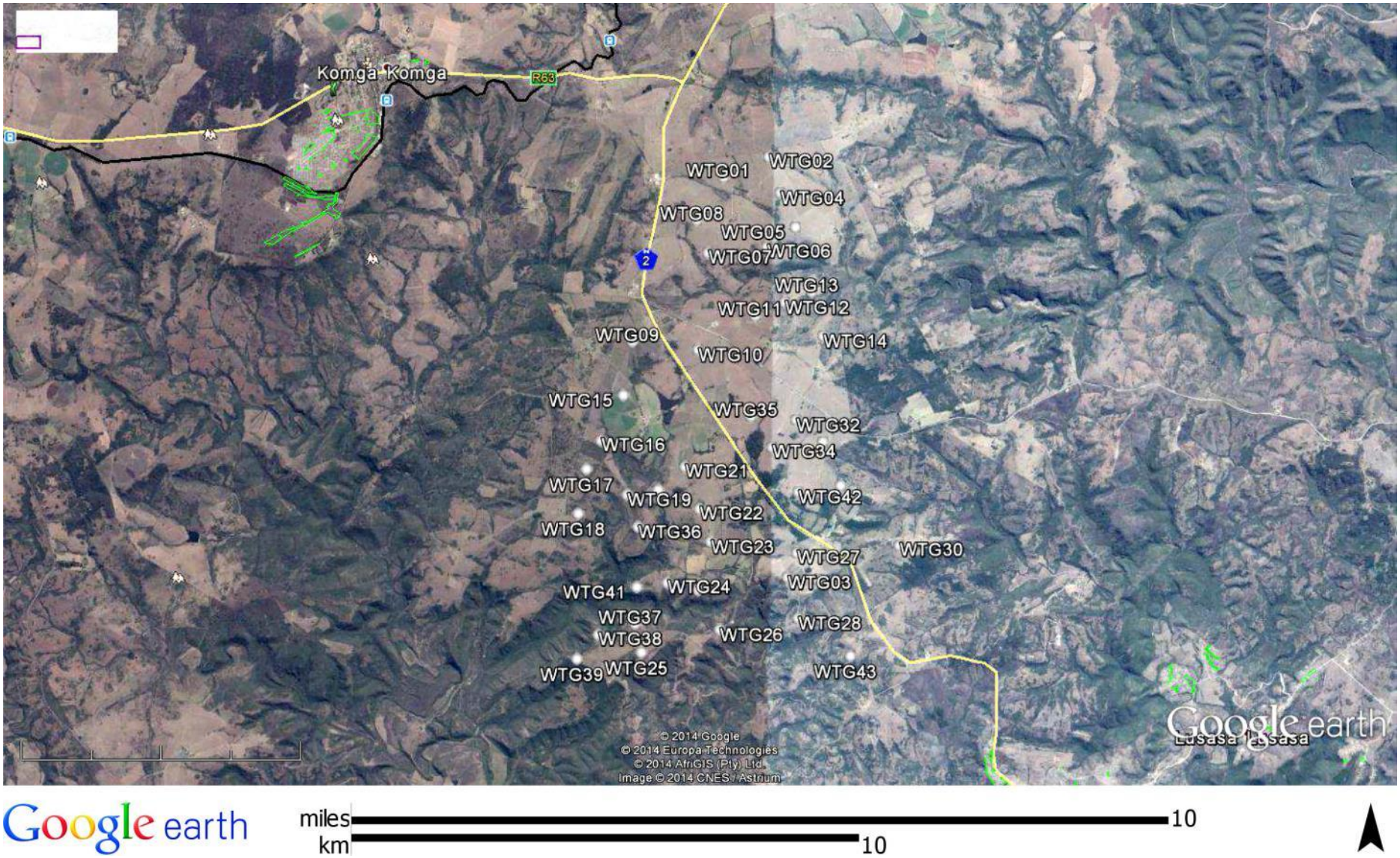


Figure 1. Location of Great Kei wind energy facility to the south-east of Komga in the Eastern Cape, to either side of the N2 National road to East London.

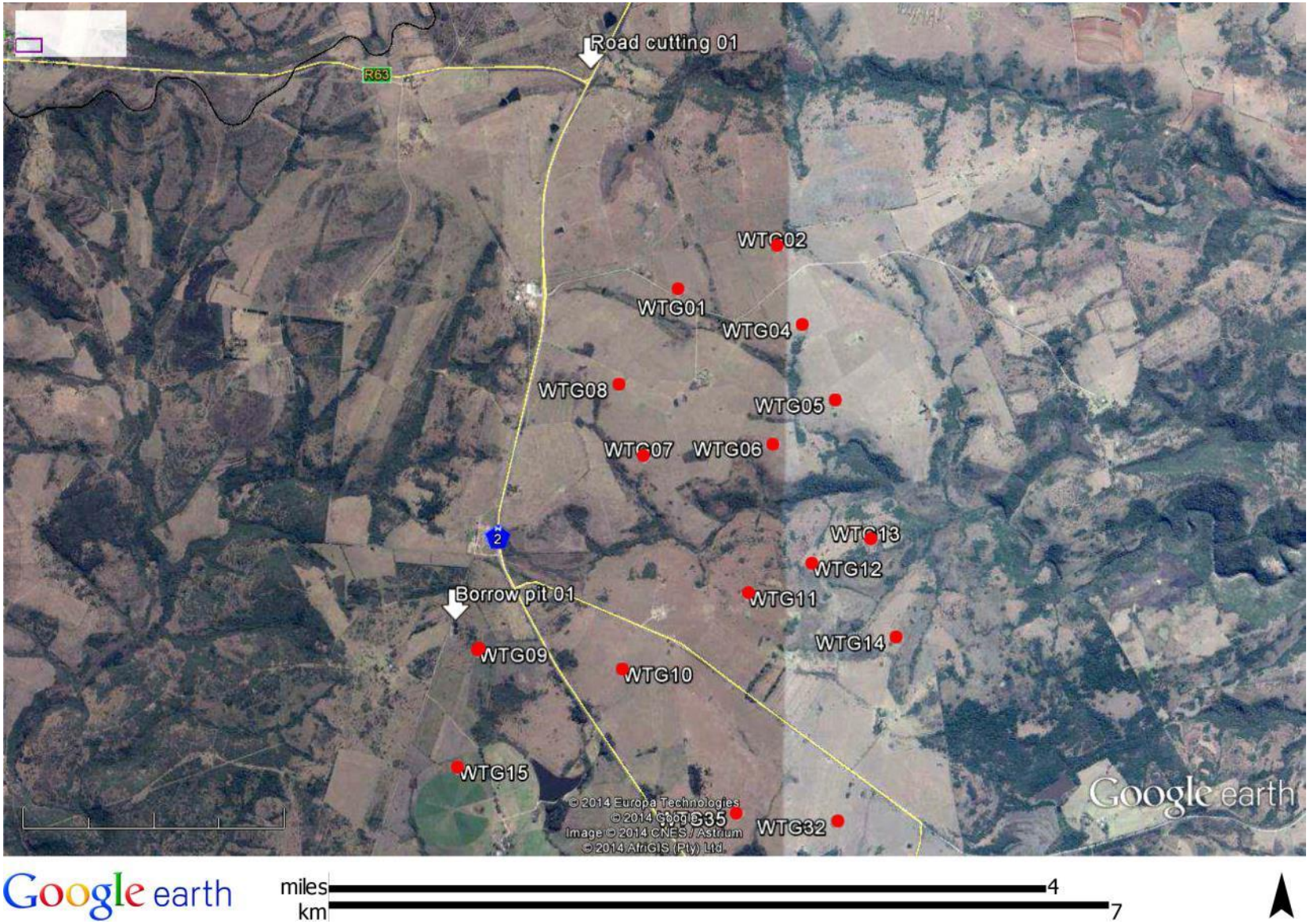


Figure 2. Northern section of the development area of the Great Kei wind energy facility, indicating proposed sites for wind turbines.

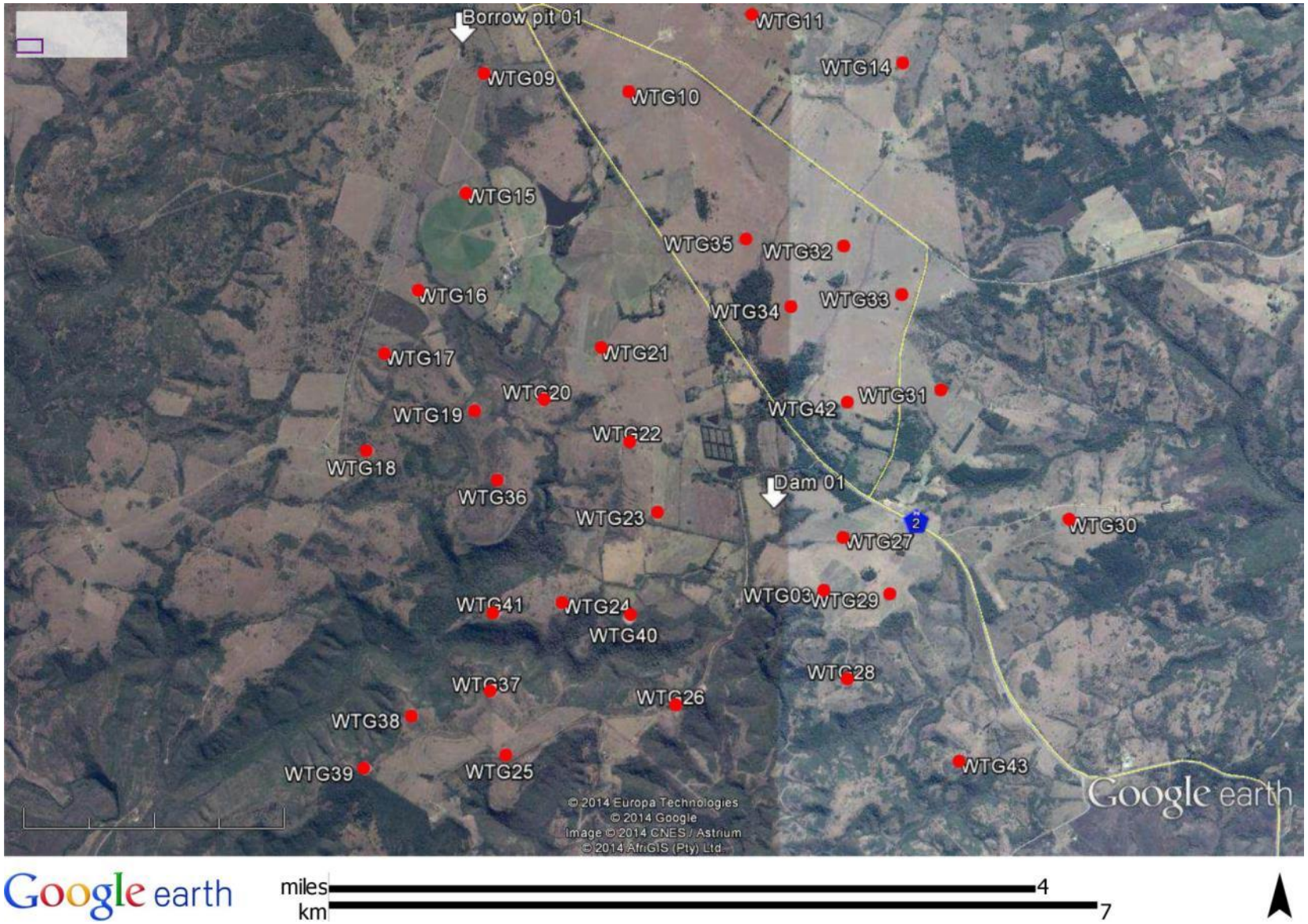


Figure 3. Southern section of the development area of the Great Kei wind energy facility, indicating proposed sites for wind turbines.

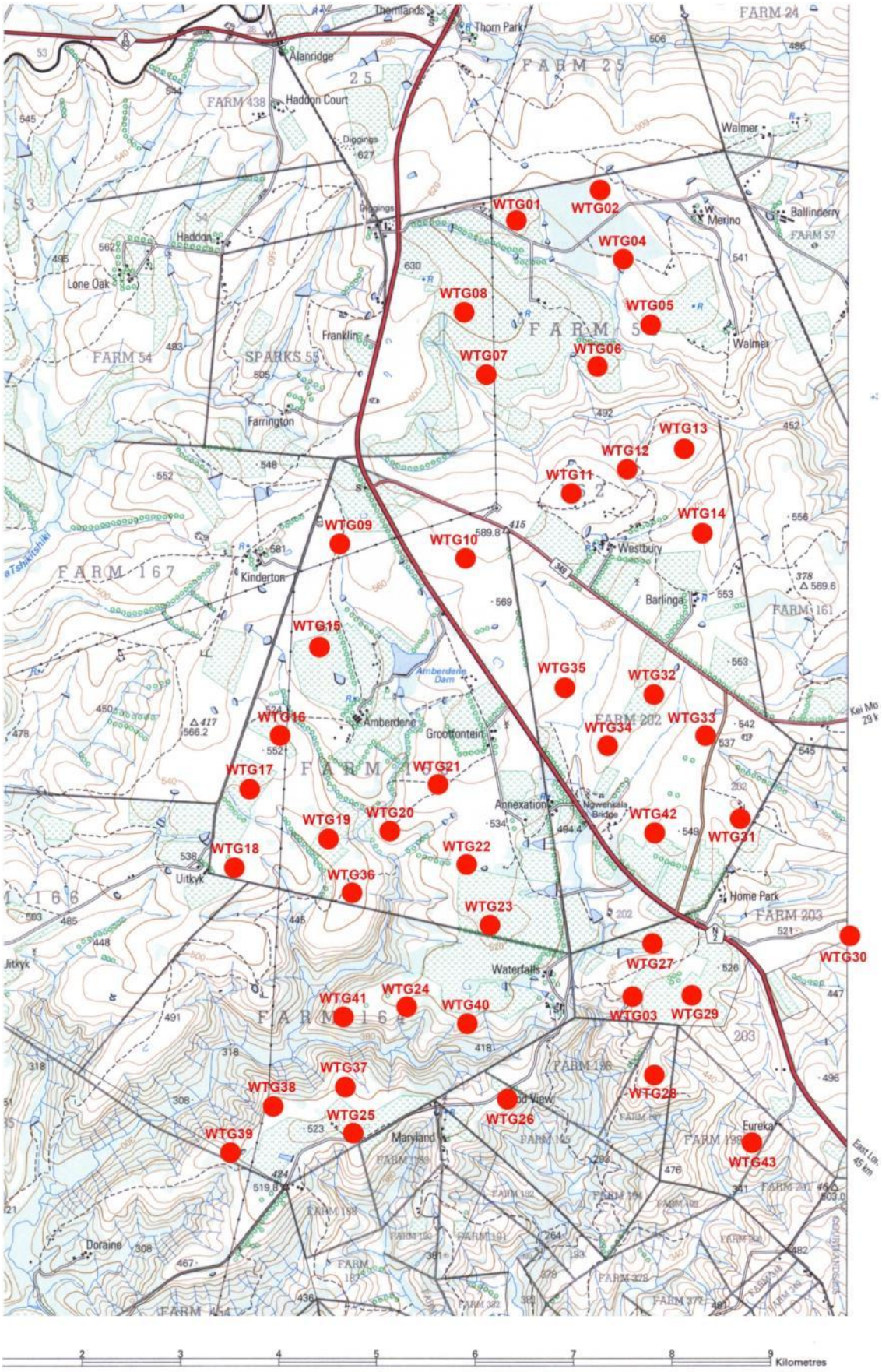


Figure 4. Extract from 1:50 000 topographic map 3227DB Komga, with proposed sites for wind turbines indicated with red dots.

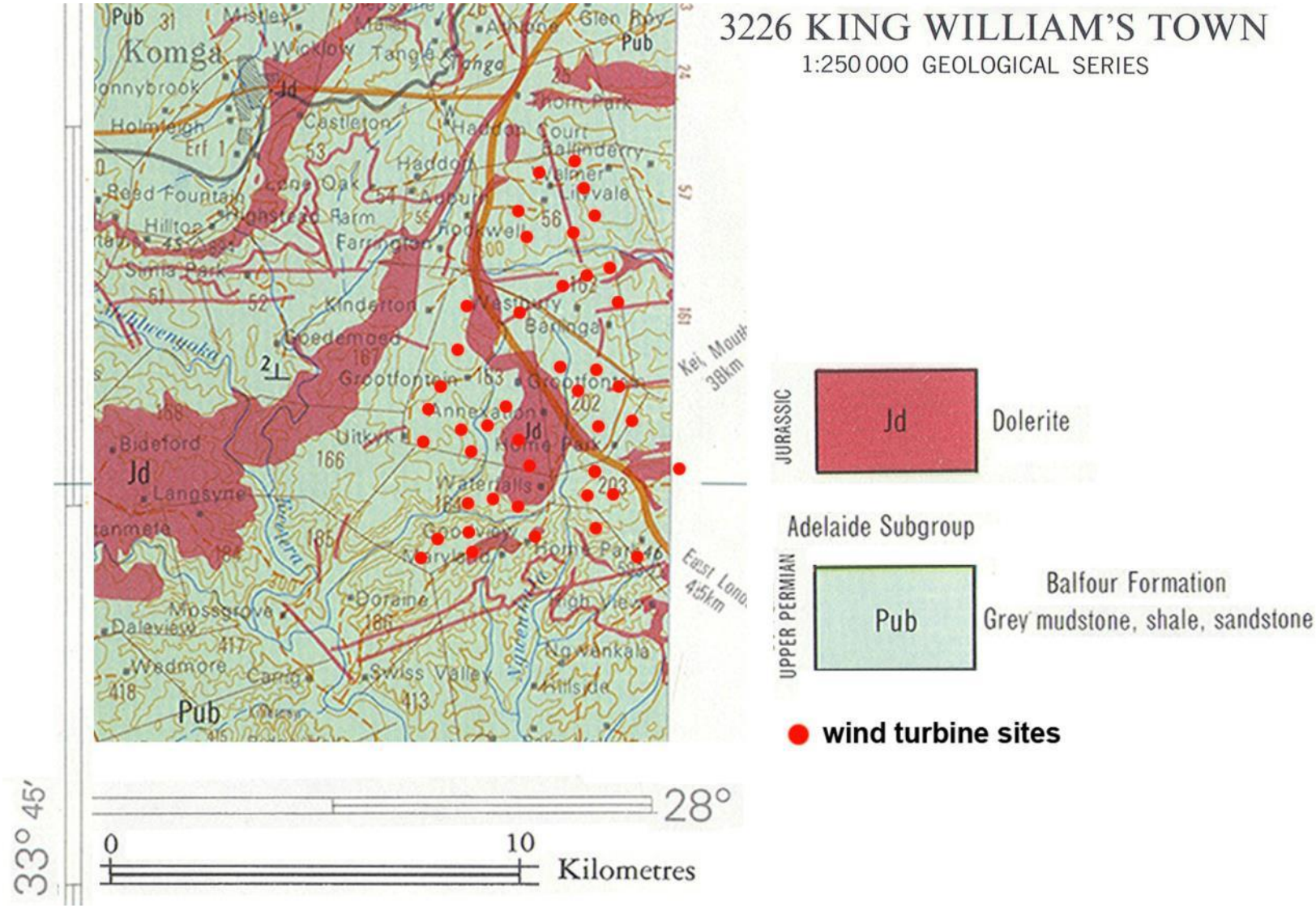


Figure 5. Extract from 1:250 000 geological map 3226 King William's Town (compiled by Johnson, 1976), indicating position of proposed sites for wind turbines (red dots) and underlying geological formations.

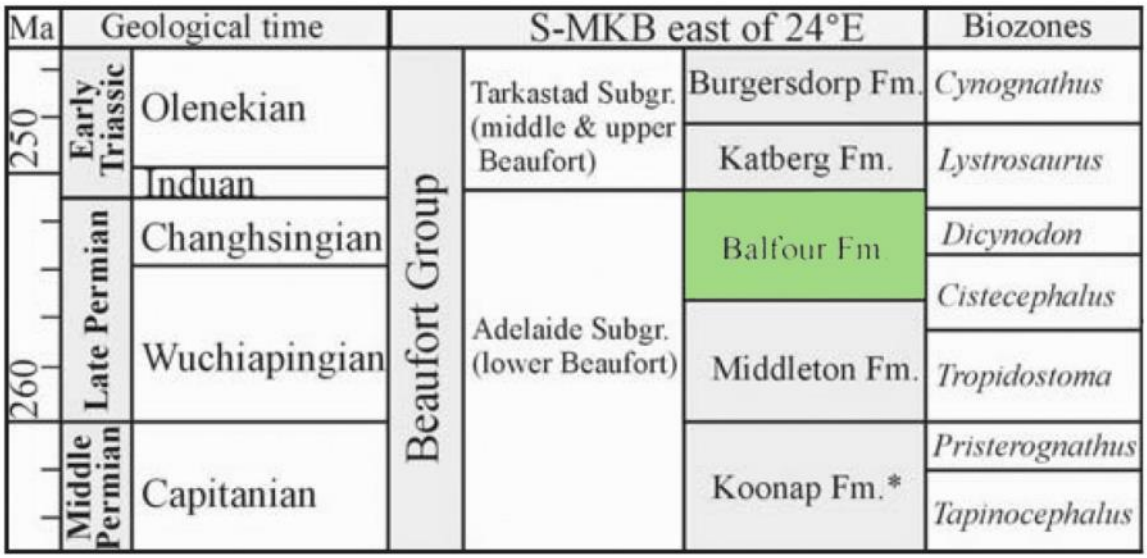


Figure 6. Lithostratigraphic subdivisions (middle Permian to Lower Triassic) of the Karoo Supergroup, in the eastern Karoo Basin, including the Balfour Formation (in green) (Johnson *et al.,* 2006). [Modified from Bordy & Prevec, 2008].

7. PALAEONTOLOGICAL POTENTIAL

The dolerites in the development area (pink areas in Fig. 5), are igneous in nature, and by definition are non-fossiliferous. This means that wind turbine sites WTG30, WTG22, WTG23 and WTG25 (figs 4 & 5) (situated on dolerite ridges), do not present a risk to palaeontological heritage.

However, the remaining sites proposed for wind turbine construction, all overlie rocks of the Balfour Formation (Fig. 6), within the *Dicynodon* and lowermost *Lystrosaurus* Assemblage Zones (Rubidge, 1995; van der Walt *et al.*, 2010). SAHRA lists the Balfour Formation as being of 'very high' palaeontological significance, and of global importance (see SAHRIS webpage: http://www.sahra.org.za/fossil-layers). This formation has yielded an important vertebrate fauna, including an array of therapsids (so-called 'mammal-like reptiles'), amphibians, parareptiles, fish such as *Atherstonia,* trace fossils (eg. Rubidge et al., 1995; MacRae, 1999; Smith and Ward, 2001; Rubidge, 2013), and rare but high quality plant fossil localities that have yielded (Prevec et al., 2010).

A paucity of reports of fossils in the Komga area is almost certainly due to an acute lack of outcrop in the region (eg. Groenewald, 2011), as well as a historical reluctance on the part of palaeontologists to work in the area.

8. METHODOLOGY

The Balfour Formation is widely acknowledged to be of high palaeontological sensitivity, and the proposed wind energy facility therefor triggered a Phase 1 PIA with a requirement for a field inspection of the area to be impacted.

The aim of this report is to:

1) identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
2) assess the level of palaeontological significance of these formations by consulting the literature for prior records of heritage in the area and geological formation, and by undertaking a field examination to identify exposed and potential heritage;
3) comment on the potential impact of the development on these exposed and/or potential fossil resources;
4) make recommendations as to how the developer should conserve, or mitigate damage to, these resources.

A field assessment was conducted in January 2014.

9. FIELD OBSERVATIONS

A visual assessment of the field area was conducted on foot, with the assistance of Albany Museum employee Mr Lindikhaya Sandi, where access was possible. The entire area is densely vegetated, particularly the rivers and gullies (eg. Fig. 23), with outcrop only exposed in road cuttings and borrow pits (Fig. 2). The rolling grasslands on the hill slopes revealed no outcrop.

All wind turbine sites were located on grassy ridges, low hills or agricultural land, and no outcrop was apparent in any of the development footprints (Figs 8–15, 17–22a, 24, 25).

However, a road cutting (Road Cutting 01; Figs 2, 7), a flooded borrow pit (Borrow Pit 01, Figs 3; 16), and a dam spillway (Dam, Figs 3, 22c,d) provided some limited exposure in the area, and were inspected for palaeontological heritage.

Road cutting 01 exposes a sequence of stacked channel sandstones, to either side of the road (Fig.7). No fossils were observed.

Borrow Pit 01 Although exposures were limited, fine-grained, pale grey siltstones yielded some well-preserved trace fossils, mostly vertical burrows, as well as some plant fragments including a sphenophyte stem, a small axis and unidentifiable organic fragments (Fig. 16). Preservation was reasonably good, and there is high potential for better quality plant fossil material in this area.

Dam 01. Minor weathered siltstone exposures were examined in the spillway of Dam 01 (as indicated in Fig. 03, 22b,c), but no fossils were discovered.

No fossils were found at surface within any of the wind turbine construction sites, because each and every one of these was well vegetated, with no bedrock exposed for inspection.

(a)

(b)

Figure 7. Road cutting 01 through channel sandstones of the Balfour Formation immediately north of the junction between the R63 and the N2 (a: western side; b: eastern side of the road).

Figure 8. View of site for WTG01, opposite Lilyvale Farm – more rolling grassland.

Figure 9. Panaramic view with Merino Farm on the left, dam left of middle, and low grassy ridge in the background the site for WTG04 (arrow: approximate position).

(a)

(b)

Figure 10. (a) location of WTG04 on low grassy ridge; (b) location of WTG02, north of WTG04, on a rolling grassy hill.

Figure 11. Site of WTG05 on grassy ridge; background view across valley shows sites for WTG11-13.

Figure 12. Looking out from Lilyvale Farm, across sites for WTG07 and WTG 08. Flat, grassy area with no outcrop.

(a)  (b) 

Figure 13. (a) Flat, grassy plain that is the site of WTG10 (opposite substation); (b) Densely vegetated site for WTG14 near Barlinga farmstead.

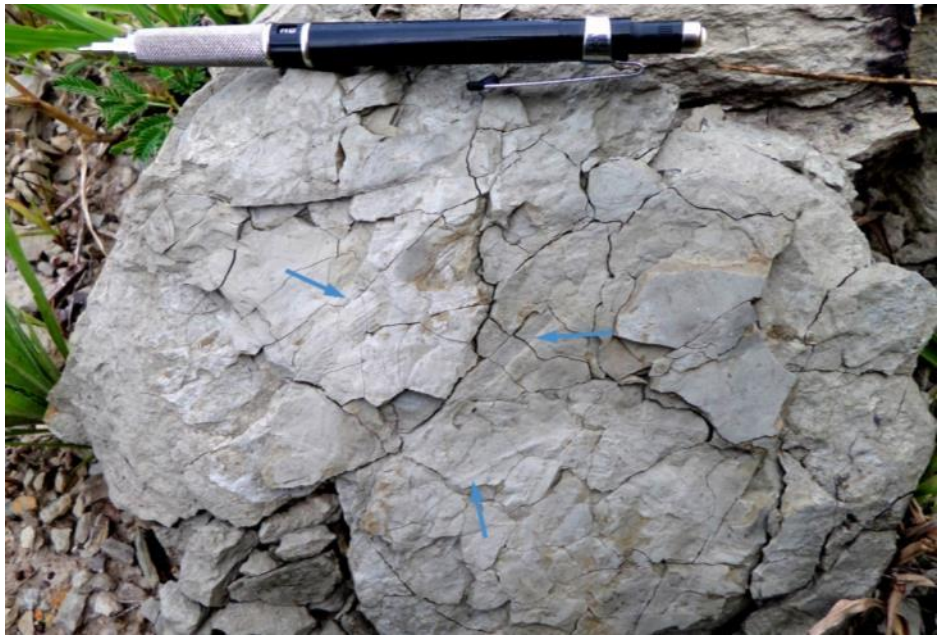
Figure 14. Southwards view overlooking sites of WTG32 and 35 – grasslands, no bedrock exposure to be found.

(a)

(b)

Figure 15. Agricultural land between the Uitkyk road and the N2 highway – site of (a) WTG09, and (b) WTG15.

(a)



(b) (c)

Figure 16. (a) Borrow pit 01 to the north-east of WTG09; (b) fine-grained siltstone with numerous trace fossils (mostly vertical burrows); (c) fine-grained siltstone with fragments of plant fossil (spenophyte axis; stems and possible roots).

Figure 17. View of agricultural and pasture lands of Amberdeen Farm, looking across to locations of WTG16-20. No rock outcrop apparent in this area.

Figure 18. Flat grassland stretching across proposed sites for WTG21, 22 and 23.

Figure 19. Location of WTG25 – rolling grassland, no rock outcrop for inspection.

Figure 20. Open grassland setting for WTG29 (far left) and WTG27 far right.

Figure 21. Proposed location of WTG03 (centre grasslands in foreground).

(a)  **(b)**  **(c)** 

Figure 22. (a) low grassy ridge that is the proposed site of WTG30; (b) minor exposures of bedrock at Dam 01 – no fossils found.

(a)

(b)

(c)

Figure 23. Streambed near Dam 01; (b) loose pebble bedload and (c) dense vegetation typical of streams/rivers in the area (no bedrock exposed).

Figure 24. Proposed location of WTG32 and WTG33 – more rolling grassland, no rock exposures.

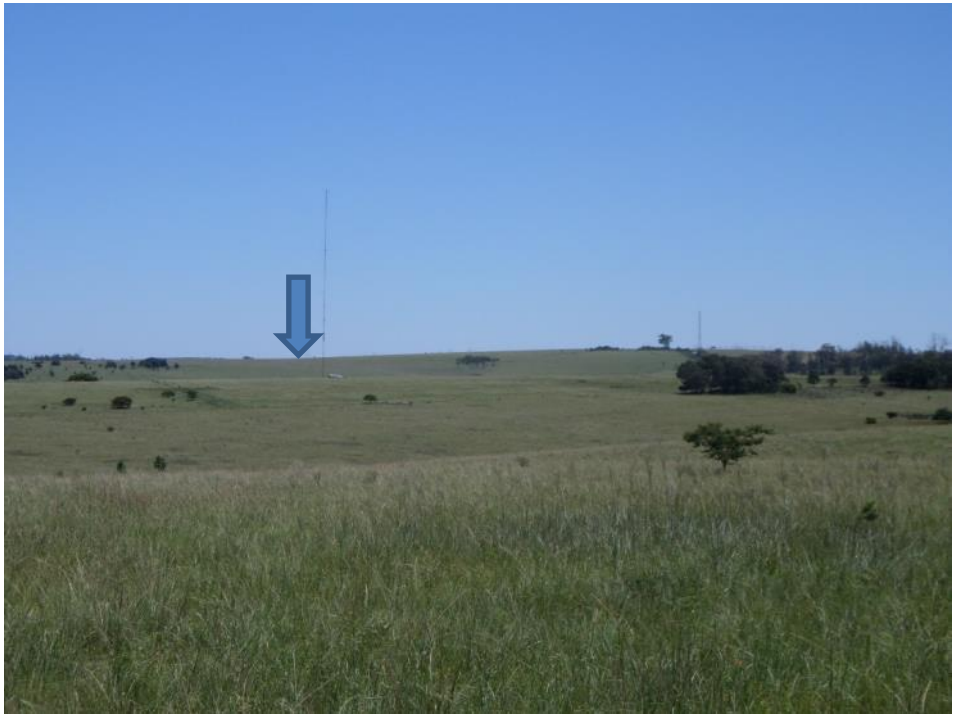


Figure 25. Proposed site of WTG33 in foreground, WTG34 in background (arrow); grasslands, no bedrock exposure.

10. IMPACT SIGNIFICANCE

The fossil faunas and floras of the Balfour Formation of South Africa are of international interest, and represent an important part of our local heritage. Any loss of this heritage due to construction activities is permanent, and should be regarded as a highly significant negative impact. Alternatively, discovery of fossils during excavation of bedrock during the construction of wind turbines and associated infrastructure, followed by effective mitigation in collaboration with a palaeontologist, would result in the curation of new and important fossil material. The development could therefore potentially have a positive, beneficial impact on South Africa's palaeontological heritage.

SIGNIFICANCE RATING							
Rock Unit	Duration	Scale	Probability	Magnitude		Overall Significance	
				with mitigation	without mitigation	with mitigation	without mitigation
Balfour Formation	permanent	International	Possible	beneficial	High negative	beneficial	High negative

12. RECOMMENDATIONS

Although no fossils requiring immediate mitigation were found in the development area, this was probably more to do with the lack of exposed bedrock, than due to a scarcity or absence of fossils in the area. Any bedrock that will be exposed during excavations has the potential to contain fossils. The following actions are recommended:

- Regular on-site monitoring of all excavations that impact bedrock, by an onsite Environmental Control Officer (ECO);
- Training of Environmental Control Officer, or responsible supervisory personnel, by a qualified palaeontologist in the recognition of palaeontological heritage;
- If any palaeontological heritage is identified on site, the ECO must immediately report the occurrence to ECPHRA (Mr Sello Mokhanya, Tel: 043 745 0888; smokhanya@ecphra.org.za) and must supply photographs of the palaeontological specimens to allow for a rapid decision to be made by a palaeontologist as to the form and extent of mitigation required. Ideally the fossil material should be left *in situ* until a palaeontologist has provided input as to how to proceed with regard to mitigation.

13. CONCLUSIONS

Wind turbine sites WTG30, WTG22, WTG23 and WTG25 are located on dolerite ridges, and therefore do not present a risk to palaeontological heritage, and require no further consideration in terms of monitoring or mitigation. However, all of the other 39 sites may have an impact on fossil heritage of the highly palaeontologically sensitive Balfour Formation.

It is imperative that onsite monitoring by a trained ECO is conducted at any time bedrock is exposed during construction of these wind turbines and any associated infrastructure, and any exposure of fossil material must be reported immediately to the ECPHRA.

With appropriate mitigation, this development could have a positive outcome in the conservation of fossil heritage, but without very careful inspections of all excavations with concomitant mitigation, extremely valuable fossil material may be destroyed.

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