PALAEONTOLOGICAL SPECIALIST STUDY: COMBINED DESKTOP & FIELD-BASED ASSESSMENT

Proposed upgrade to the reception area and development of family accommodation units at the Addo Elephant National Park Main Rest Camp, Sundays River Valley Municipality, Eastern Cape.

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July 2021

EXECUTIVE SUMMARY

South African National Parks (SANParks) is proposing to upgrade the reception area and to develop additional family accommodation units at the Addo Elephant National Park Main Rest Camp, located some 13.7 km NNE of Addo village in the Sundays River Valley Municipality, Eastern Cape. The new reception area will comprise an entrance gate, reception and day visitors' site on Portion 4 of Wolve Kop Farm No. 82. The family accommodation will comprise 19 chalet units and a communal swimming pool on Portion 5 of Wolve Kop Farm No. 82 and Farm No. 150.

The project areas for the various proposed developments at the Addo Main Rest Camp are underlain at depth by non-marine, fluvial to estuarine sediments assigned to the Kirkwood Formation (Uitenhage Group) of Middle / Late Jurassic to Early Cretaceous age. Fossil wood and other plant remains, as well as much rarer dinosaur fossils, have been recorded from the wider Addo – Kirkwood region of the Eastern Cape. These Mesozoic bedrocks are generally not well-exposed within the project areas themselves (most of which are largely inaccessible due to dense thicket vegetation). Weathered Kirkwood channel sandstones are seen in test trenches along the margins of and crop out at surface in the south-western sector of the family accommodation units project area. In the last case locally abundant but poorly-preserved fossil wood blocks occur in association with the channel sandstones. Most accessible portions of the various project areas are mantled by thick alluvial to eluvial soils, sparse surface gravels and subsurface calcrete, all of which are of low palaeosensitivity.

Given (1) the small footprints of the proposed developments and (2) the low sensitivity of the thick superficial deposits covering most of the project areas, impacts during the construction phase of the proposed development are anticipated to be of LOW (NEGATIVE) SIGNIFICANCE (Table 1). However, confidence levels for this assessment are only moderate due to the very limited site access. The possibility of scientifically valuable, well-preserved specimens of fossil wood or dinosaurs being unearthed during site clearance and excavations for foundations, services *etc* cannot be excluded, but is considered unlikely. It is noted that dinosaur remains have been recorded in association with fossil wood within Kirkwood Formation channel infills elsewhere within the Algoa Basin (*cf* geological poster at the Park Interpretive Centre).

There are no fatal flaws or objections on palaeontological heritage grounds to authorisation of the proposed developments. It is recommended that a representative sample of the fossil wood recorded here within the family accommodation units project area be collected by a professional palaeontologist in the pre-construction phase of the development for display, together with collection data and appropriate explanatory information, in the Interpretive Centre at the Addo Elephant National Park. No further palaeontological heritage studies or specialist mitigation are recommended for the proposed developments, *pending* the potential discovery or exposure of any substantial new fossil remains (*e.g.* vertebrate bones and teeth, large blocks of petrified wood, fossil plant-rich horizons) during the construction phase. The ECO responsible for these

developments should be alerted to the possibility of important fossil remains being found either on the surface or exposed by fresh excavations during construction.

Should fossil remains such as bones, shells or petrified wood be discovered during construction, these should be safeguarded (preferably *in situ*) and the ECO should alert the Eastern Cape Provincial Heritage Resources Agency (ECPHRA) (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za). This is so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a suitably qualified professional palaeontologist (See tabulated Chance Fossil Finds Procedure appended to this report). The specialist involved would require a collection permit from ECPHRA. Fossil material must be curated with accompanying collection data in an approved repository, such as the SANParks Addo Main Camp Interpretive Centre or a museum / university collection, and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA (2013). These recommendations should be included within the EMPr for the proposed development.

1. INTRODUCTION & BRIEF

South African National Parks (SANParks) has identified the need to upgrade the reception area and develop additional family accommodation units at the Addo Elephant National Park Main Rest Camp, located some 13.7 km NNE of Addo village in the Sundays River Valley Municipality, Eastern Cape. The new reception area will comprise an entrance gate, reception and day visitors' site on Portion 4 of Wolve Kop Farm No. 82. The family accommodation will comprise 19 chalet units and a communal swimming pool on Portion 5 of Wolve Kop Farm No. 82 and Farm No. 150 (Map Figs. 1, 2a, 2b). An itemised Scope of Works for the various planned development components is appended to this report (Appendix 3).

The proposed development footprints overlie potentially fossiliferous bedrocks of the Kirkwood Formation (Uitenhage Group) that are known to contain important fossil plant, wood and dinosaur remains in the Addo – Kirkwood region. The present palaeontological heritage assessment study has accordingly been commissioned on behalf of SANParks by CTS Heritage, Cape Town (Contact details: Ms Jenna Lavin, CTS Heritage. 16 Edison Way, Century City, Cape Town. Tel: +27 (0)87 073 5739. Cell: +27 (0)83 619 0854. E-mail: info@ctsheritage.com). The independent Environmental Assessment Practitioner for the Addo Main Rest Camp developments is Enviroworks, Cape Town (Contact details: Ms Megan Smith. Enviroworks, Cape Town. Tel: (021) 527 7084. Cell: (076) 965 8002. E-mail: megan.smith@enviroworks.co.za).

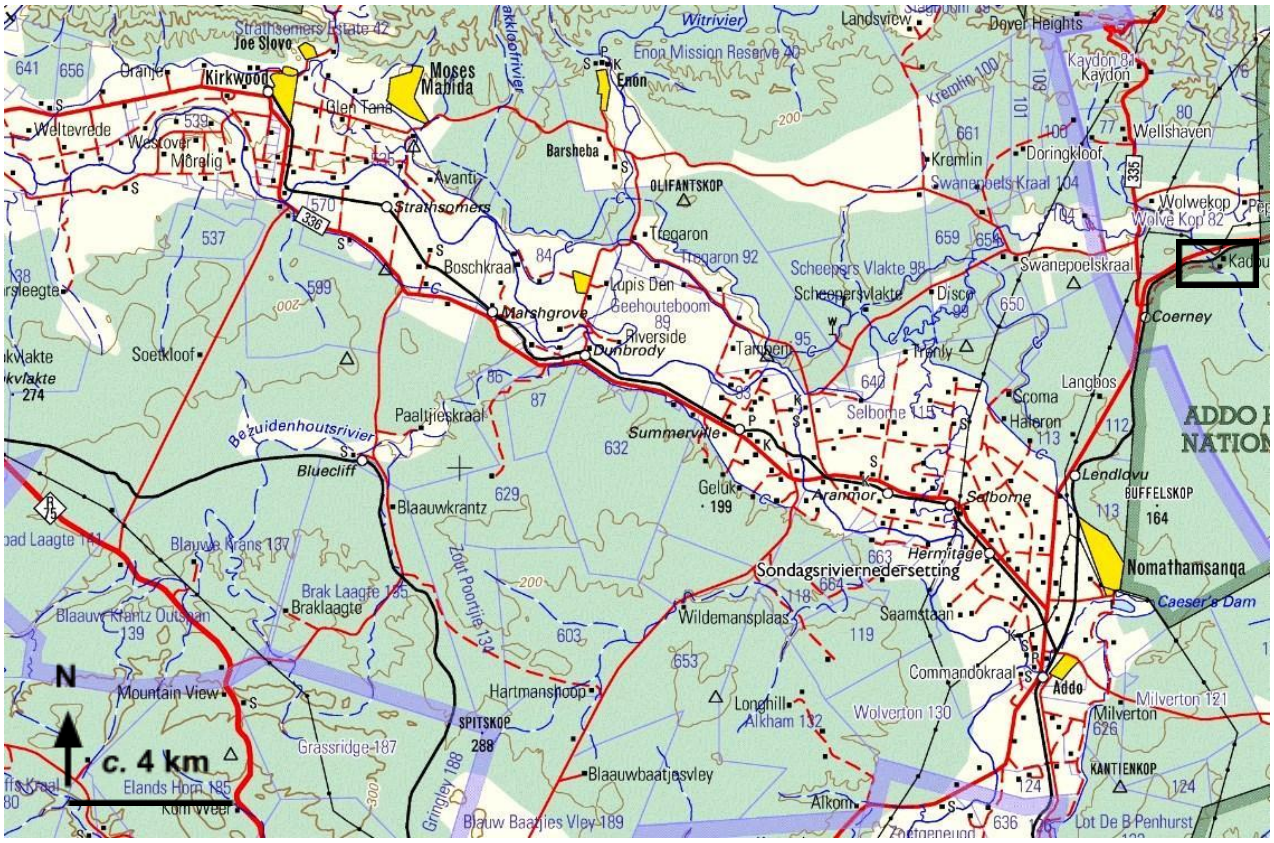

Figure 1: Approximate location of the project areas for the reception area and family accommodation units (black rectangle) at or close to the Main Rest Camp, Addo Elephant National Park, situated some 13.7 km NNE of Addo village, Sundays River Valley Municipality, Eastern Cape (Extract from 1: 250 000 topographical sheet 3324 Port Elizabeth, courtesy of the Chief Directorate: National Geo-spatial information, Mowbray).

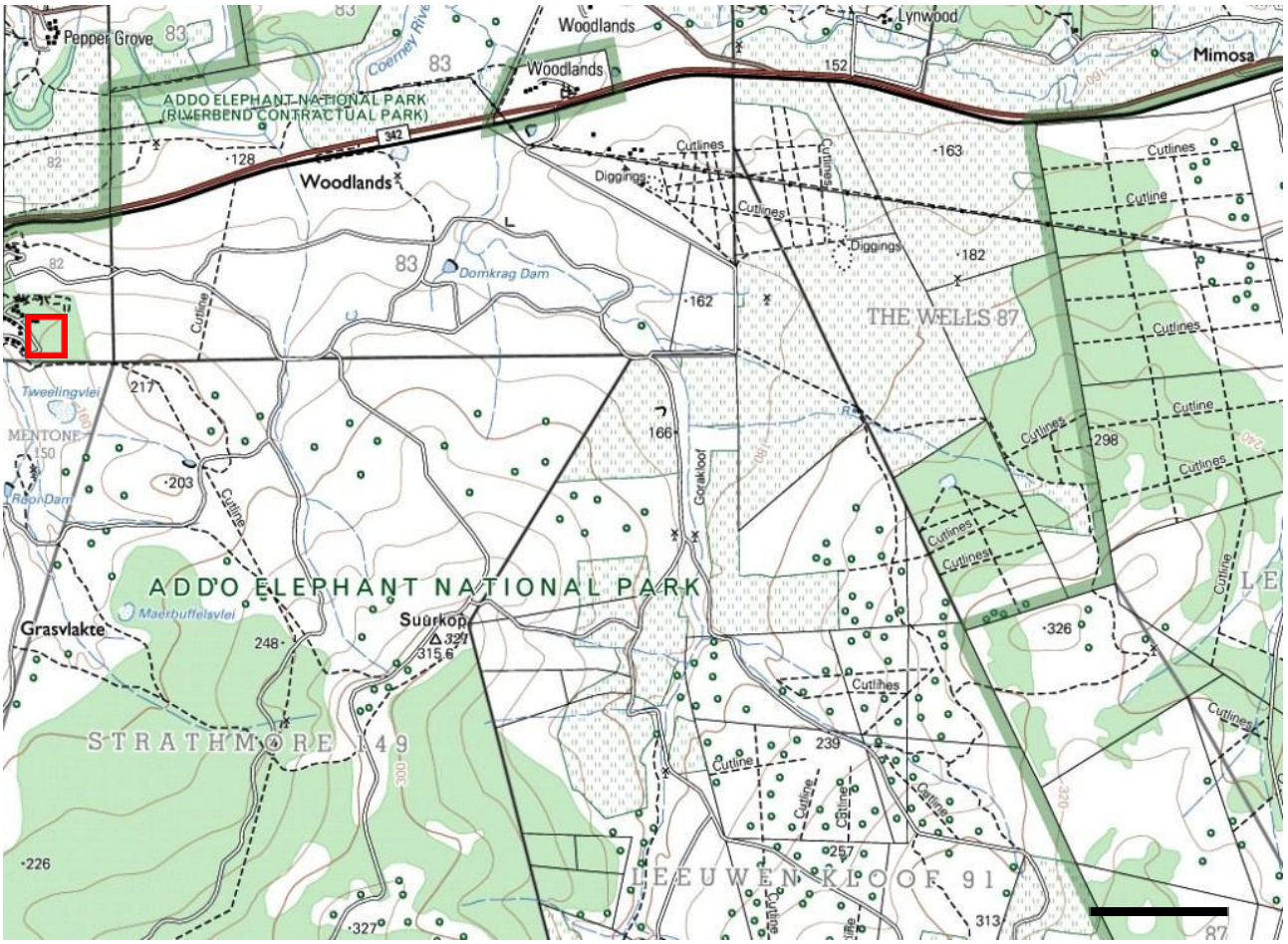

Figure 2a: Extract from 1: 50 000 topographic sheet 3325BD (courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location of the family accommodation units project area on the eastern margins of the Addo Main Rest Camp (red square). Scale bar = 1 km. N towards the top of the image.

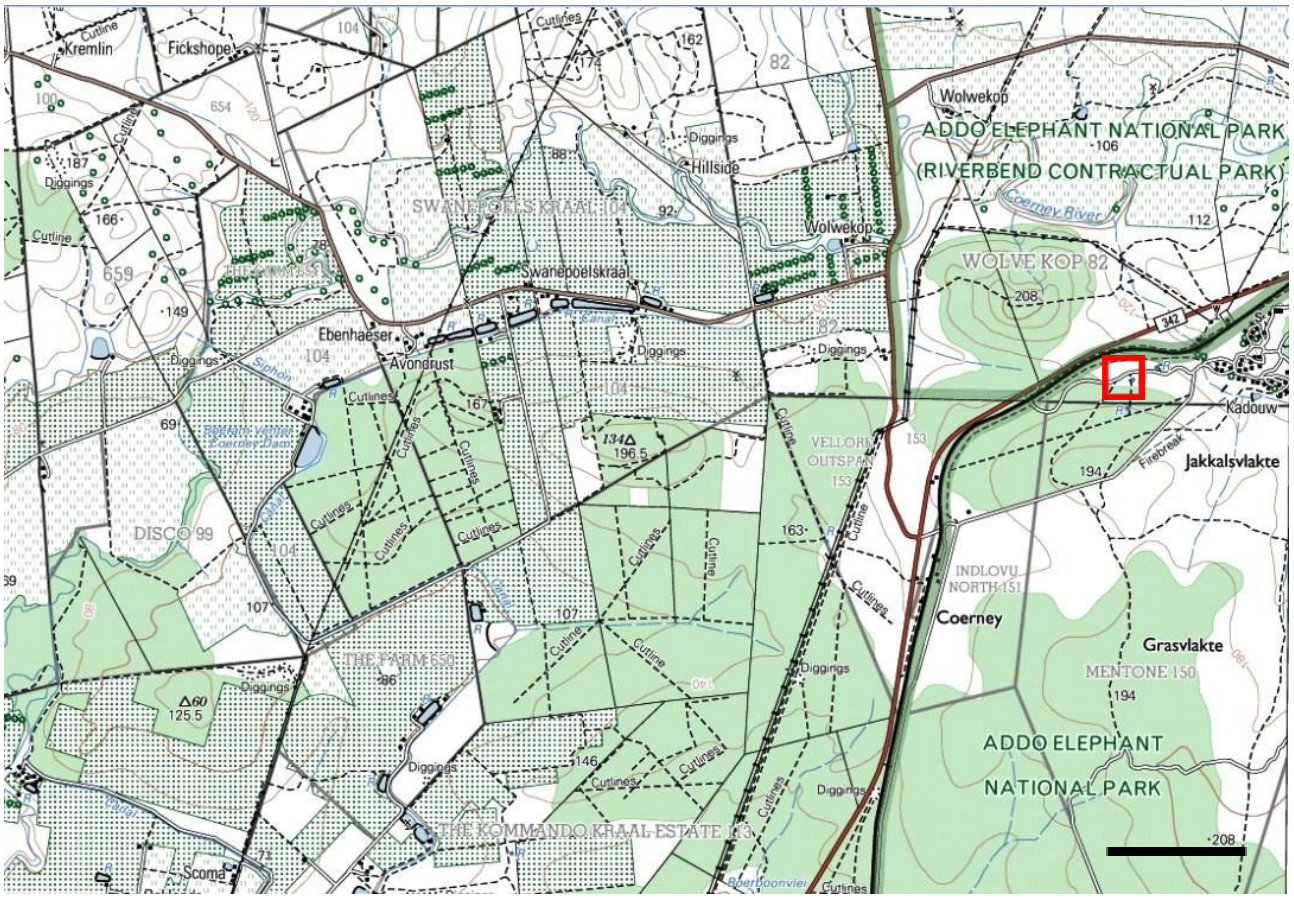

Figure 2b: Extract from 1: 50 000 topographic sheet 3325BC (courtesy of the Chief Directorate: National Geo-spatial Information, Mowbray) showing the approximate location of the project areas for the entrance gate, reception and day visitors' site *c.* 650 m to the west of the Addo Main Rest Camp (red square). Scale bar = 1 km. N towards the top of the image.

Figure 3: Google Earth© satellite image of the existing Main Gate to the Addo Elephant National Park Main Camp showing the location of the new reception area and gatehouse project area as well as the day visitors' picnic sites (red polygons) to the west and southeast respectively.

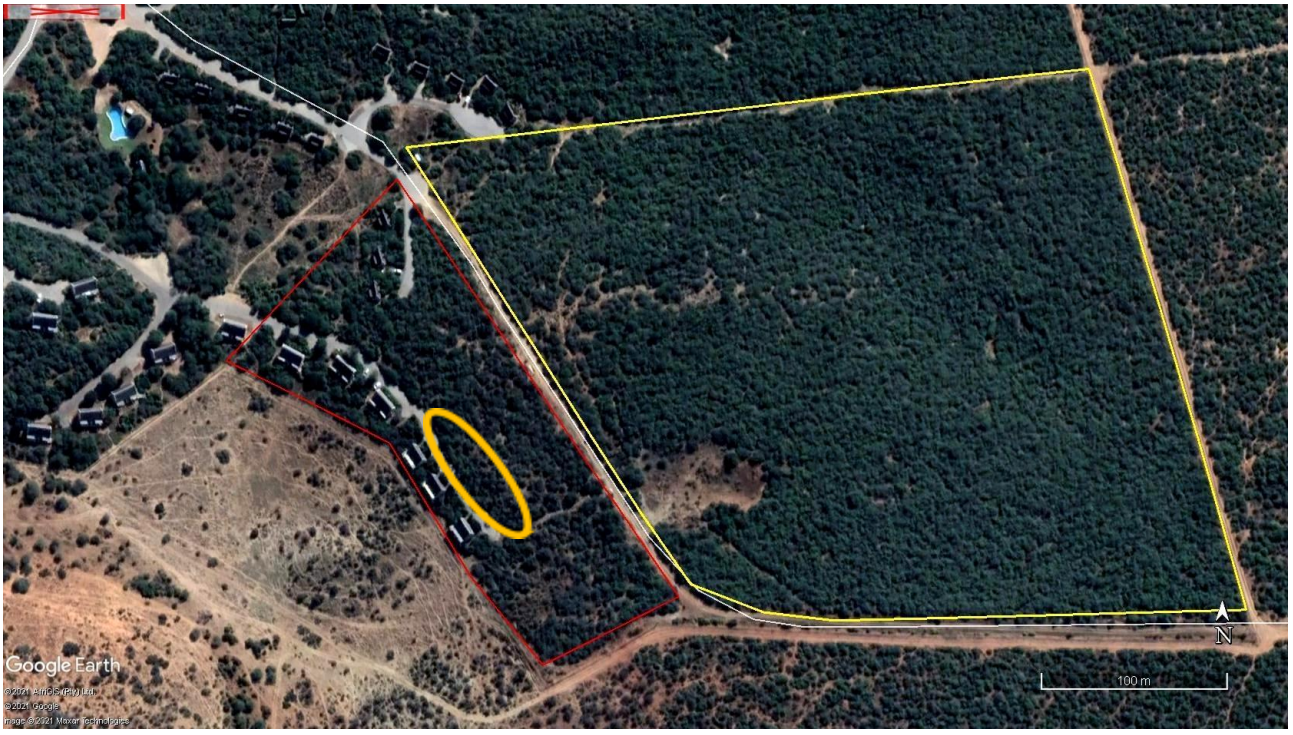

Figure 4: Google Earth© satellite image of the new family accommodation units project area (red polygon) at the Addo Main Rest Camp showing the dense cover by Sundays Thicket

vegetation. Access to the project area is limited to occasional winding paths. An access road runs along the north-eastern edge of the project area and an existing paved road cuts into the area from the northwest. The adjoining project area for the proposed Lendlovu Lodge development (yellow polygon) has also been surveyed as part of a separate PIA study. Concentrations of fossil wood associated with the outcrop of a Kirkwood Formation channel sandstone have been recorded in the elliptical area outlined by the orange dotted line (See Appendix 2, Fig. A1 for more detail).

1.1. Legislative context of this palaeontological study

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act (1999) include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- 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 Agency.
(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 have been developed by SAHRA (2013).

2. APPROACH TO THE PALAEONTOLOGICAL HERITAGE ASSESSMENT

The information used in this desktop study was based on the following:

1. A short project outline, kmz files and maps provided by CTS Heritage, Cape Town;

2. A review of the relevant scientific literature, including published geological maps (sheet 3324 Port Elizabeth, Council for Geoscience, Pretoria) and sheet explanations (Toerien & Hill 1989), satellite images, and previous palaeontological heritage assessments in the broader Addo region (*e.g.* Almond 2010, Almond 2012, Almond 2014, 2016a, 2016b, Prevec 2018, Wilken 2019);

3. A half-day site visit by the author and an experienced assistant on 21 July 2021;

4. The author's database on the formations concerned and their palaeontological heritage (cf Almond *et al.* 2008).

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. The potential impact of the proposed development on local fossil heritage is 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 assessment study by a professional palaeontologist is usually warranted to identify any palaeontological hotspots and make specific recommendations for any mitigation required before or during the construction phase of the development.

On the basis of the desktop and Phase 1 field assessment studies, the likely impact of the proposed development on local fossil heritage and any need for specialist mitigation are then determined. Adverse palaeontological impacts normally occur during the construction rather than the operational or decommissioning phase. Phase 2 mitigation by a professional palaeontologist – normally involving the recording and sampling of fossil material and associated geological information (*e.g.* sedimentological data) may be required (a) in the pre-construction phase where important fossils are already exposed at or near the land surface and / or (b) during the construction phase when fresh fossiliferous bedrock has been exposed by excavations. To carry out mitigation, the palaeontologist involved will need to apply for a palaeontological collection permit from the relevant heritage management authority, *i.e.* the Eastern Cape Provincial Heritage Resources Authority, ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za). It should be emphasized that, *providing appropriate mitigation is carried out*, the majority of developments involving bedrock excavation can make a *positive* contribution to our understanding of local palaeontological heritage.

2.1. Assumptions & limitations

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 proposed reception area and family accommodation units project areas the major limitations for fossil heritage assessment are (1) the very low levels of Mesozoic bedrock exposure due to extensive cover by largely unfossiliferous superficial sediments as well as (2) the very limited access to most of the study area because of the dense thicket vegetation.

3. GEOLOGICAL BACKGROUND

The reception area and day visitors' picnic area development sites lie in flat, densely-thicketed to disturbed terrain between *c*. 145-150 m amsl. situated either side of the existing gatehouse and paved access road to the Main Rest Camp (Figs. 1, 2b & 3). The family accommodation units project area on the south-eastern margins of the Addo Main Rest Camp, Addo Elephant National Park, is located in densely-vegetated, gently sloping to undulating terrain between 140 to 165 m amsl, with an overall slope from SE to NW (Figs. 1, 2a & 4). Due to the almost impenetrable Sundays Thicket vegetation here, access to the project area is largely limited to occasional intermittent, winding game and people paths (Figs. 3, 4, 8 to 10). An access road runs along the north-eastern edge of the project area and an existing paved road cuts into the area from the northwest. Tweeling Vlei lies some 350 m to the south while a shallow drainage line from Rooi Dam runs from the south into low-lying waterholes along the southern edge of the Main Rest Camp, eventually joining the Coerney River (a tributary of the Sundays River) north of the Addo-Paterson tar road. Bedrock exposure was only encountered on the south-western margins of the project area adjoining the existing paved road.

The geology of the Addo area is shown on 1: 250 000 geological map 3324 Port Elizabeth (Council for Geoscience, Pretoria; Toerien & Hill 1989) (Fig. 5). The study areas near the Addo Main Camp lie towards the northern edge of the extensive Algoa Basin which is infilled with a 3.5 km thick succession of alluvial fan, fluvial and estuarine to marine shelf sediments of Middle / Late Jurassic to Early Cretaceous age (*c*. 150-125 Ma) that are referred to the **Uitenhage Group** (McLachlan & Anderson 1976, Shone 2006, Muir 2015). The footprints of the proposed developments are entirely underlain at depth by non-marine sediments of the **Kirkwood Formation** (**J-Kk**, yellow in map Fig. 5) that interfinger with the conglomeratic Enon Formation to the north and outside the study area and with marine beds of the Sundays River Formation within the National Park towards the south. Upland areas to the south of the Main Camp project area (*e.g.* Zuurkop) preserve Late Caenozoic coastal sediments of the Algoa Group (Alexandria Formation coastal limestones, and Nanaga Formation aeolianites) (Fig. 7) but these younger sediments have been stripped away by erosion along the Coerney River Valley. The underlying Mesozoic bedrocks here are largely obscured by thick sandy to gravely alluvial soils so that exposure of Kirkwood bedrocks within the National Park is in practice very limited. Late Caenozoic alluvial terrace deposits of the **Kudus Kloof Formation** ("High Level Gravels") have been mapped in the Sundays River Valley to the northeast of Addo village by Hattingh (1994, 2001). Several small relict patches of Pliocene age gravels are mapped within the Addo Elephant National Park, but are not present in the present project areas.

3.1. Kirkwood Formation

The Kirkwood Formation comprises readily-weathered, silty overbank mudrocks and subordinate channel sandstones and pebbly conglomerates of fluvial origin and Middle / Late Jurassic to Early Cretaceous age. Key geological accounts of the Kirkwood Formation include those by Rigassi & Dixon (1972), McLachlan & McMillan (1976), Tankard *et al.* (1982), Dingle *et al.,* (1983), Shone (1976, 2006) and Muir *et al.* (2015, 2017). Early geologists called these rocks the "Variegated Marls" referring to the distinctive reddish-brown, pinkish and greenish-grey colour spectrum shown by the sediments (*N.B.* "marl" is a misnomer, technically referring only to calcareous, clay-rich mudrocks). Another older name for the same succession was the "Wood Beds", referring to the abundant petrified wood recorded in the Algoa Basin and elsewhere (see fossil record below). Volcanic tuffs (ashes) and reworked tuffs constitute an important component of the Kirkwood succession in parts of its outcrop area (*e.g.* Herbertsdale – Hartenbos Basin; Viljoen & Malan 1993).

At the time that the Uitenhage sediments were being deposited, Africa and South America – previously united within the West Gondwana supercontinent - were starting to pull apart. Uplift, faulting and erosion of the youthful southern African continent led to the rapid deposition of huge amounts of alluvium by systems of meandering rivers and estuaries fringing a new Mediterranean-sized seaway that was opening up in the southern Cape area. Well-preserved

calcrete-rich palaeosols (fossil soils) within the Kirkwood alluvium suggest that prevailing climates were semi-arid, warm to hot, with a low seasonal rainfall of 100-500 mm / year. This pattern is supported by the abundance of leathery- and small-leaved plants in the fossil flora, while well-developed seasonal growth rings are preserved in at least some fossil woods. Evidence for fire-prone vegetation is provided by locally abundant charcoal and charred wood (Muir *et al.* 2015).

The Kirkwood beds and their fossils in the northern part of the Algoa Basin have been addressed in detail by McLachlan and McMillan (1976), Muir *et al.* (2015, 2017) as well as in several recent palaeontological impact assessments by the author and others (See, for example, Almond 2010, Almond 2014, 2016a, 2016b, 2020a-c, Prevec 2018, Wilken 2019) who provide extensive references to the scientific literature. Good hillslope exposures of typical multi-hued Kirkwood Formation overbank facies are seen on the SE outskirts of Bontrug, just south of the irrigation channel and some 25 km WNW of the lodge project area. The beds here dip strongly southwards (Fig. 6).

The Kirkwood Formation is in general very poorly exposed within the northern portion of the Addo Main Camp, however. One exception is the gullied area near Domkrag Dam, *c*. 2.4 km due east of the Main Rest Camp study area (Fig. 7). Bedrock exposures of the Kirkwood Formation within or close to the project areas themselves are very limited. Excavated material from test trenches on the north-eastern and south-western edges of the family accommodation units project area (33 62 40.7 S, 25 45 07.2 E and 33 26 48.2 S, 25 45 08.0 E) includes weathered, friable to blocky, greenish-brown, medium-grained channel sandstone of the Kirkwood Formation (Figs. 11 and 12). Brown-weathering, friable, jointed and highly weathered Kirkwood channel sandstones crop out at surface within south-western sector of the project area adjacent to the existing paved access road (Figs. 13 & 14; see orange ellipse in Fig. 4). In addition to locally abundant blocks of fossil wood (Section 4), these contain sparse, resistant-weathering, cannon-ball sized sphaeroidal concretions of diagenetic carbonate (Fig. 15).

3.2. Late Caenozoic superficial deposits

Brown loamy soils up to several meters thick with a pervasive surface leaf litter or living crusts of moss and lichen mantle most of the project area, as seen in occasional marginal geotechnical trenches as well as along animal / people paths through the thicket (Figs. 8 to 10). Patches of bare soil have a sparse to locally dense scatter of subangular to well-rounded, pebbly to cobbly gravel clasts. These are mostly made of pale grey to pale brownish quartzite (probably derived from the Witteberg Group), with less abundant vein quartz, rubbly calcrete and typical very highly-polished sandstone pebbles reworked from the Kirkwood Formation (Figs. 16 & 17). Many of the quartzite clasts are anthropogenically flaked, forming a sparse background scatter of stone tools. Very occasional boulder-sized, angular blocks of Late Caenozoic calcrete and weathered, brownish to greenish-grey Kirkwood sandstone or sparsely pebbly sandstone (often lichen-patinated) are also seen. No Kirkwood bedrocks are exposed in the shallow quarry or borrow pit on the NE edge of the project area; some of the material seen here, including blocks of pebbly calcrete, is of exotic provenance (*e.g.* building waste). The soils are calcretised in the subsurface, locally exposed in burrows and trenches as a rubbly, pale cream-coloured to greyish-weathering hardpan (*e.g.* NW borrow pit margins). It is possible that some of the thick orange-brown soils and calcretised near-surface sediments here represent reworked calcarenites from older Algoa Group deposits at higher elevations on the margins of the Coerney River Valley (Fig. 18). The contact between alluvial soils and the underlying, saprolitic (*in situ* weathered) Kirkwood siltstones is likely to be obscure and probably gradational.

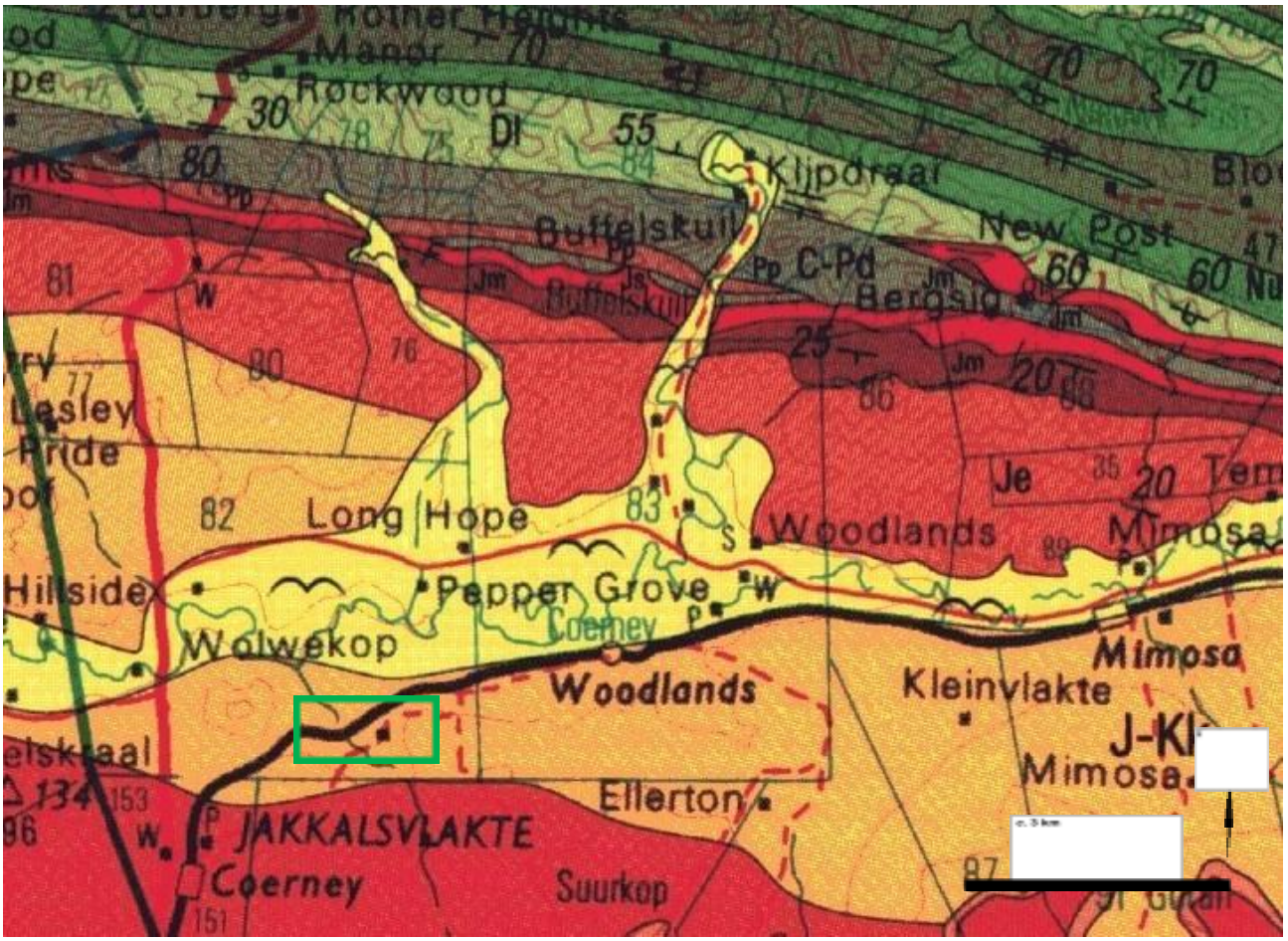

Figure 5: Extract from 1: 250 000 geological map 3324 Port Elizabeth (Council for Geoscience, Pretoria). The reception area, picnic site and family accommodation units project areas either side of the Addo Main Rest Camp (small green rectangle), c. 13.7 km NNE of Addo village, are underlain at depth by Middle / Late Jurassic to Early Cretaceous fluvial sediments of the Kirkwood Formation (Uitenhage Group) (J-Kk, orange). Bedrock exposure here is, at most, very limited due to pervasive cover by alluvial or eluvial soils and gravels as well as dense Sundays River thicket vegetation.

Figure 6: Good exposures of south-dipping, multi-hued overbank mudrocks of the Kirkwood Formation exposed along the irrigation canal near Bontrug, *c*. 25 km WNW of the Addo Main Rest Camp project area where similar bedrocks occur at depth beneath thick alluvial soils.

Figure 7: Rare gullied exposure of Kirkwood Formation bedrocks on the northern margins of the Addo Main Camp, seen here *c*. 300 m SW of the Domkrag Dam. The low plateau of Zuurkop seen on the skyline to the south is capped with Late Caenozoic calcretes of the Algoa Group (Alexandria Formation).

Figure 8: Dense Sundays Thicket vegetation with patches of bare soil in the reception area project area situated just west of the existing Addo Main Entrance Gate.

Figure 9: Similar, flat, densely-vegetated terrain with intermittent, soil-covered animal paths in the vicinity of the day visitors' picnic site project area to the southeast of the existing Main Gate.

Figure 10: Dense Sundays Thicket vegetation in the family accommodation units project area which is traversed, as seen here, by a few access paths mantled by thick, orange-brown soils and pebbly surface gravels (mainly quartzite).

Figure 11: Test trench along the track defining the north-eastern edge of the project area. The excavated material is mainly friable, greenish-brown, weathered sandstone of the Kirkwood Formation (Hammer = 26.5 cm).

Figure 12: Trench into blocky, friable, highly weathered channel sandstones of the Kirkwood Formation in the south-western sector of the family accommodation units project area.

Figure 13: Blocky-weathering, greenish-brown channel sandstones of the Kirkwood Formation exposed in a shallow road cutting in the south-western sector of the family accommodation units project area (Scale = 15 cm). The white areas reflect a Late Caenozoic calcrete patina.

Figure 14: Surface expose of weathered Kirkwood Formation channel sandstones in the southern sector of the family accommodation units project area. Float blocks of fossil wood illustrated in this report have weathered out of this channel body.

Figure 15: Dark brown, cannon ball-sized spheroidal concretions of diagenetic carbonate weathering out of Kirkwood channel sandstone facies (Scale = 15 cm). No fossils were observed within these concretions.

Figure 16: Sparse, poorly-sorted, eluvial surface gravels of quartzite (often flaked), sandstone and calcrete overlying orange sandy soils that mantle most of the exposed ground within all the Addo Main Rest Camp project areas (Scale = 15 cm).

Figure 17: Typical highly-polished, well-rounded quartzite pebble reworked from the Kirkwood Formation (bottom) as well as quartzite stone tools made from flaked pebbles. The latter form a sparse to locally abundant background scatter of Stone Age artefacts in the region (Scale in cm).

Figure 18: Areas of higher relief within the family accommodation units project area show that the mantle of orange-brown sandy to loamy soils overlying Kirkwood bedrocks here may be several meters thick. Some of this material might represent reworked Late Caenozoic Algoa Group aeolianites as well as alluvial deposits.

4. PALAEONTOLOGICAL HERITAGE

The fossil record of the main sedimentary rock units represented within the project is outlined here, together with any new palaeontological data based on the recent site visit.

4.1. Fossils in the Kirkwood Formation

The Kirkwood Formation is the most palaeontologically productive unit in southern Africa that yields terrestrial biotas of Middle Jurassic to Early Cretaceous age. Its overall palaeontological sensitivity is rated as high (Almond *et al.* 2008). Fossils include vascular plants (including concentrations of petrified logs, lignite beds, charcoal), tetrapod vertebrates (notably dinosaurs) and freshwater invertebrates, among others (Du Toit 1954, McLachlan & McMillan 1976, Almond 2010, Muir *et al.* 2015, 2017 and further references listed below). Recent palaeontological research has yielded a number of new dinosaur taxa and undescribed fossil wood taxa, for the most part from the Algoa Basin to the northeast of Port Elizabeth, but also from the Oudtshoorn Basin of the Little Karoo (De Klerk 2008, Dr Rose Prevec, pers. comm., 2016).

The palaeobotanically famous “Variegated Marls” and “Wood Beds” of the Kirkwood Formation in the Eastern Cape have yielded a diverse fossil flora. Woody vegetation was dominated by gymnosperms including conifers such as *Araucaria* and *Podocarpus*, extinct cycad-like bennettitaleans like *Zamites*, as well as true cycads. In addition there are charophytes (stoneworts, an advanced group of freshwater algae), bryophytes (liverworts) and pteridophytes such as ferns (Tate 1867, Seward 1903, Du Toit 1954, McLachlan & McMillan 1976, 1979, Anderson & Anderson 1985, Bamford 1986, MacRae 1999, Muir *et al.* (2015). Angiosperms (flowering plants), which first radiated during this period, are not represented, however. Plant microfossils include pollens, spores and cuticular fragments, while amber and charcoal are locally common. So far no inclusions such as fossil insects have been recorded within the amber, which represents the oldest Cretaceous material recorded from Gondwana (Gomez *et al.* 2002a, 2002b).

Cretaceous dinosaurs have been collected from the Kirkwood Formation of the Algoa Basin since the mid nineteenth century and a number of exciting new finds have been made recently (McPhee *et al.* 2016). Most of the Kirkwood dinosaur fossils found so far are highly fragmentary, however. The earliest discoveries, in 1845, were of the stegosaur *Paranthodon* from Bushman’s River Valley and represent some of the first dinosaur finds made anywhere in the world (De Klerk 1995, 2000). The gigantic remains – mainly isolated vertebrae, leg bones and teeth - of several different titanosaurid and diplodocid sauropods are known from the Algoa and Oudtshoorn Basins (Rich *et al*., 1983, De Klerk 2008, McPhee *et al.* 2016). These include the poorly-known *Algoasaurus* from Dispatch near Port Elizabeth (a possible camarasaurid), most of whose bones were made into bricks before they could be rescued (Broom 1904), and huge bones from the Calitzdorp area that were originally described as a giant plesiosaurus (Hoffman 1966). Disarticulated remains of numerous juveniles (hatchlings) of a primitive iguanodontian were discovered recently near Kirkwood (Forster & De Klerk 2008 and paper in press). The most completely preserved Kirkwood dinosaur is the small coelurosaur therapod *Nquebasaurus* (De Klerk *et al*., 2000); recent studies suggest this form may in fact be more closely related to the bird-like dinosaurs or alvarezsaurids (B. De Klerk, pers. comm., 2010). At least one other theropod, a basal tetanuran, is known from fragmentary remains in the Kirkwood Formation (Rich *et al*., 1983, Mateer 1987, Forster *et al*., 2009). Other vertebrate fossil groups from the Kirkwood Formation include frogs, crocodiles, turtles, sphenodontid and other lizards, mammals and freshwater fish such as garfish (De Klerk *et al*., 1998, Rich *et al*., 1983, Ross *et al*., 1999).

Non-marine invertebrate fossils in the Kirkwood Formation are represented by freshwater or estuarine molluscs (*e.g.* unionid bivalves), rare insects such as beetles, and several groups of small crustaceans including ostracods (seed shrimps), conchostracans (clam shrimps) and notostracans (tadpole shrimps) (McLachlan & McMillan 1976, Dingle *et al.* 1983, MacRae 1999, Rich *et al*. 1983, Ross *et al*. 1999, Mostovski & Muller 2010). Trace fossils include borings into petrified tree trunks that are variously attributed to bivalves (*Gastrochaena*) and insects (possibly

beetles) as well as occasional low-diversity invertebrate burrow assembklages within thin sandstone beds (Muir *et al.* 2017).

Historical records of fossils from the Kirkwood Formation in the Sundays River Valley are ably reviewed by McLachlan and Anderson (1976, their figs. 4 and 7; see Fig. 16 herein), in part culled from the earlier geological sheet explanation for the region between Grahamstown and Port Elizabeth by Haughton (1928). Several key Kirkwood fossil sites are recorded on the "Strathsomers Estate" to the south of the Sundays River along the Bezuidenhoutsrivier Valley between Blue Cliffs and Dunbrody Stations, to the west of the present study area in the Addo National Park. Fossils found in this area include a range of Early Cretaceous plants (ferns, cycads, conifers, petrified woods, lignite horizons *etc*) and vertebrate bones, including those of large dinosaurs (McLachlan & Anderson 1976, p. 204 and their Figs. 4 & 7, Muir *et al.* 2015). The plant-rich horizons here are often associated with estuarine oyster beds or non-marine unionid bivalves and gastropods (*Unio, Psammobia*), but fully marine molluscan faunas are also recorded near Dunbrodie. A marshy, marginal estuarine setting with occasional marine incursions has been postulated as a plausible depositional setting for the Early Cretaceous deposits in this area.

McLachlan and Anderson (1976) record vertebrate fossils from the Sundays River Formation within the Addo Elephant National Park but not from the Kirkwood Formation here (Fig. 19). A comprehensive database of fossil and geological sites within and bordering the proposed GAENP has been compiled by De Klerk *in* Cocks *et al.* 2002 (*not* seen). Abundant fossil wood was reported weathered-out at surface as well as *in situ* within Sundays River Valley Kirkwood bedrocks on the farm Farm Strathsomers Estate 42 by Almond (2016a). Many of the petrified wood pieces do not appear to preserve the original woody fabric in detail - as is often the case in the Kirkwood Formation - but some examples do show well-preserved xylem structure (Fig. 20). The blocky surface texture seen occasionally might reflect the partially-rotted or charred condition of the wood when it was fossilised. In some cases the woody material is associated with and enveloped by dark brown carbonate concretions. Earlier authors refer to "calcified wood" in the Strathsomers Estate area (McLachlan & McMillan 1976, Fig. 7 and refs. therein). Thin sandstone beds with a basal layer of comminuted and often rounded wood fragments suggest that woody material was sometimes transported downstream as a concentrated slurry, perhaps following major storms (*cf* Muir *et al.* 2015). Prevec (2018, her satellite map fig. 4) reported a range of fossil taxa from the Uitenhage Group in the region between Enon, Bontrug and the Sundays River (*e.g.* along the banks of the irrigation canal). They include fragmentary bone material (some of dinosaurian affinities), lungfish tooth plates, shelly invertebrates (oysters) and locally abundant trace fossils. Wilken (2019) recently recorded blocks of silicified wood associated with Kirkwood channel sandstones in road cuttings along the Addo to Kirkwood tar road.

Locally abundant blocks of poorly-preserved fossil wood (Figs. 21 to 25, Appendix 2) associated with weathered Kirkwood channel sandstones have been recorded at surface within the south-western sector of the project area for the Addo Main Rest Camp new family units (See orange ellipse in Fig. 4 and Appendix 2 Fig. A1). The blocks are up to 20 cm wide and result from the break-up of fossil logs embedded within the underlying channel sandstones (No fossil material was observed here *in situ*, however). Many of the blocks are angular, but several are rounded in cross-section. While the outer surfaces of some blocks display fibrous woody fabrics, there is no evidence of preservation of xylem tissues by petrification; cross-sections of blocks generally show structureless sandstone indicating that the material is preserved as sandstone casts rather than by replacement by silica or other mineral (Well-preserved silicified fossil wood showing excellent, detailed replication of original woody tissue is occasionally recorded in the Algoa Basin). It is recommended that a representative sample of the fossil wood recorded here be collected by a professional palaeontologist in the pre-construction phase of the development for display, together with collection data and appropriate explanatory information, in the Interpretive Centre at the Addo Elephant National Park. It is also noted that dinosaur remains have been recorded in association with fossil wood within Kirkwood Formation channel infills within the Algoa Basin (*cf* geological poster at the Park Interpretive Centre).

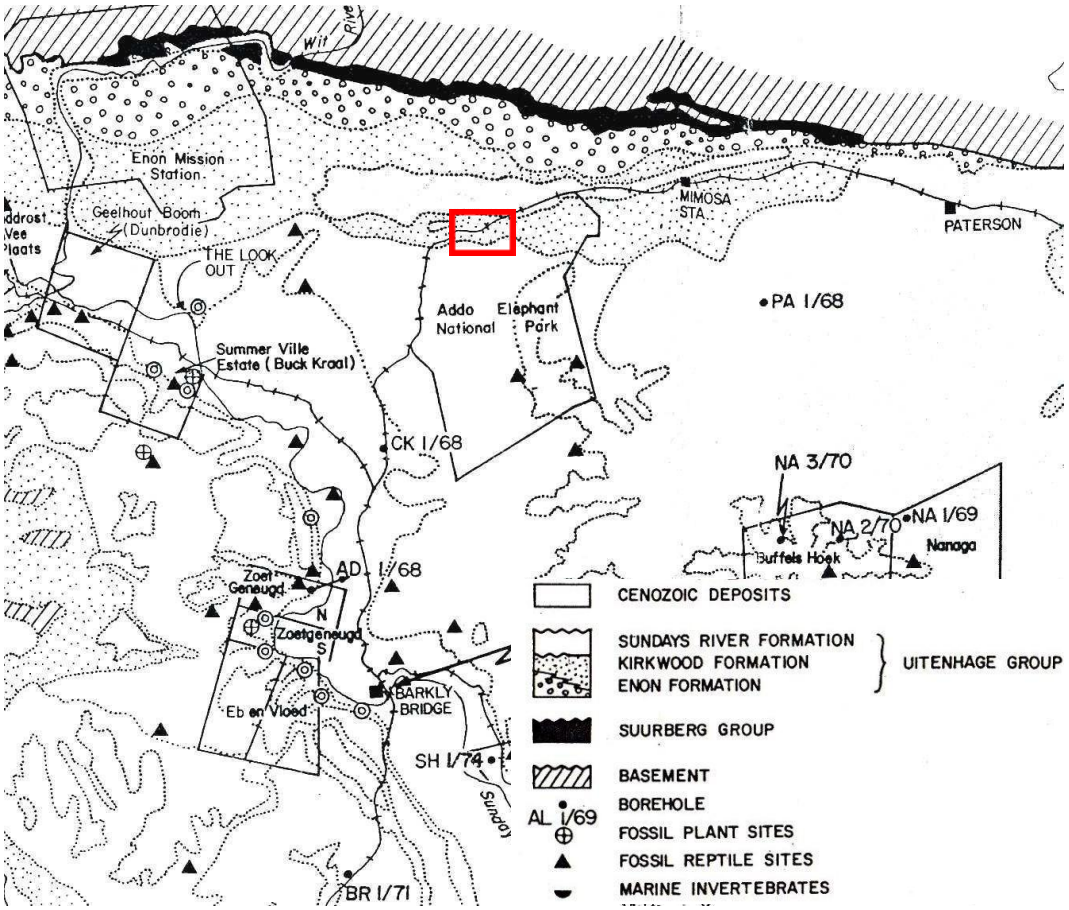

Figure 19: Historical fossil localities in the Kirkwood Formation of the Algoa Basin near Addo, Eastern Cape (Modified from McLachlan & Anderson 1976, their Fig. 8). The location of the Addo Main Rest Camp is *approximately* indicated by the red rectangle. Note that fossil vertebrate sites are recorded here within the Addo Main Camp of the Addo Elephant National Park from the Sundays River Formation but not the Kirkwood Formation that crops out along the Main Camp's northern margin (stippled area).

4.2. Fossils in Late Caenozoic superficial deposits

Neogene to Recent colluvial, alluvial and lag gravel, sand and clay deposits may also contain fossil remains of various types. In coarser sediments like river conglomerates these tend to be robust, highly disarticulated and abraded (*e.g.* rolled bones, teeth of vertebrates) but well-preserved skeletal remains of plants (*e.g.* wood, roots) and invertebrate animals (*e.g.* freshwater molluscs and crustaceans) as well as various trace fossils may be found within fine-grained alluvium. Embedded human artefacts such as stone tools that can be assigned to a specific interval of the archaeological time scale (*e.g.* Middle Stone Age) can be of value for constraining the age of Pleistocene to Recent drift deposits like alluvial terraces. Ancient to modern "High Level Gravels" tend to be coarse and to have suffered extensive reworking (*e.g.* winnowing and erosional downwasting), so they are generally unlikely to contain useful fossils. No fossils are reported from the Kudus Kloof Formation by Hattingh (1994, 2001); these Miocene to Holocene fluvial terraces are dated by reference to correlated fossiliferous marine terraces along the coast. Fine-grained carbonaceous muds associated with *vlei* areas may contain peats, palynomorphs (pollens, spores) and other microfossils as well as the bones and teeth of mammals and other fauna that died in the area.

No fossil remains of any sort were recorded from the Late Caenozoic deposits (calcretes, soils, surface gravels) within the Addo Main Rest Camp study area.

Figure 20: Large piece of fossil log preserving some original woody fabric weathered out of Kirkwood Formation bedrocks on farm Farm Strathsomers Estate 42, situated *c*. 27 km west of the Addo Main Rest Camp project area (From Almond 2016a) (Hammer = 30 cm).

Figure 21: Float blocks of fossil wood, poorly-preserved as casts without original woody fabric, recorded within the new family accommodation units project area adjacent to the Addo Main Rest Camp (Scale = 15 cm) (Loc. 039). Some of the angular blocks once formed parts of larger logs while others retain their original rounded section.

Figure 22: Weathered-out block of fossil wood (*c.* 15 cm long) from the Kirkwood Formation channel sandstone, family accommodation units project area (Loc. 051).

Figure 23: Small block of fossil trunk showing clear woody surface texture (probably a decorticated, transported log), family accommodation units project area (Scale in cm) (Loc. 039).

Figure 24: Section of *c*. 20 cm – wide fossil log exposed at surface in the family accommodation units project area (Loc. 049).

Figure 25: Cross-section of piece of fossil wood (5 cm across) with no obvious internal fabric showing that the logs here are preserved as sandstone casts and not as petrified woody material (Loc. 034).

5. SITE SENSITIVITY VERIFICATION

According to the Department of Forestry, Fisheries and the Environment (DFFE) screening tool, the rock units within the Addo Main Rest Camp area are assigned a Very High palaeosensitivity. In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a combined field-based and desktop site sensitivity verification has therefore been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the DFFE National Web-Based Environmental Screening Tool. The present site sensitivity verification of the proposed Addo Main Rest Camp project areas is based on:

- A review of the relevant scientific literature, including published geological maps (sheet 3324 Port Elizabeth, Council for Geoscience, Pretoria) and sheet explanations (Toerien & Hill 1989), satellite images, and previous palaeontological heritage assessments in the broader Addo region (*e.g.* Almond 2010, Almond 2012, Almond 2014, 2016a, 2016b, Prevec 2018, Wilken 2019);
- A half-day site visit by the author and an experienced assistant on 21 July 2021.

Local concentrations of poorly-preserved fossil wood were recorded within the southern sector of the family accommodation units project area but no fossils were observed over the majority of this area, nor at any of the development sites near the Main Entrance Gate. Dense thicket vegetation prevents access to most of the project areas. Given the limited scientific value of the fossils recorded (poorly preserved and widely represented within the outcrop area of the Kirkwood Formation) and the pervasive cover by palaeontologically insensitive soils and calcrete, a provisional INDETERMINATE but probably LOW palaeosensitivity is assigned to the combined project areas. The original Very High Sensitivity assigned by the DFFE Screening Tool is therefore *contested*.

6. CONCLUSIONS & RECOMMENDATIONS

The project areas for the various proposed developments at the Addo Main Rest Camp are underlain at depth by non-marine, fluvial to estuarine sediments assigned to the Kirkwood Formation (Uitenhage Group) of Middle / Late Jurassic to Early Cretaceous age. Fossil wood and other plant remains, as well as much rarer dinosaur fossils, have been recorded from the wider Addo – Kirkwood region of the Eastern Cape. These Mesozoic bedrocks are generally not well-exposed within the project areas themselves (most of which are largely inaccessible due to dense thicket vegetation). Weathered Kirkwood channel sandstones are seen in test trenches along the margins of and crop out at surface in the south-western sector of the family accommodation units project area. In the last case locally abundant but poorly-preserved fossil wood blocks occur in association with the channel sandstones. Most accessible portions of the various project areas are mantled by thick alluvial to eluvial soils, sparse surface gravels and subsurface calcrete, all of which are of low palaeosensitivity.

Given (1) the small footprints of the proposed developments and (2) the low sensitivity of the thick superficial deposits covering most of the project areas, impacts during the construction phase of the proposed development are anticipated to be of LOW (NEGATIVE) SIGNIFICANCE (Table 1). However, confidence levels for this assessment are only moderate due to the very limited site access. The possibility of scientifically valuable, well-preserved specimens of fossil wood or dinosaurs being unearthed during site clearance and excavations for foundations, services *etc* cannot be excluded, but is considered unlikely. It is noted that dinosaur remains have been recorded in association with fossil wood within Kirkwood Formation channel infills elsewhere within the Algoa Basin (*cf* geological poster at the Park Interpretive Centre).

There are no fatal flaws or objections on palaeontological heritage grounds to authorisation of the proposed developments. It is recommended that a representative sample of the fossil wood recorded here within the family accommodation units project area be collected by a professional palaeontologist in the pre-construction phase of the development for display, together with

collection data and appropriate explanatory information, in the Interpretive Centre at the Addo Elephant National Park. No further palaeontological heritage studies or specialist mitigation are recommended for the proposed developments, *pending* the potential discovery or exposure of any substantial new fossil remains (*e.g.* vertebrate bones and teeth, large blocks of petrified wood, fossil plant-rich horizons) during the construction phase. The ECO responsible for these developments should be alerted to the possibility of important fossil remains being found either on the surface or exposed by fresh excavations during construction.

Should fossil remains such as bones, shells or petrified wood be discovered during construction, these should be safeguarded (preferably *in situ*) and the ECO should alert the Eastern Cape Provincial Heritage Resources Agency (ECPHRA) (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za). This is so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a suitably qualified professional palaeontologist (See tabulated Chance Fossil Finds Procedure appended to this report). The specialist involved would require a collection permit from ECPHRA. Fossil material must be curated with accompanying collection data in an approved repository, such as the SANParks Addo Main Camp Interpretive Centre or a museum / university collection, and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA (2013). These recommendations should be included within the EMPr for the proposed development.

Table 1: Construction phase of the new entrance gate, reception area, day vistors' picnic area and family accommodation units at the Addo Main Rest Camp: assessment of anticipated impacts on scientifically valuable palaeontological heritage

Nature of the Impact	Disturbance, damage or destruction of scientifically-valuable fossil heritage preserved at or beneath ground surface within development footprint during the construction phase due to (1) surface clearance and (b) excavations into bedrock. High significance impacts on scientifically valuable local fossil heritage resources are not anticipated due to the small development footprint, partially disturbed nature of the terrain, weathered bedrocks, poor preservation of recorded fossil material and the generally low palaeosensitivity of the Late Caenozoic superficial deposits.
Extent	Site Specific (project footprint)
Duration	Permanent
Consequence/Intensity	Low (fossils recorded in vicinity are poorly preserved; potentially-fossiliferous channel sandstone host rock not well represented at or near surface in majority of project area)
Probability	Probable
Degree of Confidence	Moderate (access to most of site precluded by dense vegetation)
Reversibility	Irreversible
Irreplaceable Loss of Resources	Unlikely (fossil wood occurs widely within the Kirkwood Formation bedrocks)
Status and Significance (without mitigation)	LOW NEGATIVE (-)
Mitigation	· A representative sample of fossil wood blocks exposed at surface within the project area should be collected in the pre-construction phase by a professional palaeontologist for curation and display in the Addo Elephant National Park Interpretive Centre. · Any further substantial fossil remains (*e.g.* vertebrate bones, shells, fossil wood) encountered during excavation should be safeguarded *in situ* and reported to ECPHRA for possible mitigation by a professional Palaeontologist (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za). · A Chance Fossil Finds Protocol to be appended to the Construction EMPr and implemented should any substantial fossil remains be uncovered. · Fossil material must be curated in an approved repository (*e.g.* National Park Interpretive Centre, museum / university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA (2013).
Status and Significance (after mitigation)	Neutral (0). Possible loss of fossil heritage (negative impact) in part offset by new knowledge and palaeontological collections resulting from specialist palaeontological mitigation (positive impacts).

7. ACKNOWLEDGEMENTS

Ms Jenna Lavin of CTS Heritage, Cape Town is thanked for commissioning this palaeontological study and for providing the necessary background information. I am grateful to Mnr Altheo Botha of SANParks for introducing me to the study area as well as the Mnr Curt Jones and Ms Esther Howard for helpful discussions concerning new developments at the Addo Main Camp. Palaeontological assistance, logistical back-up as well as companionship in the field from Ms Madelon Tusenius are, as ever, highly appreciated.

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9. 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, Northwest, Gauteng, KwaZulu-Natal, Mpumalanga and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as 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">APPENDIX 1: CHANCE FOSSIL FINDS PROCEDURE: Family accommodation units and main entrance project areas, Addo Main Rest Camp, Addo Elephant National Park</td></tr>
<tr><td>Province & region:</td><td colspan="2">Eastern Cape, Sundays River Valley Municipality</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">ECPHRA (Contact details: Mr Sello Mokhanya, 74 Alexander Road, King Williams Town 5600; Email: smokhanya@ecphra.org.za).</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Kirkwood Formation (Uitenhage Group) fluvial mudrocks and channel sandstones. Neogene calcretes, younger alluvium, soils, surface gravels.</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Vertebrate bones and teeth (including dinosaurs), estuarine molluscs, fossil wood in Kirkwood “wood beds”.
Freshwater molluscs, calcretised trace fossils, possible bones and teeth of mammals, freshwater molluscs in Late Caenozoic alluvium.</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 Agency 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 Agency 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 Agency and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Agency, 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 Agency</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 Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.</td></tr>
</table>

APPENDIX 2: FOSSIL LOCALITY DATA

All GPS readings were taken in the field using a hand-held Garmin GPSmap 64s instrument. The datum used is WGS 84. Please note that:

- Locality data for South African fossil sites in *not* for public release, due to conservation concerns.
- The table does *not* represent all potential fossil sites within the project area but only those sites recorded during the July 2021 field survey. The absence of recorded fossil sites in any area therefore does *not* mean that no fossils are present there.

See Figure A1 for mapping of fossil sites on a satellite image of the project area.

Loc. No.	GPS data	Comments
029	33°26'46.41"S 25°45'8.04"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
030	33°26'46.67"S 25°45'8.23"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
031	33°26'46.86"S 25°45'8.40"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
032	33°26'47.19"S 25°45'8.39"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
033	33°26'47.49"S 25°45'8.23"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
034	33°26'47.43"S 25°45'8.53"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
035	33°26'47.58"S 25°45'8.37"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
036	33°26'47.43"S 25°45'8.70"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
037	33°26'47.49"S 25°45'8.66"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
038	33°26'47.67"S 25°45'8.73"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
039	33°26'47.63"S 25°45'8.10"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from

		Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
040	33°26'47.62"S 25°45'8.00"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
041	33°26'47.71"S 25°45'7.96"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
042	33°26'47.67"S 25°45'8.14"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
043	33°26'47.79"S 25°45'8.03"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
044	33°26'47.86"S 25°45'8.13"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
049	33°26'45.48"S 25°45'7.26"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
050	33°26'45.73"S 25°45'7.58"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
051	33°26'44.72"S 25°45'6.94"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.
052	33°26'44.38"S 25°45'6.69"E	Main Rest Camp, Addo Elephant National Park (family accommodation units project area). Block(s) of poorly-preserved wood in float, weathered out from Kirkwood Formation channel sandstone. Proposed Field Rating IIIC. Recommended pre-construction sampling of selected fossil wood blocks by professional palaeontologist for display in National Park Interpretive Centre.

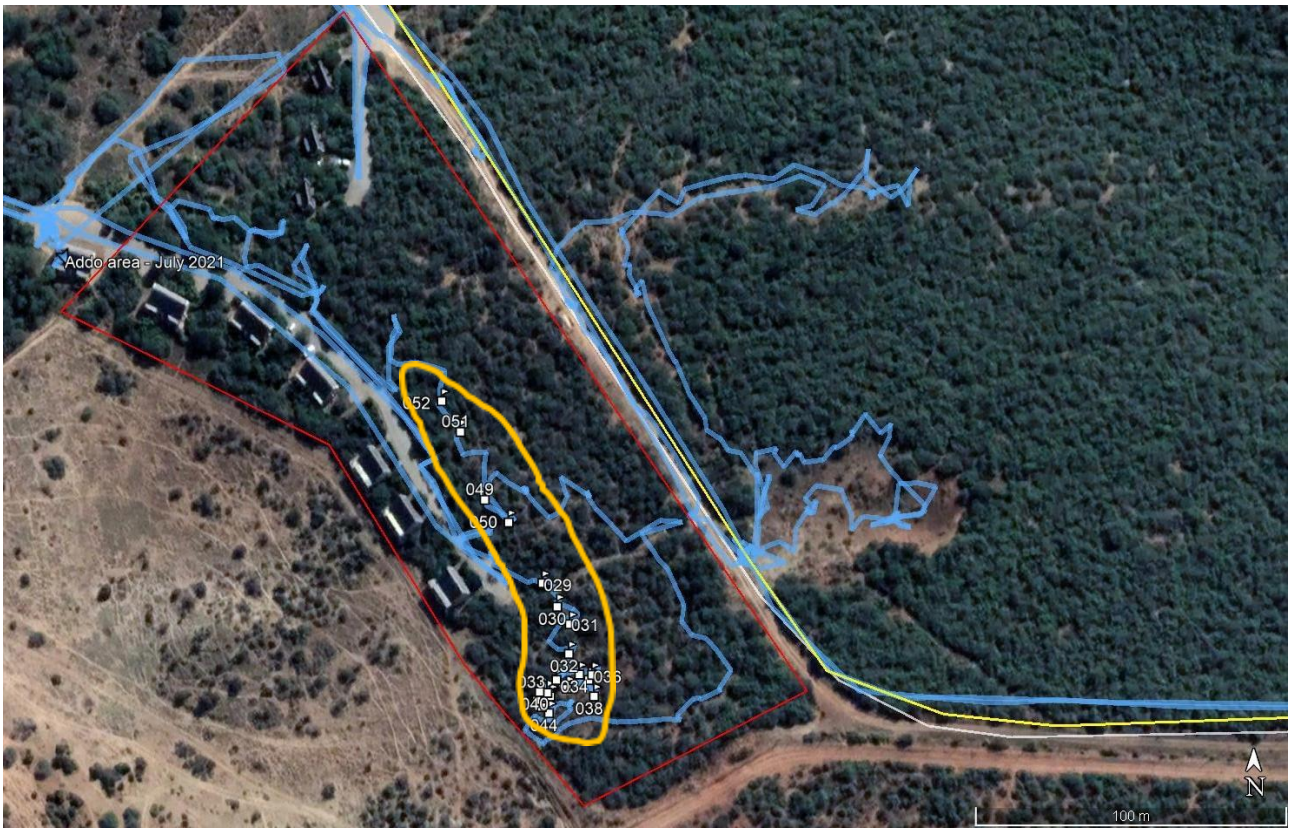

Figure A1: Google Earth© satellite image of the family accommodation units project area at the Addo Main Rest Camp showing survey tracks (blue) as well as waypoints for recorded surface blocks of poorly-preserved fossil wood from the Kirkwood Formation (numbered sites). The area enclosed by the orange dotted shape is likely to contain further unrecorded fossil wood samples at surface, while additional subsurface material may be present elsewhere at depth within the project area. It is recommended that a representative sample of the fossil material is collected by a professional palaeontologist in the pre-construction phase for display in the National Park Interpretive Centre.

APPENDIX 3: ADDO MAIN REST CAMP AND GATE UPGRADES - SCOPE OF WORK

1. ENTRANCE GATE, RECEPTION AND DAY VISITORS SITE

1.1 Reception

Design Philosophy

The existing Reception has become inadequate to cope with the increasing volume of visitors. The decision has been made to change the reception process and locate it at the Park entrance gate. A number of support staff will have to move to the new reception location. This frees up the existing reception building which will now function as a game drive booking / waiting area. The new entrance gate will also need to cater for increased visitor volumes.

Design Development

Due to increasing numbers of visitors the Reception needs to be much larger to cater for crowds quickly and efficiently. A new toilet block and office area will also need to be constructed. The buildings will need to create a plaza area to form waiting spaces.

Traffic flows and disabled access is also taken into consideration. The Entrance gate will be located in the same position as the existing but will have more vehicle lanes as well as a dedicated bus and technical delivery lane.

Building Areas

- Reception 177.5m²
- Toilets 114.2m²
- Office 114.6m²
- Entrance Gate 180m²
- Gravel Parking 112.5m²
- Paved Parking 374.2m²

Roadworks

- The construction of a 400m long asphalt surfaced road with barrier kerbs;
- Construction of a 40m gravel bypass road for service vehicles and staff use;
- The construction of a 110m long asphalt surfaced road to the day visitors' site;
- Construction of two entrance and two exit gates;
- Construction of 625m^2 concrete block paved parking areas for 24 public parking bays;
- Construction of a 300m^2 gravel parking area for 9 staff parking bays.

Stormwater Management

- Parking area stormwater will be managed by an 80m concrete pipe network; and
- The remainder of the stormwater will be managed by overland sheet flow.

Water Reticulation

- A potable and reclaimed water network will be constructed;

- Construction of 550m long 75mm diameter HDPE PE100 PN10 potable and fire water pipes;
- Construction of a 500m long 50mm diameter HDPE PE100 PN10 rising main will be constructed to fill a 200kl water storage tank with reclaimed water;
- Reinstatement of a dilapidated 200kl brick reservoir;
- Construction of one fire hydrant; and
- Construction of 550m long 75mm diameter HDPE PE100 PN10 potable and fire water pipes.

Sewer Reticulation

- Construction of a 300m gravity network consisting of 160mm uPVC Heavy Duty Solid Wall Class 34 sewer pipes and 1000mm diameter pre-cast concrete ring manholes; and
- A sewage pumpstation and 640m long 75mm uPVC HDPE PE100 PN10 rising main system will be used to connect the proposed sewerage system to the existing sewerage network; OR
- A septic tank and 640m long 75mm uPVC HDPE PE100 PN10 inverted siphon system will be used to connect the proposed sewerage system to the existing sewerage network.

Structural

- The construction of foundations for the reception building.

1.2 Day Visitor Area

Design Philosophy

The existing Day Visitor area is situated at the existing reception. This causes noise and congestion so needs to be moved to a new location.

Design Development

This area requires a toilet and dish washing up area and a number of picnic areas. 16 picnic sites will be provided, each with a fixed table and benches and a small braai. The Toilet block will provide male and female toilets and a communal wash area.

The Day visitor area is to be easily accessible from the main road and located within the main camp fenced area.

Building Areas

- Toilet Block 77.6m²
- Total Day Visitor Area 1200m²

1. **FAMILY CHALETS**

Design Philosophy

SANPARKS has identified the need to provide more family type accommodation at Addo Main Camp. Style and image is to be similar to the existing Park units but eliminating the thatch roof.

Design Development

The proposed chalet has 2 double bedrooms each with en-suite bathrooms. There is an open plan livingroom / kitchen and undercover patio with braai. Units are designed with open ceilings and large glass sliding doors.

They are all situated to take advantage of the views to the existing waterhole.

Universal access units will also be provided. Development is to be phased with Phase 1 consisting of 9 units and Phase 2 of 10 units. A communal swimming pool is also planned in this area.

Building Areas

- Swimming Pool 32m²
- Individual Unit 115.88m²
- Total of 19 units 2201.72m²

Roadworks

- The construction of 4m wide, 550m long asphalt surfaced roads; and
- Construction of 19 concrete block paved driveways, each 3m wide and approximately 20 - 30m long.

Stormwater Reticulation

- Roads will be sloped with the contours so as to manage stormwater via sheet flow.

Water Reticulation

- Construction of a potable and reclaimed water network to the chalets;
- Construction of a 570m long, 75mm diameter HDPE PE100 PN10 ring main will be provided for potable water;
- 19 no. off 25mm diameter HDPE connections will be made to chalets with an average length of 25m;
- Construction of a 570m long, 75mm diameter HDPE PE100 PN10 reclaimed ring main will be provided for firefighting and flushing of toilets;
- 19 no. off 25mm diameter HDPE PE100 PN10 connections will be made to chalets with and average length of 25m; and
- Construction of two fire hydrants are made for this area.

Structural

- The construction of foundations for the chalets.