

Palaeontological impact Assessment for proposed mixed-use housing development, Kwanobuhle Extention 11, Uitenhage

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Background

SRK Consulting (SRK) was appointed by the Nelson Mandela Bay Municipality (NMBM) to conduct the Environmental Impact Assessment process for a proposed mixed-use housing development in KwaNobuhle Extension 11 in the Uitenhage area, within the NMBM.

The study site, which extends over approximately 143 hectares, is proposed for mixed-use development and includes:

- Residential stands of different housing categories – approximately 2575 stands covering 63 hectares.
- Business stands – approximately 5 stands covering 5 hectares
- Community facilities covering about 12 hectares
- Mixed use areas of 1 hectare
- Public open space of 22 hectares
- And streets covering a total of about 36 hectares

The necessary internal roads, bulk water, stormwater and sewerage services infrastructure will be upgraded and installed as required for the proposed development.

Stratigraphy, Age, Origin and Palaeontology of Strata

The study area is underlain by sequences of strata assigned to very different aged Periods in geological history (Figure 1). Strata in the south of the study area were deposited as part of the Cape Supergroup of rocks and comprise early Devonian aged sediments of the 400 million year old Ceres Subgroup (Bokkeveld Group, Cape Supergroup) (Dc). Those within the study area have further been subdivided by the Geological Survey into the shaly Gydo Formation (Ceres Subgroup, Bokkeveld Group, Cape Supergroup) (Dga) and the sandy Gamka Formation (Ceres Subgroup, Bokkeveld Group, Cape Supergroup) (Dg).

Far more recently during the Cretaceous (142 to 65 million years ago) a number of faults systems (resulting from the breakup of the supercontinent Gondwana), opened up along the coastline of southern Africa. Slow downward collapse of large chunks of continental margin resulted in the formation of a number of shear sided basins along the coast of southern Africa. Those of the Algoa Basin were filled with sediments that became the semi consolidated strata of the Uitenhage Group. Strata assigned to the Enon (Je) and Kirkwood Formations (J-Kk) of the Uitenhage Group underly the study area.

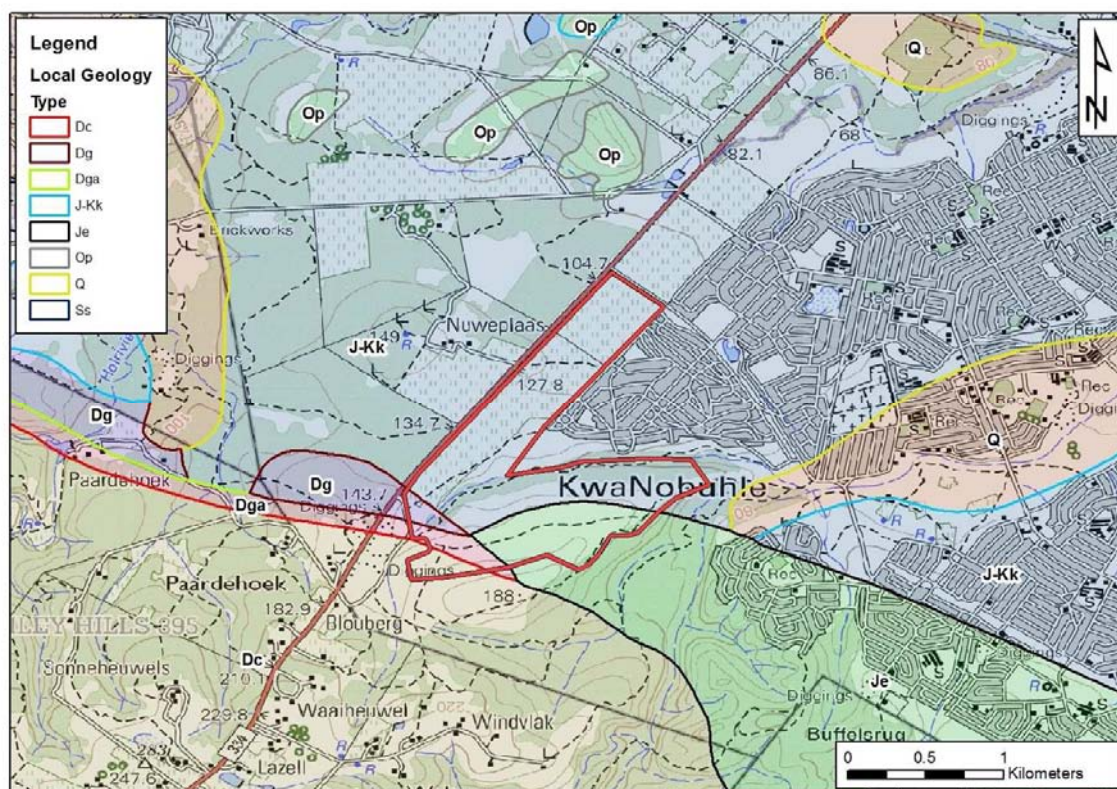


Figure 1. Geological map: study area outlined in red at centre, Dc = Ceres Subgroup (Bokkeveld Group), Dg = Gydo Formation (Ceres Subgroup), Dga = Gamka Formation (Ceres Subgroup), Je = Enon Formation (Uitenhage Group), J-Kk = Kirkwood Formation (Uitenhage Group), Q = Quaternary cover .

Rocks of the **Cape Supergroup** represent sediments deposited in the Agulhas Sea, which opened to the south of the current southern African landmass in response to early rifting between Africa and South America. The layered strata derived from these sediments are divided into 3 distinct Groups. The lowermost of these is the Table Mountain Group. It consists of quartzitic sandstones derived from coarse sands deposited within the Agulhas Sea, and along its coastal plane. It was deposited during the Ordovician, Silurian and earliest Devonian Periods, approximately 500-400 million years ago.

The Bokkeveld Group, which is represented in the study area, constitutes the middle subdivision of the Cape Supergroup and conformably overlies the Table Mountain Group. Bokkeveld strata consist largely of shales and thin interbedded sandstones derived from marine continental slope muds of early to mid Devonian (+/- 400 - 370 myo) age.

The Witteberg Group (Cape Supergroup) in turn overlies the Bokkeveld Group.

GROUP	SUBGROUP	FORMATION	THICKNESS (metres)	AGE
WITTEBERG	LAKE MENZ SUBGROUP	WAAIPOORT	35	WISEAN
		FLORISKRAAL	70	TOURNASIAN
		KWEEKVLEI	50	
		WITPOORT	310	FAMMENIAN
	WELTEVREDE SUBGROUP	SWARTRUGGENS	450	FRASNIAN
		BLINKBERG	80	
		WAGEN DRIFT	70	
BOKKEVELD	BIDOUW SUBGROUP	KAROOPOORT	50	GIVETIAN
		OSBERG	55	
		KLIPBOKKOP	170	
		WUPPERTAL	65	
		WABDOMBERG	200	
	CERES SUBGROUP	BOPLAAS	30	EIFELIAN
		TRA-TRA	85	
		HEX RIVER	100	
		VOORSTEHOEK	115	
		GAMKA	135	
		GYDO	160	
TABLE MOUNTAIN	NARDOUW SUBGROUP	RIETVLEI	150	PRAGIAN
		SKURWEBERG	206	SILURIAN
		GODINI	120	
	CEDARBERG	120	HIRNANTIAN	
	PAKHUIS	40	ORDOVICIAN	
	PENINSULA	1550		
	GRAAFWATER	150		
	PIEKENIERSKLOOF	390		

Figure 2. Stratigraphy of Ordovician to Carboniferous rocks of the Cape Supergroup. Red line represents strata affected by the proposed development

Cape Supergroup strata were already ancient at the time of the opening of the Algoa Basin, (in which the **Uitenhage Group** sediments were deposited), and the cliffs defining the south

western edge of the Algoa basin passed through the southern part of the study site. This basin margin is represented by the contact between the resilient Cape Supergroup strata and the less well consolidated Uitenhage Group Strata, which filled the basin (see Fig. 1). As is reflected on the geological map (Figure 1), coarse pebbly conglomerates assigned to the Enon Formation (Uitenhage Group) formed in close proximity to the fault scarp, where mountain valleys disgorged their contents into the basin. Further from the fault scarp rivers meandering across the coastal plain towards the sea deposited the muddy sands that gave rise to the Kirkwood Formation (Uitenhage Group). A third formation deposited in the Algoa Basin, but which is not represented within the study area, is the Sundays River Formation (Uitenhage Group). This was simultaneously deposited within a marine setting.

The Enon Formation is generally unfossiliferous however the Kirkwood Formation is South Africa's primary source of Cretaceous Dinosaur fossils. It was in Kirkwood Formation rocks, on the banks of the Bushman's River that South Africa's first dinosaur discovery was made in 1845 by William Atherstone and his wife. Originally dubbed "Cape Iguanodon" the fragmentary remains have, more recently been shown to be those of a *Stegosaurus*. Remains of two types of Sauropod Dinosaur, as well as a Theropod Dinosaur and an Ornithomimid Dinosaur have subsequently been collected from Kirkwood Formation strata at various localities. Recent research has also revealed the remains of a primitive lizard, a type of crocodile and a primitive early mammal. These remains are sometimes found in association with fossil logs and chunks of fossil wood, which are fairly common in Kirkwood Formation rocks. Associated mudstones have yielded a range of finely preserved plant leaves and fructifications, including those of a number of species of ferns, cycads and conifers

Dr Billy de Klerk of the Albany Museum has recently collected fragments of fossil bone and a very large dinosaur vertebra from the Kirkwood Formation adjacent to Kwanobuhle, a little to the south east of the study area (*pers comm.*, 2011)

Site visit

The study area was systematically surveyed by vehicle and on foot on the 28th and 29th of July.

A number of small outcrops were found in the south of the study site, in the area mapped as belonging to the Gamka Formation (Ceres Subgroup, Bokkeveld Group, Cape Supergroup). Though quite plausibly belonging to the Ceres Subgroup it is more likely that they belong to the Gydo Formation (Ceres Subgroup, Bokkeveld Group, Cape Supergroup), as they consist of fine grained shaly mudstone. No clastic fossils were found, however the shale was densely packed with vermicelli-like feeding traces. A series of quarries extending from just outside the south easterly limit of the study area, for 600 metres parallel to the R334 was found to be comprised of similar shaly mudstones with characteristic vermicelli-like traces.



Figure 3. Abundant small trace fossils in Ceres Subgroup (Bokkeveld Group, Cape Supergroup) strata in the south of the study are.

In most of the study area, the outcrop was found to be obscured by soily (muddy) alluvium. To the west of Kwanobuhle the alluvium has been farmed and a small vegetable growing project is active in this area (Fig. 4. left)

It was hoped that exploration of the valley to the south of Kwanobuhle might be more palaeontologically productive, however weathered sediments and soil obscure the bedrock here too (Fig. 4. *right*). A reddish hue to much of the soil indicates that in many places the Kirkwood Formation lies just beneath the surface. Road cuttings in the area demonstrate the presence of soils shallowly covering the Kirkwood Formation strata (Fig. 5).



Figure 4. *left*. General view of the study area from the slope overlooking the south west corner, Kwanobuhle on hill in background. *right*. Soily alluvium in the valley south of Kwanobuhle.



Figure 5. Development of thin soil cover over pinkish Kirkwood Formation sediments seen in a roadcutting near the study area.

Conclusions and Recommendations

Although it is possible that Bokkeveld Group strata underlying the study area may contain marine fossils this is considered unlikely as all outcrops studied in and adjacent to the study area were unproductive.

It is also unlikely that any palaeontological material will be encountered in the Enon Formation as the high energy environment in which it formed did not favour the preservation of fossils.

There remains a reasonable chance that dinosaur remains occur in the sediments of the Kirkwood Formation, beneath a thin layer of soil

It is therefore recommended that after the bulk service trenches have been dug (and before they have been refilled) they should be inspected by a palaeontologist to establish whether or not dinosaur remains have been disturbed and to collect or arrange excavation thereof.

This will probably be the last opportunity for the scientific community to obtain material from this part of the (very small) Algoa Basin.