HERITAGE IMPACT ASSESSMENT
A PROPOSED PEBBLE BED MODULAR REACTOR
FARM DUYNEFONTEIN 34 (KOEBERG)
WESTERN CAPE PROVINCE

A specialist study component of an EIA
Prepared for:
Arcus Gibb (Pty) Ltd

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EXECUTIVE SUMMARY

The Archaeology Contracts Office (ACO) of the University of Cape Town was appointed to assess the heritage impact of the proposed construction of a Pebble Bed Modular Reactor for research, development and demonstration purposes on the Farm Duynefontein 34, close to the site of Koeberg nuclear power station. The ACO team was requested by Arcus Gibb (Pty) Ltd on behalf of Eskom Holdings to assess the possible impacts that the following activities would have on cultural heritage:

- An integrated reactor building and generator building a construction laydown area on the eastern side of the R27.
- A generator and associated electrical and auxiliary power plant;
- A services building;
- An ancillary building;
- A cooling water plant building; and
- An administration office building.
- The estimated total footprint of the development post-construction is 9 ha. This includes a transmission line, internal roads and a temporary deviation of the road (R27) at the Modder River Bridge (just north of Ganzekraal).

The study was carried out in terms of the spirit of section 38 of the National Heritage Resources Act and is presented as a specialist report in the overall EIA for the study.

Impact assessment

The study has revealed that the area is potentially rich in buried archaeological and palaeontological resources that range from Pleistocene archaeology and palaeontology to ancient Pliocene and Miocene palaeontology of the deeper sediments.

The digging of deep excavations to a depth of 23 m for the PBMR will impact these fossiliferous deposits, however careful mitigation could have positive scientific benefits. None of the other activities associated with the proposed activity are likely to result in negative impacts to heritage, either due to the shallow depth of impact or the fact that much of the land involved has been subject to prior disturbance.

Fatal flaws

There are no fatal flaws.

Conclusion and recommendations

The proposed activity is considered to be acceptable in heritage terms, however heritage management action is required during the bulk excavations for the PBMR. In summary, given that the deep excavations for the PMBR will penetrate the full sequence of Cenozoic geology in this area of the west coast, it is essential that an

archaeologist and palaeontologist familiar with the Holocene – Pleistocene archaeology and palaeontology of the west coast be appointed to the project. The specialists will need to:

- Monitor excavations at a frequency of visits deemed appropriate by him/her.
- Be afforded opportunity and budget to record the stratigraphic profiles within the excavation.
- Be afforded the opportunity and budget to sample the sequence of fossil faunas and/or archaeology that will be exposed by the proposed activity.
- Be given all assistance by the proponent to carry out the work to the highest standards, and as quickly as is reasonable.

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GLOSSARY

Archaeology: *Remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.*

Calcrete: *A soft sandy calcium carbonate rock related to limestone which often forms in arid areas*.

Cenozoic: *The most recent of the three major geological times periods ongoing since 65 million years ago.*

Fossil: *Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.*

Geophysical survey: *A scientific study generally conducted by geologists and sedimentologists to describe and assess the below ground conditions of a given area.*

Heritage: *That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act of 2000.*

Holocene: *The most recent geological time period which commenced 10 000 years ago.*

Palaeontology: *Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.*

Pleistocene: *A geological time period (of 3 million – 20 000 years ago).*

Pliocene: *A geological time period (of 5 million – 3 million years ago).*

Miocene: *A geological time period (of 23 million - 5 million years ago).*

SAHRA: *South African Heritage Resources Agency.*

Structure (historic:) *Any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith. Protected structures are those which are over 60 years old.*

Varswater Formation: *Sediments laid down under estuarine circumstances by the proto-Berg River during the Pliocene. Certain members of this formation are highly fossiliferous.*

Velddrif Formation: *Shelly estuarine sands of the last interglacial (Pleistocene) that can be consolidated into calcrete.*

Wreck (protected): *A ship or an aeroplane or any part thereof that lies on land or in the sea within South Africa is protected if it is more than 60 years old.*

1 Introduction

The Archaeology Contracts Office of the University of Cape Town was appointed by Arcus Gibb (Pty) Ltd on behalf of the proponent, Eskom Holdings to conduct a heritage impact assessment (HIA) as part of an Environmental Impact Assessment for the proposed Pebble Bed Modular Reactor (PBMR) which is to be located on the existing Koeberg site at Duynefontein 34, Western Cape Province (Figure 1). The existing Koeberg nuclear power station is located north of the proposed site. The study not only involves the proposed site of the plant itself, but also the various peripheral aspects of the proposed activity. Laydown areas including one on the eastern side of the R27 will be required along with access roads, and as well as modifications to the R27 road to facilitate the transporting of ultra-abnormal loads from the Port of Saldanha.

A previous environmental impact assessment process was completed for a proposed 320 MW PBMR on the same site, however this was successfully challenged in court by Earth Life Africa which has necessitated an entirely new EIA co-coordinated by Arcus Gibb (Pty) Ltd, of which this study forms part. The current proposal is for a 400 MW demonstration unit to be constructed on the same site. Hence many of the findings of the previous EIA study remain relevant and have been consulted.

1.1 Background Information

"To address electricity supply needs, Eskom considers electricity generation technologies that are commercially proven as well as those that are not yet commercially proven or have not previously been applied in the South African context. Besides developing more conventional power stations, Eskom undertakes research, development and demonstration (RD&D) of alternative and innovative technologies to evaluate their viability in the South African energy demand and supply context." (General terms of Reference for Specialists 2007).
Examples of such RD&D projects are the Klipheuwel Demonstration Wind Energy Facility commissioned in 2003, (a full sized wind generation facility is planned north of the Olifants River), the Underground Coal Gasification project first constructed in 2005 near Amersfoort, and a proposed concentrated solar thermal power plant in Upington (General terms of Reference for Specialists 2007).

1.2 PBMR

PBMR shows great promise in terms of revolutionising the generation of electricity through nuclear power, however in Germany, where the technology was pioneered, political decisions brought RD&D to a halt and closure of that country's PBMR. South African and China have resumed development of the technology (PBMR 2005).

"The PBMR is based on nuclear energy technology. At the heart of the process is a vertical steel reactor pressure vessel, which has a 6.2 m inner diameter, and is approximately 27 m high. The reactor pressure vessel contains and supports a metallic core barrel, which contains pebble fuel spheres. The PBMR fuel consists of particles of enriched uranium dioxide coated with silicon carbide and carbon. The particles are encased in graphite to form a fuel sphere or pebble about the size of a billiard ball. When fully loaded, the core would contain approximately 452 000 fuel spheres" (General terms of Reference for Specialists 2007).

The heat generated by the nuclear reaction within the reactor pressure vessel (housed in the nuclear island) will be used to heat helium which in turn will drive helium powered turbines coupled to generators which will be housed in a generator building. After passing through the turbines, the helium is cooled and recycled back to the reactor vessel for reheating. The hot pressurised gas is then returned to the turbines, hence the process is cyclical. Building of the facility will involve the placement and housing of very large components and machinery which means that extensive local disturbance of the landscape along with substantial excavations to a depth of 23 m is anticipated (PMBR 2006).

The according to PBMR (2006) the potential advantages of PBMR technology are:

- Increased inherent safety
- More economical use of nuclear fuel (less threat in terms of nuclear proliferation)
- Non-reliance of complex cooling systems (which means that units can be situated away from the coast)
- Potentially small size and simplicity of operation
- Production of clean cost effective energy.

1.3 Terms of reference

Arcus Gibb (Pty) ltd required that the specialist consultant design and execute a study to establish the answer to the following question:

"Are there any archaeological and/or historical resources on the proposed site of the PBMR DPP? What protection and management measures should be put in place to protect the above resources should they exist?"

The specialist team must identify all areas of potential archaeological or heritage significance and conduct an assessment of the impact of the proposed activity on such resources. All identified heritage occurrences must be recorded in a register with co-ordinates. Mitigation measures for preventing and/or minimising the impact must be proposed and recommended for inclusion in the EMP.

The study must comply with the assessment of significance criteria as indicated in the regulations of Heritage Western Cape and as prescribed in the National Heritage Resources Act, 1999 (Act 25 of 1999).

In fulfillment of the above requirement the Archaeology Contracts Office (ACO) has undertaken to complete the following tasks

- Assess the potential (heritage and archaeological) impacts associated with the construction and operation of the proposed PBMR
- Provide an assessment of the site as identified during the scoping process as well as proposed alternatives for related activities such as laydown yards and associated infrastructure.
- Assess the no-go alternative
- Indicate whether the sites are acceptable in terms of any significant identified heritage issues.

- Recommend appropriate and practical mitigation measures to minimise the negative impacts and maximise potential benefits associated with the proposed activity.

1.4 The proposed activity

The proposed activity is the construction of a 400 MW demonstration PBMR along with associated infrastructure as detailed below.

Building and Infrastructure Requirements

- An integrated reactor building and generator building;
- A generator and associated electrical and auxiliary power plant;
- A services building;
- An ancillary building;
- A cooling water plant building; and
- An administration office building.
- The estimated total footprint of the development post-construction is 9 ha (including roads, transmission lines and laydown areas).

Additional Infrastructure Requirements

The following infrastructure is required in addition to that for the PBMR DPP:

- A 132 kV transmission power line to be constructed between the proposed PBMR DPP and the Koeberg HV Switch Yard;
- The road from the Koeberg Power Station to R27 turnoff requires improvement of the intersection
- Construction of internal roads on the PBMR DPP site for access to the PBMR DPP;
- Deviations on the road from Saldanha Harbour to the proposed site which are required for the transportation by road of large components from the Port of Saldanha. The road will require deviation in specific short portions to avoid damage to existing infrastructure (overhead lines and bridge structures). These deviations will be around the Modder River Bridge, a conveyor close to the Saldanha Harbour and the existing 132 kV power line at Koeberg;
- Construction of a laydown area across R27 turnoff to Koeberg.

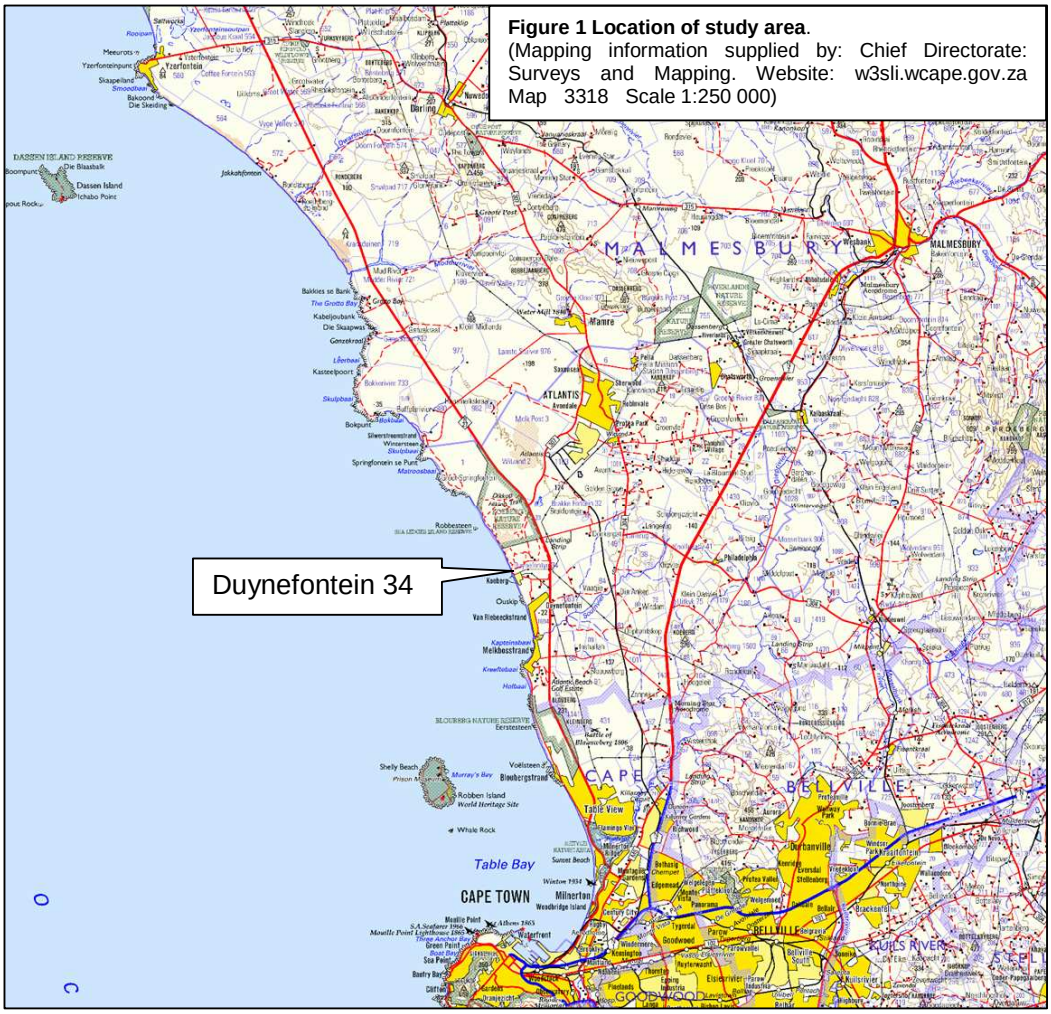


Figure 1 Location of study area.
(Mapping information supplied by: Chief Directorate: Surveys and Mapping. Website: w3sli.wcape.gov.za Map 3318 Scale 1:250 000)

1.5 Project alternatives

The Revised Final Environment Scoping Report (RFESR) compiled by the previous consultants scoped out all alternatives except the no-go alternative. This means that the Koeberg site as indicated on Figure 2 is the only locality under consideration,

2 The study approach

Physical field survey of the affected areas and review of existing information forms the basis of this assessment. A sub-consultant palaeontologist has been contracted to assist with the assessment of palaeontological heritage resources, while an archival research study has been undertaken to establish if the site has any recent historical significance.

2.1 Legislative framework

The basis for all heritage impact assessment is the National Heritage Resources Act 25 (NHRA) of 1999, which in turn prescribes the manner in which heritage is assessed and managed. In the case of Environmental Impact Assessments the guidelines published by the Provincial Department of Environment Affairs and Tourism are directly based on the provisions of the National Heritage Resources Act (Winter and Baumann 2005).

Loosely defined, *heritage is that which is inherited*. The National Heritage Resources Act 25 of 1999 has defined certain kinds of heritage as being worthy of protection, by either specific or general protection mechanisms. In South Africa the law is directed towards the protection of human made heritage, although places and objects of scientific importance are covered. The National Heritage Resources Act also protects intangible heritage such as traditional activities, oral histories and places where significant events happened. Generally protected heritage which must be considered in any heritage assessment includes:

- Cultural landscapes
- Buildings and structures (greater than 60 years of age)
- Archaeological sites (greater than 100 years of age)
- Palaeontological sites and specimens
- Shipwrecks and aircraft wrecks
- Graves and grave yards.

Section 38 of the NHRA requires that Heritage Impact Assessments (HIA's) are required for certain kinds of development such as rezoning of land greater than 10 000 sq m in extent or exceeding 3 or more sub-divisions, or for any activity that will alter the character or landscape of a site greater than 5000 sq m. "Standalone HIA's" are not required where an EIA is carried out as long as the EIA contains an adequate HIA component that fulfils Section 38 provisions.

Heritage Western Cape (HWC) is responsible for the management and protection of all Provincial Heritage sites (grade 2), generally protected heritage and structures (grade 3a-grade 3c) in the Western Cape Province. In terms of this particular project they are an important commenting authority but are not responsible for final compliance as this study forms part of an EIA process for which the Department of Environment Affairs and Tourism is the compliance authority in terms of section 38.10 of the National Heritage Resources Act.

2.2 Information base

The study has been assisted by information and experiences obtained when the existing Koeberg Power Station was built and the body of knowledge, especially geological, that has been obtained from the extensive studies which are necessary for establishing the safety of the site (Eskom 2006). Furthermore, recent archaeological excavations by an international team led by Prof R.G. Klein of Stanford University, California, USA has provided valuable insights into the Pleistocene archaeology and palaeontology of the area. Within the reference collection of our own organisation are numerous reports on studies conducted in the Saldanha Bay, Koeberg and Atlantis areas. In short, information from both published and unpublished sources are readily available. Dr Graham Avery who provided information for the previous EIA has been consulted.

Physical survey of the affected area has been carried out to evaluate the baseline situation, however the bulk of available knowledge of the site and immediate environs is based on available data and accumulated local experience.

2.3 Assumptions

A characteristic of the Koeberg area is that the most important archaeological and palaeontological heritage are mainly buried below the ground surface. This means that any assessment of impacts is based on existing information and published sources, which is fortunately relatively good. It is unfeasible at this early stage in the project to conduct trial excavations to the full depth that will be required to accommodate the lowermost structures of the PBMR which are up to 23 m below sea level. This means that the assessment of certain impacts cannot be scientifically verified, but a rather anticipated based on the solid body of evidence that exists.

2.4 Limitations

Physical assessment of archaeological and palaeontological heritage was based on surface observations only. On the site of the proposed laydown area to the east of the R27, thick vegetation inhibited ground surface visibility. No trial excavations were conducted during this study; however trial excavations on the PBMR site were inspected by Iziko Museum archaeologist Dr Graham Avery during the previous EIA. The study has also drawn on the knowledge of Prof Richard Klein (Stanford University, California, USA) who conducted research at at Duinefotein in 1973 and observed the deep excavations for the existing power station. The area identified for a potential alternative laydown site is too big to conduct a comprehensive survey of, however parts of the broader Koeberg site are well known to members of the ACO allowing us to make a broad brush assessment. A site for the proposed construction camp has not been identified as yet, so this has not yet been assessed.

2.5 Methodology

A detailed literature review was conducted to establish the kinds of heritage material that could be affected by the proposed activities. This was followed up by ground-proofing of undisturbed land that would be involved. This, as standard practice, involves recording of any heritage material, establishing position using a hand-held GPS receiver (where necessary). The proposed PMBR site, laydown areas and changes to the R27 provincial road to the Port of Saldanha were inspected. John Pether, palaeontologist has been appointed to review palaeontological information that was obtained from the deep excavations for the Koeberg Nuclear Power Station which is expected to be similar to that at the proposed PMBR site close by.

3 Description of the study area, context and setting

The farm Duynefontein 34 is the site of the existing Koeberg power station, its administrative offices, stores, workshops and road infrastructure. Locally, the two reactor and generator buildings dominate the built environment of the area being visible from Table Mountain and the Cape Town Foreshore almost 27 km to the south. This enormous industrial complex lies in a rural context outside of the physical urban edge of Cape Town and is surrounded by a development exclusion zone (radius of 5 km) which makes up much of the Koeberg Nature Reserve (situated on farm Klein Springfontein to the north). The undeveloped areas, once heavily infested by stands of alien vegetation has been rehabilitated by Eskom and function as a well stocked private nature reserve with high levels of bio-diversity and large expanses of Strandveld and coastal Fynbos. The public are permitted into the reserve to view game, flora and walk the coastal hiking trials that have been created.

Generally the area consists of coastal flatlands. There are active dunes systems (recent Witsand Formation) on the northern side of the reserve. Immediately north of the Koeberg power station security fence is a large stable

dune field which is known to contain archaeological and palaeontological sites. Inland of the coastal dunes lies a flat coastal plain which eventually transforms into a mosaic of alien infested undeveloped or agricultural land east of the R27. Blaauberg Hill some 9 km to the south, is the only prominent hill in the immediate area. Immediately to the south of the study area (1.4 km) is the settlement of Duynefontein, originally the construction and staff town for Koeberg Power Station but now privatised. This represents the most northerly encroachment of the Cape Town urban edge.

The site identified for the PBMR is a portion of land immediately to the south of the Koeberg power station nuclear reactors and generator buildings. The structure will not encroach on the coastal dunes but is located inland of them. The land is presently undeveloped, and covered with low vegetation. At the time of the site inspection zebra and springbok were found grazing in the area.

The proposed laydown area (1) is situated on the eastern side of the R27 on a sandy flat portion of land that has no particular use (apart from firewood cutting) and is heavily infested with alien vegetation. A second section of the laydown area is situated immediately west of the PMBR site just inland of the coastal fore dunes.

The R27 is the main provincial road that connects the City of Cape Town with the four main towns of the Vredenberg Peninsula (Langebaan, Saldanha, Vredenberg and Veldrift). The Port of Saldanha is the Provinces' only deep water terminal with multi-purposes capability and a relatively un-impeded road linkage to Koeberg. It is envisaged that ultra-heavy loads will be transported down the R27 from the Port of Saldanha rather than from Cape Town as the road system out of the city is too constricted and complex for the purpose. Some changes will need to be made to the R27 to accommodate the very large vehicles that will be required. The R27 is a recent person- made construction (built in the 1970's) and is not protected by the National Heritage Resources Act.

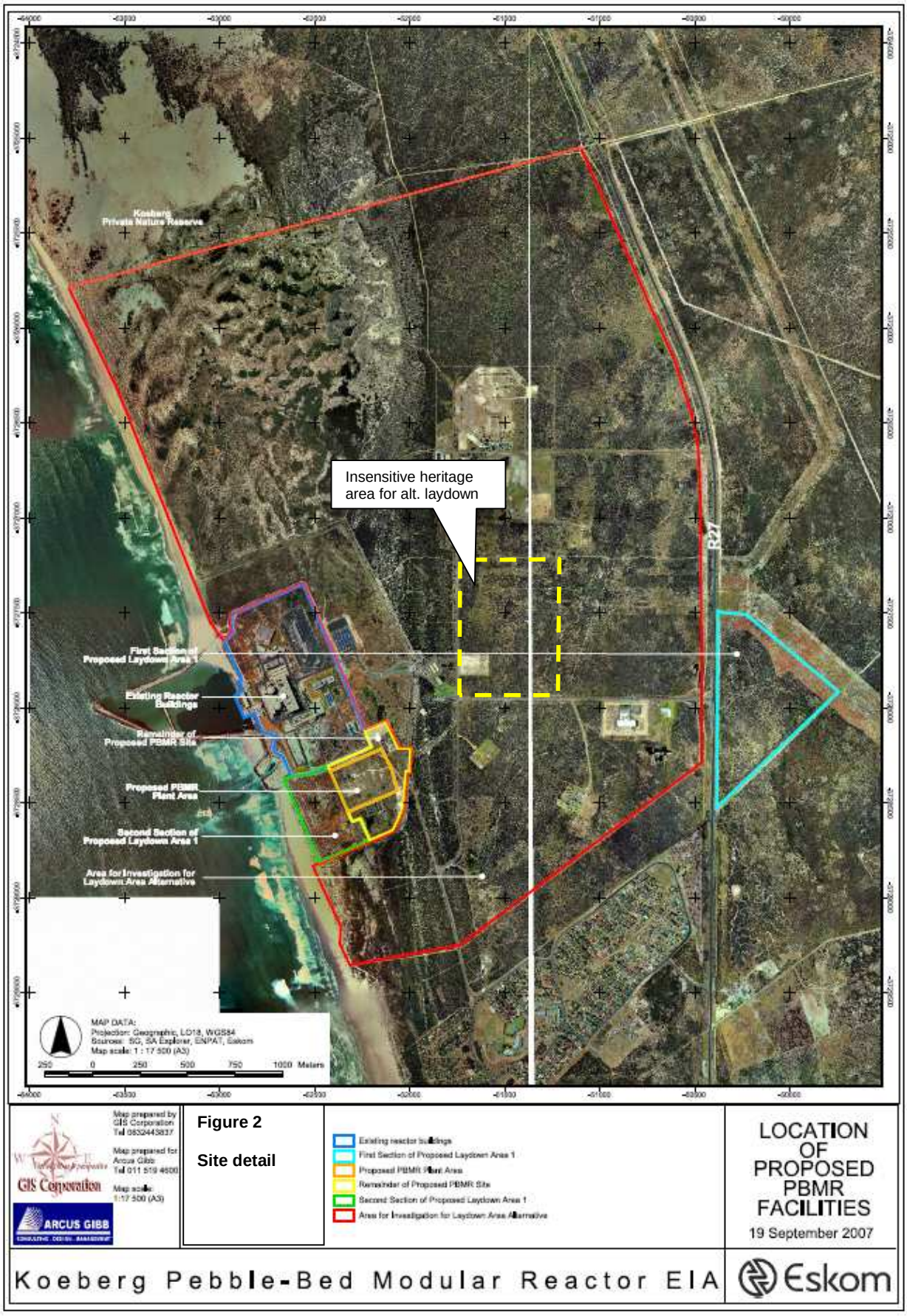
3.1 Heritage context of the proposed activities and identification of heritage resources

3.1.1 The regional heritage context

In recent years the west coast has become famous for its fossil wealth. Just inland of Langebaan is the largest Miocene (5-6 million years old) fossil deposit in the world, parts of which are on display at the West Coast Fossil Park (Hendey 1982). This material was deposited in sandbar sediments at the mouth of the proto-Berg River (an ancient river and estuary that was the precursor to the Berg River), the course of which changed over the millennia in response to sea level changes. The excavation for the existing Koeberg power station exposed fossiliferous formations of similar age which were reported on by Rogers (1980). Close to Hopefield, further inland, are the Pleistocene fossil beds at Elandsfontein (last million years) famous for the discovery of the early human species *Homo ergaster* (Saldanha man). On the edges of the Langebaan lagoon Dr Dave Roberts and Dr Lee Berger discovered the 200 000 year old footprints of an early modern human fossilized in calcrete sediments. At Hoedjiespunt Prof. John Parkington has excavated on the site of an ancient hyena lair where skull fragments and teeth of an early human were found showing that parts of the body of this unfortunate person were consumed by hyenas more than 300 000 years ago (Parkington 2006). Nearby, fossilized within the calcretes and aeoleanites are shell fish, animal bone, ashy hearths of people who lived in the area more than 100 000 years ago (Parkington, Poggenoel, Halkett and Hart 2004). Further south at Yzerfontein, Prof

Richard Klein, Iziko Museums of Cape Town and the ACO team has been conducting an ongoing project on a Middle Stone Age shell midden, one of the earliest known (Halkett et *al.* 2003). In 1973, Richard Klein discovered the archaeological site known as Duinefontein 2 – fragments of fossil animal bone which had been un-earthed during trial excavations for South Africa's first nuclear power station. The archaeological site Duinefontein 2 was extensively excavated between 1998 and 2003. It produced a wealth of Pleistocene fauna (about 300 000 years old) and resulted in numerous publications of the findings in international journals, putting the Koeberg Private Nature Reserve firmly on the map as a place of high archaeological and palaeontological significance (Klein et *al.* 1999, Cruz-Uribe *et al.* 2003).

Late Stone Age sites (the heritage of the Khoekhoen and San peoples of Southern Africa) are relatively numerous along the Western Cape Coast and can be observed close to any area of rocky shoreline where shell fish and other marine resources could be exploited (Parkington 2006). These kinds of sites, which are mostly less than 5000 years old, and characterized by piles of shellfish, stone artefacts and from time to time pottery, have been observed in the Koeberg Nature reserve (all though no comprehensive survey has been completed). Unfortunately, outside of any area that is either isolated or protected, shell middens have suffered from disturbance caused by people, construction activities, property development and off-road vehicles to the extent that a once common (but finite) heritage resource has become alarmingly depleted. Intact shell middens have become highly valued heritage resources with several having been identified recently for Provincial Heritage Site nomination.


Insensitive heritage area for alt. laydown
Koeberg Private Nature Reserve
R27
First Section of Proposed Laydown Area 1
Existing Reactor Buildings
Remainder of Proposed PBMR Site
Proposed PBMR Plant Area
Second Section of Proposed Laydown Area 1
Area for Investigation for Laydown Area Alternative
MAP DATA:
Projection: Geographic, LO18, WGS84
Sources: SG, SA Explorer, ENPAT, Eskom
Map scale: 1 : 17 500 (A3)
250 0 250 500 750 1000 Meters
Map prepared by GIS Corporation
Tel 0832443837
Map prepared for Arcus Gibb
Tel 011 519 4600
Map scale: 1:17 500 (A3)
GIS Corporation
ARCUS GIBB
Figure 2
Site detail
Existing reactor buildings
First Section of Proposed Laydown Area 1
Proposed PBMR Plant Area
Remainder of Proposed PBMR Site
Second Section of Proposed Laydown Area 1
Area for Investigation for Laydown Area Alternative
LOCATION OF PROPOSED PBMR FACILITIES
19 September 2007
Koeberg Pebble-Bed Modular Reactor EIA
Eskom

4 Findings

4.1 Description of heritage that may be affected by proposed activities

4.1.1 Recent history of the farm Duynefontein 34

The coastal regions of the southwestern Cape were occupied in pre-colonial times by peoples who exploited marine resources for their livelihood. Human occupation of the coast is archaeologically reflected in the thousands of shell midden sites and rock shelter deposits. Herder sites, such as at Kasteelberg, show occupation between 1800 and 1600 years ago. European explorers had contact with many of the Khoekhoen groups along the coast. These peoples included the CochoqQua, whose territory stretched from Saldanha Bay to Vredenburg, and the ChariGuriQua or GuriQua who occupied the lower Berg River area, St Helena Bay and points around Piketberg. Shell middens have been observed locally at Blouberg Beach, Atlantic Beach and within the Koeberg Nature Reserve. The implications of this are that shell midden material could be encountered in the form of surface archaeological sites, or as buried lenses anywhere within the study area.

In the archival documentation there is reference to a Hermanus Dempers as 'inhabitant and owner of the 'Opstal' on the loan place named Duynefontein' (CA CO 3985 ref, 117, CO 3887 ref 79).

Dempers became the owner of the then extensive property in 1799, but it is unclear who the first grantee was. It is indicated in a complaint letter lodged by Dempers (dated 26 Sept 1811) that 'tenants' were cutting wood that belonged to him. These tenants were apparently awarded certain land rights in 1731, and paid rent to the Cape Government. The struggle over marginal land is demonstrated in the competing livelihoods at Duynefontein. Dempers was a brickmaker and as such was "always in great want of bushes and other small wood and for that reason never cut away any wood in the vicinity of his house at Duynefontein, but always saved it in order to let it grow to greater perfection." The 'illegal' cutting of wood "even about his house" exposed his "cultivated ground to be blown away." He laments that "to his greatest sorrow in what manner some persons make ill use of the privileges which they have obtained" and begs the authorities to protect him against the "attempts of those who are striving to injure him" (CA CO 3985 ref, 117, CO 3887 ref 79).

When the property was surveyed in 1834 for the quitrent grant, there is no indication of houses or any built structures. There is, however, a 'Kraal Ordannantie' which features on the diagram (Figure 3) as well as the later 1890 SW Cape survey map (Figure 4).

The land ownership of Duynefontein is summarized as follows:

Deed	**Date**	**To**	**From**	**Extent**	
C.Q 8.10	25.07.1834	Petrus Johannes Wohl & Johannes Christian Kotze		Grant	1468 M
2052	04.05.1892	Pieter Joseph Vink	PJ Vink	whole	
12822	15.12.1926	Pieter Loubser	Est. PJ Vink	whole	
4774	17.04.1945	Jacob Eliza de Villiers Loubser	Est P Loubser	whole	
21209	13.09.1967	Elektrisitie Kommisee	JE de Villers Loubser	whole	

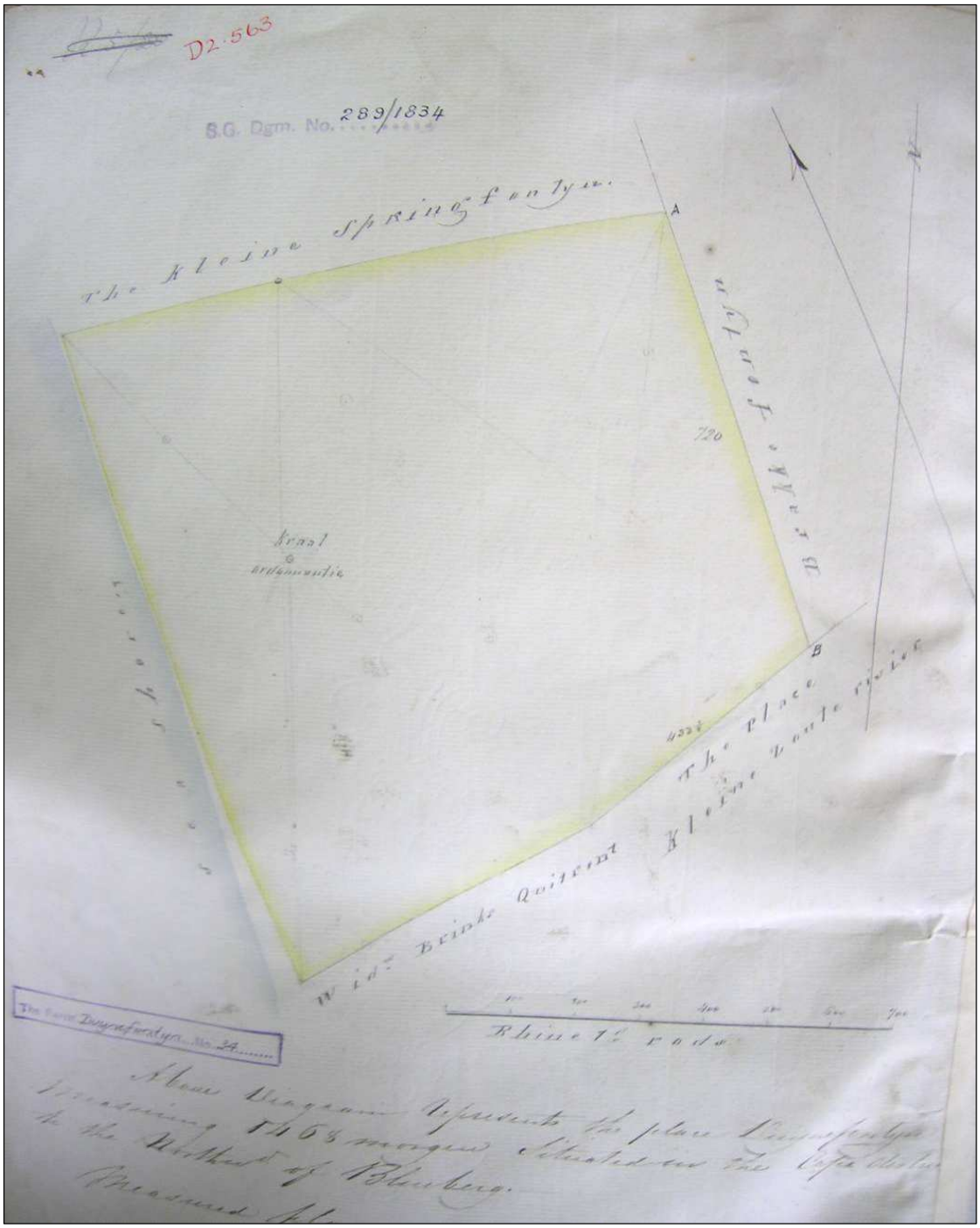


Figure 3. Old Kraal indicated on surveyors diagram. Cape Quitrent 8.10, dd 25.7.1834 Dgm 289/1834

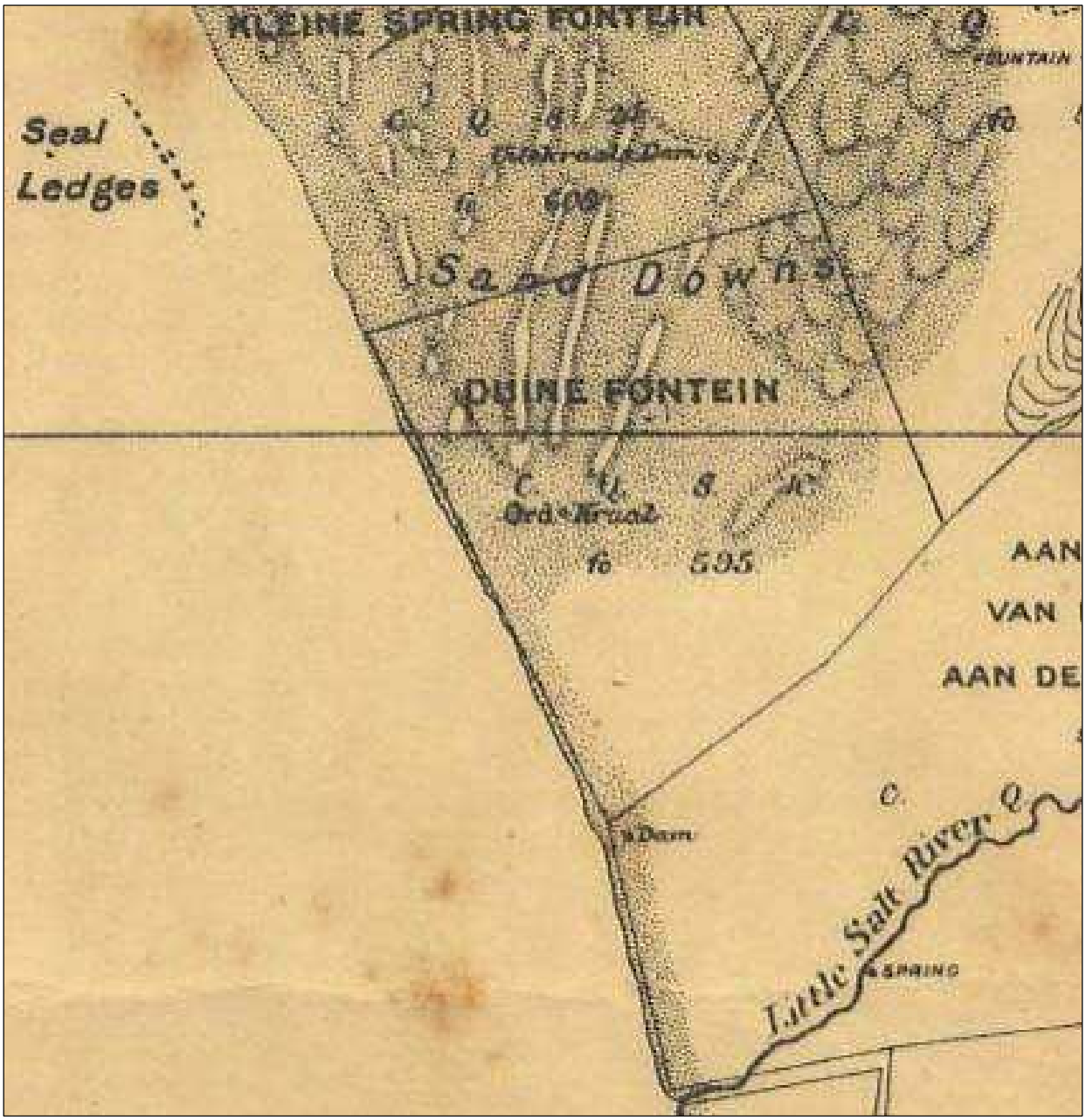


Figure 4. Detail from SW Cape Survey Map c.1890

The colonial period history of Duynefontein is interesting, however it does not reveal any particular significance in terms of associations with events, or important historical personalities. The early surveyor's diagrams have been superimposed over modern plans of the farm in an effort to locate the historic kraal. The kraal location appears to be outside of the study area. The site of Demper's house is not known as is that of any of his tenants. It is possible that ephemeral evidence of its presence may lie under the dune sands somewhere on the property.

4.1.2 Pleistocene archaeology and palaeontology

One of the greatest difficulties experienced in terms of the assessment of archaeological and palaeontological heritage is the fact that most of the significant material is buried. It is known that at the site of Duinefontein 2 in the nature reserve just a few kilometers form the PBMR site, there are at least 3 buried horizons (ancient land surfaces) (Klein 1999) each of which represents different ages in the Pleistocene and Holocene prehistory of the region. Klein and his team found the fossilized remains of ancient Pleistocene fauna on a 300 000 year old land surface along with traces of human activity. The animals included many species not seen in the Cape today as well as several extinct species such as the giant buffalo, giant pigs, extinct species of elephant, hippopotamus and the cape horse. The main fossil horizon lay roughly 1 m below the surface of the present day wind blown sands. Nodular calcretes had developed over the fossil horizon making excavation very difficult at times. Deep soundings by Klein and his team revealed the presence of an even older deeper horizon; however ground waters at a depth of 2 m prevented its detailed excavation. Klein (pers. comm.) is of the opinion that archaeological and palaeontological deposits such as those found at Duinefontein 2 have the potential to exist anywhere within the Eskom held property and beyond – the difficulty however is that there are no known methods of establishing where they are without extensive trial excavations. It is anticipated that given the knowledge that has been gained from the Duinefontein 2 excavations and the even earlier observations that were made when Koeberg was built, it is likely that Pleistocene archaeology and palaeontology will be encountered during the proposed bulk excavations for the PBMR

4.1.3 Pliocene and Miocene palaeontology

When the excavation for Koeberg nuclear power station took place in the 1970's, a deep sequence of fossil bearing sediments was exposed. The most recent sands and calcretes contained Pleistocene mammalian fossils as well as evidence of Early Stone Age occupation in the form of stone artefacts (Klein pers. comm.). Deeper down in the sequence the sediments contained marine fossils of the Miocene period deposited during periods of marine transgression. The proposed site of the Pebble-bed Modular Reactor (PBMR) at Koeberg is adjacent to the existing nuclear power station. The fossil material that will be exposed in the excavations will thus be similar to that described by Rogers (1980, 1982), as observed during the latter phases of construction of the extant plant during 1978. Palaeontologist John Pether (2007) has summarised the palaeontological potential of the study area thus:

"The main excavations for the installation will expose the bedrock, at 10-14 m bsl., underneath a vertical section of 24-28 m of sediment.

The bedrock is weathered shale of the Tygerberg Formation (Malmesbury Group) and is ~600 Ma (Mega-annum - million years old), highly deformed and metamorphosed deep-sea turbidites. It has no intrinsic palaeontological potential. However, the softer zones in the bedrock were colonized by boring bivalves when the bedrock was last seabed, producing *Gastrochaenolites* trace fossils (*Glossifungites* ichnofacies). These features exhibited no offsets due to shear forces in the bedrock, which was taken as reassurance that the area had been seismically quiescent since the Pliocene 2-5 Ma ago.

The bedrock is overlain by a fossiliferous marine gravel basal to a sequence dominated by bioturbated, slightly muddy, fine quartz sand, ~10 m thick, that has been dubbed the "Duynefontyn Member" of the Varswater Formation. A thin peaty sand caps the sequence. The "Duynefontyn Member" is richly fossiliferous and includes:

- Teeth, bones and scales of sharks, rays and bony fish.
- Fossil whale bone, dolphin and seal teeth.
- Marine birds, incl. the type specimens of a unique extinct penguin, *Nucleornis insolitus*.
- Terrestrial mammals, incl. bovid, hare.
- Terrestrial reptiles, snake and tortoise.
- Terrestrial plant pollen in the peaty sands.

The "Duynefontyn Member" is interpreted to be a regressive sequence of barrier beach coast succeeded by subtidal and intertidal facies of coastal tidal flats which are overlain by freshwater, peaty marsh deposits of coastal *vleis*.

The peaty sands are erosively overlain by a basal gravelly sand unit with gastropod casts and shark teeth, the "Gastropod Bed". The latter is overlain by a mixed fine and coarse quartz sand unit, yellow-brown in colour and becoming paler upwards, which is regarded as an aeolianite. This is the Springfontyn Formation. Some terrestrial fossils from this formation are seemingly of middle-Pleistocene age.

The section is capped by calcareous sands and calcrete which should probably be relegated to the Langebaan Formation aeolianite. Middle Stone Age artefacts occur in the calcrete. Closer to the coast the Springfontyn Formation is truncated by the sea-level highstand of the Last Interglacial 128-119 ka (ka: kilo-annum, thousand years ago), when shelly beach sands were deposited."

The excavations necessary for the construction of the PBMR will need to penetrate down to approximately 23 m below see level. This presents palaeontologists with a second opportunity to examine the sequence with the hind-sight of 30 more years of accumulated knowledge.

4.2 Impacts caused by the PBMR site

Dr Graham Avery of Iziko museums reports that he was invited to examine trial excavations that opened on the proposed PBMR site (pers comm). His oral testimony formed the basis of the heritage component of the previous EIA. Avery reported that nothing was found in the trail excavations, however visibility was poor due to the "roughness" of the geological trenches. He also inspected the surface of the proposed site and did not find any evidence of archaeological or palaeontological material.

The ACO inspection of the same site supports Avery's observations. It is noted that the proposed PBMR site was used as a lay-down or construction area when the existing Koeberg power station was built. The landscape has been bulldozed and flattened. In places the surface is covered with large concrete bases, expanses of gravel surfacing. Although vegetation has re-established itself in this landscape the entire area

should be considered highly disturbed. The chances of finding in-tact shell midden material or any other form of surface archaeology within a radius of 500 m from the existing power station is very low as this was a massive construction site. Careful rehabilitation which has resulted in an acceptably scenic landscape, has hidden the massive disturbance which occurred here in the past.

While the surface palaeontology and archaeology has been disturbed, there is a strong possibility that palaeontological material in the form of Pleistocene, Pliocene and Miocene fossils will be impacted by deep excavation. Pether 2007 states "Excavations made during construction of the proposed installation are certain to intersect fossiliferous layers. The fossil potential is rated very high. Fossil material recovered during the 1970's provided a tantalizing, but small sample. This can now be improved and the exposures of the geology under Koeberg are scientifically valuable as there is some ambiguity in the delineation of formations in this area."

4.2.1 Second section of proposed laydown area 1

Like the proposed PBMR site, this area is also highly disturbed. No surface palaeontology or archaeology was observed. Since this is a laydown area, it is not anticipated that a deep excavation will be required therefore minimal impact is expected.

4.2.2 Proposed laydown area 1

This site, located east of the R27 is a flat area covered with dense alien vegetation in places. The site inspection revealed no evidence of any archaeological material, however the visibility constraints caused by dense vegetation must be taken into account. It is not expected that any significant impacts will occur as the site is a laydown area and will not have to be subject to extensive excavation.

4.2.3 Alternative laydown area

The alternative laydown area (Figure2) is a very large portion of land, not all of which has been subject to archaeological assessment. Nevertheless, certain parts of it are archaeologically known while other areas are anticipated to be sensitive.

*Safe area*s. Insensitive areas which have been subject to prior disturbance are anywhere within the inner security cordon around the existing power station, and secondly the "old parking area" (which has been ripped and rehabilitated) to the north of the Koeberg access road (see Figure 2). This area is deemed to be archaeologically and palaeontologically "safe" as it has already been subject to extensive archaeological testing for a previous proposal by the ACO team (Halkett 2005).

A further possible area that could be considered lies outside the inner security cordon immediately north of the existing power station. Spoils from bulk excavation were dumped here obscuring the original land surface (Figure 2). While this area can be considered to be archaeologically and palaeontologically safe it is known to be close to the palaeontological site known as Duinefontein 1 and furthermore, it has been carefully rehabilitated and has high amenity value as part of the Koeberg Reserve.

Unsafe areas. The dune sea (both vegetated and mobile) which makes up the northern half of Koeberg Private Nature Reserve is known to be archaeologically and palaeontologically sensitive. Any leveling of the dunes in these areas is discouraged on account of not only archaeology and palaeontology but also the conservation and amenity value they offer.

The coastal plain to the south of the secondary dune system is unlikely to be as sensitive as the coastal dunes, however it has never been surveyed and should be considered to be an unsafe area, unless the a survey of the surface of any proposed future site has been subject to assessment.

4.3 Access roads

4.3.1 Site access roads

Any site access road situated with the large disturbed envelope of land within the inner security fence is unlikely to result in either archaeological or palaeontological impacts. Modifications to the Koeberg access road will occur in largely disturbed areas within the road reserve which will not result in any new impacts to archaeological material. Road construction is largely a surface modification which will not affect buried Pleistocene palaeontology.

4.3.2 The R27 modifications and access to Port of Saldanha

The survey of the R27 did not result in the identification of any heritage sites close to the road servitude. The R27 itself along with its bridges and culverts is less than 60 years old and is therefore not a generally protected structure in terms of the NHRA. It is not expected that temporary deviation of the road at the Modder River bridge will result in any significant impacts.

Access roads and bridges within the jurisdiction of the Port of Saldanha have been subject to heritage assessment and are not considered sensitive. Marine shell deposits (resulting from marine transgressions of Saldanha Bay) are known to exist below surface but will not be impacted by the surface modifications such as temporary road deviations.

4.4 Built environment and other generally protected heritage

No protected structures were identified in the study area. No graves were identified.

4.4.1 Cultural landscape

Before the existing power station was built, Duynefontein was a rural landscape of sandy and mainly un-farmed land and prior to the construction of the R27, very remote. Although through the efforts of the Koeberg Private Nature Reserve staff, the property has retained its wilderness qualities in places, the power station is an exceptionally powerful visual intrusion, which together with its support structures, and access road has completely transformed the place into a peculiar combination of an industrial and rural ambience. The introduction of a further industrial element will strengthen the industrial character of the place, but given the already established bulk of the existing facility, it is not anticipated that the proposed activity will impact the sense rural character or change the character/identity of Duynefontein and surrounds in a significant way.

4.5 Potable Water Pipeline

In late June 2008 the author was asked to survey this new area as part of this report. The area was visited on 1 July 2008 by Mr J. Lanham who surveyed the area and found no heritage impacts to be visible on the surface. The areas close to the R27 and the power station are heavily disturbed and were not visited. At the commencement of work an archaeologist should undertake daily site inspections, this should be adjusted to ad hoc site inspections if no material is identified.

5 Assessment of impacts

5.1 The ways in which heritage can be impacted

Destruction of tangible heritage inevitably takes place during the construction process of development activities rather than during the operational phases as the main source of impact normally is due to the disturbance of undisturbed ground or landscape and/or demolition of structures and places protected by the National Heritage Resources Act 25 of 1999. Invariably the kinds of impacts resulting are irreversible and of permanent duration. Cultural landscapes are highly sensitive to accumulative impacts and large scale development activities that change the character and public memory of a place, however this particular site does not lie within an easilt definable cultural landscape context – there are no significant streetscapes or concentrations of historic structures in or close to the area. Impacts to the visual environment are the subject a separate specialist study.

Archaeological sites (including shipwrecks), Pleistocene palaeontology, and graves are highly fragile and context sensitive, which means that their value is very easily destroyed when the landscape in which they are situated is disturbed by bulk excavation, or installation of services. Mitigation can be achieved through scientific recording, sampling or excavation - however these are also destructive processes. In general, full rectification of heritage impacts is not normally possible in the case of archaeology, but is possible to a degree in the context of built environment where restoration and reconstruction can be achieved (but with loss of authenticity). Generally, the best way to avoid impacts is to identify potential sensitivities first, then to take pro-active measures to avoid impacting the resource and ensure conservation thereafter.

Palaeontological material will also be destroyed by bulk earthmoving and mining operations, however palaeontological resources tend to be extensive (depending on the resource) and are rather more resistant to impact than archaeological material for the simple reason is that there is more of it. Because palaeontological material is often very deeply buried, scientists often rely on human intervention in the land surface to collect data. Aside from natural exposures, open cast mines, quarries and deep road cuttings often present the only opportunities for palaeontologists to examine deep sediments which under normal circumstances they may not have access to. In short, provided that palaeontolgists can use the opportunity arising from major construction works to adequately sample and record profiles and exposed material as part of the environmental management process, a potential negative impact can be transformed into a positive opportunity to increase the levels of knowledge about a locality and the species of fauna and flora that were present in the past.

5.2 Impacts caused by the proposed activities

5.2.1 PBMR site:

Overall impacts to heritage are considered to be low given the previous observations of trial excavations by Dr Graham Avery and supported by the observations from this study. There is a possibility that Pleistocene fossil horizons below ground surface may be impacted by excavations, and a certainty that Cenozoic palaeontology will be encountered in deep excavations.

***Mitigation*:** Bulk excavation of the PMBR site should be monitored by an archaeologist until such time that the archaeologist, through consultation, deems it not necessary to continue. In the event of a find, there needs to be a contingency budget to employ a team to sample and evaluate any exposed fossiliferous/archaeological horizons (suggest a minimum sample size of 100 sq m). This contingency could range from between two to three hundred thousand rands at current rates. This will mean a temporary local work stoppage and diversion of machinery to another part of the site. Work stoppages could range from 2 hours to 2 weeks depending on the find.

The possibility of finding extremely rare or unique specimens cannot be ruled out. The find of Pleistocene human skeletal material (extinct forms of human) would be of international significance (which is possible in this geological context), in which case the archaeologist would need as much time as is needed to remove the find according to the highest possible standards. The disruption is likely to be localised.

An arrangement must be made with a Cenozoic period palaeontologist with good local knowledge. He/she will need to monitor and inspect excavations frequently. The palaeontologist must be given adequate opportunity to log profiles to his/her satisfaction, collect samples of specimens at regular intervals throughout the period of bulk excavation. The palaeontologist must be given access to all geological reports as well as any available geotechnical cores that would assist in understanding the geological sequence.

Table 1. Summary of impacts PBMR site

Bulk excavation impacts to Pleistocene palaeontology/archaeology	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Bulk excavation will cause displacement and destruction of archaeological/ palaeontological material.*	Negative	Local	Medium	Long term	High	Medium	Medium	High
With mitigation *Provided that an archaeologist/palaeontologist is appointed to monitor bulk excavation and sample as necessary.*	Neutral - positive	Local	Low	Long term	High	Low	Low	High
Bulk excavation impacts to Palaeontology (Cenozoic)	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Bulk excavation will cause*	Negative	Local	Medium	Long term	High	Medium	Medium	High

displacement and destruction of Cenozoic palaeontological material.and loss of potential scientific data.								
With mitigation *Provided that palaeontologist is appointed to monitor and sample bulk excavation as necessary.*	Neutral - positive	Local	Low	Long term	High	Low	Low	High
Impacts on construction of PBMR on cultural landscape	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Given that the area has an established industrial character, additional buildings will have a moderate effect on changes to the cultural environment.*	Negative	Local	Low	Long term	Medium	Low	Low	Medium
With mitigation *Provided that spread of new structures into the natural environment is controlled and that architecture appropriate to surroundings is used (where possible), impacts will be very low.*	Negative	Local	Very low	Long term	Medium	Low	Low	Medium

5.2.2 Proposed laydown area 1 and second section of laydown area 1

The overall impacts to heritage in both of these areas caused by vegetation clearing and levelling are likely to be low as the intensity of the impact is likely to be confined to surface deposits only. Temporary changes to sense of place will be experienced as a result of new temporary elements.

Mitigation: No mitigation is suggested, other than normal rehabilitation of laydown areas after use.

Table 2. Summary of impacts: Proposed laydown area 1 and second section of laydown area 1

Impacts on construction of proposed laydown area on palaeontology/archaeology	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Given that impacts will largely be of a surface nature in an area that contains very little cultural material, impacts caused by physical disturbance will be few or none at all.*	Negative	Local	Very low	Long term	Low	Low	Low	Medium
With mitigation *Any finds made during site clearing and preparation should be reported to an archaeologist who will conduct an on site assessment and implement rescue measures if needed.*	Negative	Local	Very low	Long term	Medium	Low	Low	Medium
Impacts on construction of proposed laydown area on cultural landscape	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation	Negative	Local	Very low	Medium term	Low	Low	Low	Medium

Impacts will largely be of a temporary nature in an area that contains no protected built environment, the rural landscape will be subject temporary loss of vegetation cover and increased industrial ambience during construction.								
With mitigation *Good post-construction rehabilitation could result in an overall positive gain in general environmental and heritage terms.*	Positive	Local	Low	Long term	Medium	Low	Low	Medium

5.2.3 Proposed alternative laydown area (Figure 2)

It is premature to develop a statement of impact. This area has not been comprehensively surveyed, which means that the statement of impact should be considered to be tentative. It is possible that use of the alternative laydown area will result in negative impacts in certain areas. In particular the dune field is identified as being palaeontologically sensitive. Apart from the old parking area to the north of the main access road and the disturbed envelope within the inner security area (indicated by yellow line on Figure 2), no part of the site should be considered archaeologically safe.

Mitigation: Apart from the old parking area to the north of the main access road, and the disturbed envelope within the inner security area, no part of the site should be considered archaeologically safe unless it has been ground proofed. The provisions of the NHRA do not apply to areas of land less than 5000 sq m in extent.

5.2.4 Ranking of alternative laydown areas

Most favoured: Laydown area 1 and second section of laydown area 1

Least favoured: The alternative laydown area is less favoured as only limited parts of it are archaeologically and palaeontologically safe.

Table 3. Summary of impacts: Alternative laydown area

Impacts on construction of alternative laydown area on palaeontology/archaeology	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Certain parts of the broader alternative laydown area are known to be sensitive, however only a small portion of it kwon to be "safe" in heritage terms. Disturbance in un-checked areas may damage archaeological sites.*	Negative	Local	Medium	Long term	Low	Medium	Medium	Medium
With mitigation *Any area other than those indicated as being safe (Figure 2) will need to be subject to a field assessment so that any sensitive area*	Neutral	Local	Very low	Medium term	Medium	Low	Low	High

can be identified and avoided..								
Impacts on construction of alternative laydown area on cultural landscape	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Impacts will largely be of a temporary nature in an area dominated by industrial ambience, however the rehabilitated natural landscape has setting and amenity value which will be temporarily impacted*	Negative	Local	Very low	Medium term	Low	Low	Low	High
With mitigation *Good post-construction rehabilitation could result in an overall positive gain in general environmental and heritage terms.*	Neutral - Positive	Local	Low	Long term	Medium	Low	Low	High

5.2.5 Modifications to R27

The R27 is a recent construction not protected by any heritage legislation. Alterations to bridges and fabric do not trigger a heritage impact assessment. Transnet land affected by the proposed activity has been inspected and is not considered sensitive.

Mitigation: No mitigation is required, other than rehabilitation of temporary deviations. Any finds made during site preparation and construction should be reported to an archaeologist.

Table 4. Summary of impacts: R27 modifications

Impacts of modifications of R27 on palaeontology/archaeology	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Areas around Modder river bridge and Port of Saldanha operations are not archaeologically sensitive. There is a very low chance of impacts from land surface disturbance*	Negative	Local	Very low	Long term	Low	Low	Low	Medium
With mitigation *Any finds made during site clearing and preparation should be reported to an archaeologist who will conduct an on site assessment and implement rescue measures if needed.*	Negative	Local	Very low	Long term	Medium	Low	Low	Medium
Impacts of modifications of R27 on cultural landscape	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *R27 is not a protected linear feature, impacts are not expected*	n/a							
With mitigation	n/a							

5.2.6 Access roads

The access roads within the inner security fence all lie on land which has been subject to disturbance in the past. Impacts to surface archaeology are highly unlikely.

Mitigation: No mitigation is required.

Table 5 Summary of impacts – access roads to PBMR

Impacts of construction of access roads on generally protected heritage	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Access roads are located mainly within the previously disturbed envelope of land. Impacts caused by surface disturbance of any surviving heritage material are considered to be unlikely.*	Negative	Local	Very low	Long term	Low	Low	Low	High
With mitigation *Any finds made during site clearing and preparation should be reported to an archaeologist who will conduct an on site assessment and implement rescue measures if needed.*	Negative-neutral	Local	Very low	Long term	Medium	Low	Low	High

5.2.7 132kV Powerline to Koeberg sub-station

This is a minor intrusion in an industrial landscape which passes over disturbed ground. There is a low possibility that excavation of bases may impact buried archaeological or fossiliferous material.

Mitigation: Excavations for tower bases should be inspected by an archaeologist.

Table 6 Summary of impacts – 132 kV powerline

Impacts of construction of 132 kV transmission line on generally protected heritage	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Transmission line is to be located mainly within the previously disturbed envelope of land. Impacts caused by surface disturbance of any surviving heritage material are considered to be unlikely.*	Negative	Local	Very low	Long term	Low	Low	Low	High
With mitigation *Any finds made during site clearing and preparation and excavation of tower bases should be reported*	Negative-neutral	Local	Very low	Long term	Low	Low	Low	High

to an archaeologist who will conduct an on site assessment and implement rescue measures if needed.								

5.2.8 Potable Water Pipeline

In late June 2008 the author was asked to survey this new area as part of this report. The area was visited on 1 July 2008 by Mr J. Lanham who surveyed the area and found no heritage impacts to be visible on the surface. The areas close to the R27 and the power station are heavily disturbed and were not visited. At the commencement of work an archaeologist should undertake daily site inspections, this should be adjusted to ad hoc site inspections if no material is identified.

Table 7 Summary of impacts – Potable Water Pipeline

Impacts of potable water pipeline on generally protected heritage	***Nature***	***Extent***	***Intensity***	***Duration***	***Probability***	***Significance***	***Consequence***	***Confidence***
Without mitigation *Pipeline is to be located mainly along the firbreak under the powerlines. Impacts caused by surface disturbance of any surviving heritage material are considered to be unlikely.*	Negative	Local	Very low	Long term	Low	Low	Low	High
With mitigation *Any finds made during site clearing and preparation and excavation of the pipeline trench should be reported to an archaeologist who will conduct an on-site assessment and implement rescue measures if needed.*	Negative-neutral	Local	Very low	Long term	Low	Low	Low	High

5.3 The no-go alternative

Exercising the no go alternative will maintain the status quo in terms of impacts to heritage.

6 Conclusion

Indications are that the proposed activities, namely the construction of the PBMR and ancillary facilities are acceptable in heritage terms.

Research has shown that Duynefontein is not a farm that played any major role within the history of the Cape, it contains no buildings or landscape of heritage significance. Although Holocene archaeological sites are known to be fairly prolific on the west coast, the ground surface of the proposed PMBR site is highly disturbed and of low heritage potential.

Only one area, the PBMR site itself, has raised concerns in heritage terms. The excavations required for the PBMR are substantial and continue into underlying bedrock. This means that sediments proven to contain

palaeontological and probably archaeological material will be impacted. Unfortunately, since it is impractical to conduct trial excavations to the depth of Miocene sediments that are at least 10m below sea level, it is impossible to quantify the degree of impact in any great detail, apart from to say it is known that fossiliferous sediments exist and that impacts are a certainty.

Although in general terms the paleontological resources may be quite large, it is possible that unique specimens (including early human fossils in the upper layers) may be encountered – the study of which can make a real contribution to scientific knowledge.

Provided that good scientific mitigation and management is put in place, what could potentially be negative impact can be transformed into a real opportunity for gaining knowledge.

7 EMP Heritage management planning

This section of the report does not intend to be prescriptive at this early stage of the process, but recognizes that mitigation measures will need to be discussed and workshopped with key personnel, so that they can lock in with the construction schedule and methodology. Heritage Western Cape (the compliance and permitting authority and potentially Iziko Museums who would be responsible for storage of specimens will need to be kept informed.

As a guiding principal it is important that a clear chain of communication be developed between the construction team and a heritage consultant who can be on call to attend meetings, conduct site inspections and resolves any queries. The heritage consultant should be a professional archaeologist/palaeontologist. This process needs to be in place at the inception of construction work. The success of any mitigation measures for both palaeontology and archaeology is dependent on the willingness and co-operation of projects managers, site engineers, foremen and the workers themselves. Without their willingness to become involved as part of the heritage management process, the chances of successful and complete mitigation are considerably diminished. It would be of benefit to identify and invite key personnel to attend a “short heritage course” to enable them to assist in the recognition of fossil material and work out a process for consultation, collections of specimens and temporary on-site curation.

A second principal worth considering is that of developing the information that will be gained from the heritage management process into an educational resource – a booklet, pamphlet or even a small display that could be included within a visitor or information center (if one is planned). Obviously the potential for this is dependent on the outcomes of the heritage management process, however the idea can be proactively considered and a decision made “down the line”.

7.1 Management of archaeological heritage

The main area of concern that has been identified is the PBMR site itself. It is essential that an archaeologist is appointed to monitor the excavation of the upper sediments. Ideally the archaeologist should be familiar with the area, and better still be familiar with the archaeology of the Koeberg Nature Reserve as manifested at the site Duinefontein 2.

- He/she must initially be on site at all times that excavation is taking place. If there is good reason to believe that the site is not sensitive, the frequency of monitoring can be decreased.

- In the event of a find of fossil bone or artefactual material, the archaeologist will need to identify the horizon that the find is associated with and, if necessary, be given the opportunity and budget to bring a "rescue" team onto site to excavate the find, expose the material and sample it accurately and adequately.

- The fact that old land surfaces and the fossil faunas that inhabited them are preserved on Duinefontein 2, means that there is a possibility that fossil human remains may exist on or close to the site. Fossil human remains from the late Pleistocene (and earlier) are exceptionally rare and of exceptional scientific importance on a global scale. Any find of this kind must be removed with exceptional care. In the unlikely event of a find such as this occurring, it is requested that the proponent facilitate the necessary work in such a way that it is done to the highest standards, and as quickly as is reasonable.

7.2 Management of palaeontological heritage

7.2.1 Monitoring

In general, fossil bones are sparsely scattered in coastal deposits and much depends on spotting them as they are uncovered during digging. In contrast, shelly layers are usually fairly extensive and normally are exposed in the sides of the finished excavation, when they can be documented and sampled easily.

In archaeologically-sensitive areas, monitoring by a qualified archaeologist of excavations as they are made might be a requirement stipulated by the provincial heritage authority. In such cases the archaeologist is likely to spot, investigate and report fossil material and separate monitoring by a palaeontolgist should not be necessary. Most areas have relatively low potential for fossil bone material and it is expensive and impractical to have excavations constantly monitored by a team of professionals during the construction phase. This task could be allocated to a senior student or junior archaeologist. Sporadic fossil occurrences can be particularly important and efforts made to spot them are often worthwhile.

In order to spot the rare occurrences, it is very desirable to have the co-operation of the people "on the ground". By these are meant personnel in supervisory/inspection roles, such as engineers, surveyors, site foremen, etc., who are willing and interested to look out for occurrences of fossils. These personnel are also critical in informing excavator operators and manual workmen, whom being close to the sediments, would be more likely to spot smaller fossils.

Successful and cost-effective monitoring depends a lot on this goodwill and co-operation of managers and on-site people. To aid this process, a general background information document/orientation session is useful. There should also be guidelines for potential finds and a reporting/action protocol in place when finds are uncovered.

Isolated finds that are turned up should be handed over to a designated person for safekeeping, noting as far as possible where they came from. Excavated material with a clump of bones included can be stockpiled temporarily for safekeeping, until the site visit by the palaeontologist.

If major bone finds are encountered, the contracted specialist should be immediately informed. A temporary pause in activity at the limited locale will be required. The strategy is to "rescue" the material as quickly as possible. The method would be to remove representative samples and "best" material in encased blocks. In the case of considerable occurrences of bones, the methods could include the removal of a large, disturbed sample by excavator and conveying this by truck from the immediate site to a suitable place for "stockpiling". This material could then be processed locally, by sieving and further preparation.

7.2.2 Primary Mitigation

When the phases of bulk excavation are near or at completion and before the walls are sheet piled/gunited:

- The excavation faces will be inspected for fossil content.
- Any already-rescued material as above will be examined, processed and packaged.
- Representative samples of fossils will be collected.
- In the case of shelly beds, bulk samples will be taken.
- If material is delicate/poorly-preserved, it will be removed within blocks of the enclosing sediment, reinforced if required by encasement.
- Key vertical sections representative of the exposures will be identified.
- These will be described in detail sedimentologically (logged), photographed and sampled, to fully record the contexts of the fossils.

For the purposes of planning and costs containment, the contracted specialist must be informed on the scheduled excavation planning and the progress being made i.e. would need to establish liaison protocols with a suitably-placed persons. A prescribed data requirement is adequate 3D spatial referencing. For this the specialist would require the assistance of the surveyor, co-ordinates and base maps, to plot the locations of finds during monitoring, the measured sections, samples and other observations.

8 References

Eskom 2006. *Seismology and Geology* In: Koeberg Site Safety Report.

Cruz-Uribe, K., Klein, R. G., Avery, G., Avery, M., Halkett, D., Hart, T., Milo, R. G., Sampson, C. G., & Volman, T. P. 2003. Excavation of Buried Late Acheulean (Mid-Quaternary) Land Surfaces at Duinefontein 2, Western Cape Province, South Africa. *Journal of Archaeological Science*. 30: 559-575.

Hendey Q.B. 1982. *Langebaanweg, a record of past life*. Cape Town: South African Museum.

Halkett, D., Hart, T., Yates, R., Volman, T.P., Parkington, J.E., Klein, R.J., Cruz-Uribe, K. & Avery,

G. 2003. First excavation of intact Middle Stone Age layers at Ysterfontein, western Cape province, South Africa: implications for Middle Stone Age ecology. *Journal of Archaeological Science*

Halkett, D 2005. *Trail excavations for a proposed training centre, Duynefontein 34*. Unpublished ACO report prepared for Eskom

Klein, R. G., G. Avery, K. Cruz-Uribe, D. Halkett, T. Hart, R. G. Milo, and T. P. Volman. 1999. Duinefontein 2: An Acheulean Site in the Western Cape Province of South Africa. *Journal of Human Evolution* 37(2): 153-190.

Parkington, JE 2006. *Shorelines, Strandlopers and shell middens*. Cape Town: Krakadouw Trust.

Parkington, JE. Poggenpoel, C. Halkett, D. & Hart, T.2004 Initial observations from the Middle Stone Age Coastal settlement in the Western Cape In Conard, N. Eds. *Settlement dynamics of the Middle Paleolithic and Middle Stone Age*. Tubingen: Kerns Verlag.

Pether, J, Roberts, D.L. and Ward, J.D. 2000. Deposits of the West Coast (Chapter 3). In: Partridge, T.C. and Maud, R.R. eds. *The Cenozoic of Southern Africa*. Oxford Monographs on Geology and Geophysics No. 40. Oxford University Press.

Rogers, J. 1980. First report on the Cenozoic sediments between Cape Town and Elands, Bay. *Geological Survey of South Africa Open File* **136**.

Rogers, J. 1982. Lithostratigraphy of Cenozoic sediments between Cape Town and Eland's Bay. *Palaeoecology of Africa* **15**: 121-137.

Rogers, J. 1983. Lithostratigraphy of Cenozoic sediments on the coastal plain between Cape Town and Saldanha Bay. *Technical Report of the Joint Geological Survey/University of Cape Town Marine Geoscience Unit* **14**: 87-103.

PBMR 2005 General Overview of PBMR Technology. PBMR (Pty) Ltdskom 2006 Koeberg

Sources from the Cape Archives