.

HERITAGE IMPACT ASSESSMENT AS PART OFTHE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR THE PROPOSED DEVELOPMENT OF A CRUDE OIL STORAGE TANK FARM WITHIN THE SALDANHA BAY MUNICIPAL AREA.

Portion of Remainder of Farm Os Fontein 194

WorleyParsons RSA (Pty) Ltd, 31 Allen Drive, Loevenstein, 7530
(Ms Michelle Herbert)

DRAFT 3

COMPILED BY:

Tim Hart (General heritage assessor and archaeologist)
Deano Stynder (Palaeontologist)

ACO Associates cc
Unit c26
Prime Park
Mocke Road
Dieprivier
Cape Town

8 Jacobs Ladder
St James
7945

Phone 0217064104
Fax 0866037195
Email Tim.Hart@aco-associates.com

Draft 3 sent March 19 2013

EXECUTIVE SUMMARY

WorleyParsons RSA (Pty) Ltd was appointed by MOGS (Pty) Ltd (MOGS), as an independent environmental consultant to facilitate the Environmental Impact Assessment (EIA) process for the proposed development of a crude oil storage tank farm located in the Saldanha Bay Municipal Area. ACO Associates was appointed by WorleyParsons to undertake the heritage assessment component of the EIA process. The envisaged site for the proposed activity lies adjacent to the existing SFF crude oil storage facility constructed by the Government of RSA during the 1970's. The land in question lies within an area of Saldanha Bay Municipality that has been identified for industrial use. The proposed activity (Figure 1) is the construction of a crude oil storage facility to contain in the order of 15 million barrels of crude oil. MOGS is in the process purchasing 52 hectares of remaining portion of Farm Os Fontein 194 for the proposed development. The proposed activity will be the construction of 12 truncated square concrete storage tanks, which will be surrounded by an earth berm. Most of the activity will be above ground surface.

Two alternatives for the site location were provided and have been evaluated. In addition alternative technical layouts were provided (which have no bearing in heritage impacts).

Impact assessment

The study has revealed that the area is not rich in heritage resources other than palaeontology; meaning that the proposed activity is generally acceptable. Very few impacts to built environment, landscape or archaeology were identified.

The general area is characterised by a surface geology that contains various Cainozoic formations which are variably fossilifierous. There is a possibility that excavations for the proposed activity will impact fossiliferous material, however the quality and quantity of material cannot be predicted. The fossil record from this area of South Africa is considered to be highly important with the nearby West Coast Fossil Park being declared a Grade 1 heritage site.

Mitigation

Excavations and preparation work for foundations of the facility including excavation of pipe trenches must be monitored by a palaeontologist or his/her representative. They must be assisted by the site staff to "rescue" material found during excavation and where needed systematically sample and record layers that contain fossil shell and bone clusters.

Material found must be curated at West Coast Fossil Park who has agreed that they are the appropriate facility.

Fatal flaws

There are no fatal flaws.

Assessment of alternatives

Neither alternatives proposed differ significantly is terms of their potential to result in impacts. Site position 2 is marginally favoured over position 1 as previously disturbed land can be utilised.

Conclusion

The only heritage resource which may be significantly impacted is palaeontology. Provided that mitigation is carried out adequately, this could result in a positive impact which will see new scientific knowledge and educational material added to the Provincial estate.

CONTENTS

I. GLOSSARY

Aeolianite *A calcium carbonate rich sandstone that is formed from windblown sand which compacts over time.*

Archaeological material *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.*

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.*

Fossiliferous Bearing or containing fossils.

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.)*

Palaeontological *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.*

Pliocene *A geological time period (of 6 million – 3 million years ago).*

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

SAHRA *South African Heritage Resources Agency.*

Stratification *The natural layering of soil, sediments or rock.*

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 *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.*

Acronyms

asl.	above (mean) sea level.
BP	Before Present. (Before AD 1950).
bsl.	below (mean) sea level.
(D&D)	Reference to De la Cruz, M.A. and Du Plessis, A. 1981. The Geology of Saldanha Bay. *Geological Survey of South Africa Bulletin* **70**, 45 pp.
DWA	Dept. of Water Affairs
Fm.	Formation.
HWC	Heritage Western Cape
I&AP	Interested and Affected Party
ka	Thousand years or kilo-annum (10^3 years). Implicitly means "ka ago" *i.e.* duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present. Sometimes "kyr" is used instead.
k.y.	Thousand years. Used for duration only *e.g.* the duration of the LIG was 10 k.y.
LGM	Last Glacial Maximum. Interval of maximum "Ice Age" ice volumes ~30 to 19 ka.
LIG	Last Interglacial. Warm period 128-118 ka BP. Relative sea-levels higher than present by 4-6 m. Also referred to as MIS 5e or "the Eemian". (see Text Fig. 6.0)
Ma	Millions years, mega-annum (10^6 years). Implicitly means "Ma ago" *i.e.* duration from the present, but "ago" is omitted. The "Present" refers to 1950 AD. Generally not used for durations not extending from the Present.
MIS	Marine Isotope Stage. Numbered stages of the marine oxygen-isotope record ($\delta^{18}O$).
(MR&M)	Reference to Miller, Ramsay and MacHutchon, M.R. 2006. *Marine geophysical survey of the area adjacent to the iron ore jetty - Port of Saldanha*. Marine Geosolutions (Pty) Ltd Report No. 2006-003. 60 pp.
m.y.	Million years. Used for duration only *e.g.* the duration of the Eocene Epoch was ~22 m.y.
NHRA	National Heritage Resources Act
w.r.t.	with respect to.

INTRODUCTION

1.1 PROJECT TEAM

This study was undertaken jointly by Tim Hart (MA) of ACO Associates and Deano Stynder (Phd) of University of Cape Town (UCT).

Tim Hart is an archaeologist and general heritage consultant with 24 years of experience, as well as experience in an academic and teaching setting.

Deano Stynder is a palaeontologist and lecturer in the Department of Archaeology at UCT. He has worked extensively on west coast fossil sites, in particular with the specimens found at the West Coast Fossil Park.

ACO Associates has completed some two hundred projects in the last two years, the most significant of which are:

- Heritage Impact Assessments for three proposed Nuclear Power Station sites in the Western and Eastern Cape Provinces.
- Upgrades of the N7 at various points between Melkbosstrand and Klawer
- The excavation and ongoing research into massive un-marked burial grounds in Green Point, Cape Town.
- A proposed 400kV transmission line from Aberdeen (Eastern Cape) to Beaufort West (Western Cape)
- Investigations for the restoration of the Minister of Environment Affairs residence at De Meule, Mowbray Cape Town.
- Stage 1 Heritage Impact Assessment for the re-vitalisation of the Prestwich Street precinct, Cape Town.
- Excavation of a late 18th century shipwreck, Silo precinct, Victoria and Alfred Waterfront.

1.2 PROJECT BACKGROUND

WorleyParsons RSA (Pty) Ltd was appointed by MOGS (Pty) Ltd (MOGS), as an independent environmental consultant to facilitate the environmental impact assessment (EIA) process for the proposed development of a crude oil storage tank farm located in the Saldanha Bay Municipal Area. ACO Associates was appointed by WorleyParsons to undertake the heritage assessment component of the EIA process as per NEMA requirements and section 38(8) of the National Heritage Resources Act (25 of 1999). The proposed project by its very nature (which involves the storage of hazardous materials) has triggered a full EIA process. The envisaged site for the proposed activity lies adjacent to the existing SFF crude oil storage facility constructed by the Government of RSA during the 1970's, on a portion of

Portion 0 of the Farm Os Fontein 194. The land in question lies within an area of Saldanha Bay that has been identified for industrial use (Saldanha Bay draft zoning scheme 2007) and is currently zoned as agricultural use. Existing facilities such as Saldanha Steel, the Portnet Iron Ore Terminal, Salkor railway yard and the Exxaro Smelter are situated in the general area. Prior heritage work done in the area has shown that the flat coastal plains that lie to the North of Saldanha Bay are not sensitive in terms of either built environment or archaeology; however notable palaeontological finds have been located at almost all major industrial sites in the area. This study as per the recommendations of the Notification of Intent to Develop (NID) submitted to Heritage Western Cape (HWC) has identified archaeology, palaeontology and visual impacts (in heritage terms) as being the major heritage issues requiring assessment. An independent visual impact assessment for the proposed activity has been undertaken by Aurecon (Pty) Ltd.

1.3 TERMS OF REFERENCE

A notification of "Intent to Develop" form was submitted to HWC (Case No: 120921TS19) indicating the initial identification of heritage resources.

HWC affirmed that the contents of the assessment should include:

- An assessment of the impact of the proposed development on archaeological resources.
- An assessment of the impact of the proposed development on palaeontological resources.
- A consolidated set of recommendations.

This study being part of an EIA process has taken cognisance of the requirements of Section 32 of the EIA Regulations, 2010 which indicates the format and contents of a specialist report.

1.4 HERITAGE LEGISLATION

Loosely defined, *heritage is that which is inherited*. The National Heritage Resources Act 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, and natural places 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 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.

The National Environmental Management Act (Act No. 107 of 1998) as amended independently requires the assessment of the cultural environment in any environmental impact assessment process.

1.4.1 Grading of heritage

The law provides a framework for the assessment and grading of heritage sites. The system that is currently in use is presented in Table 1 below. By far the majority of heritage sites fall within the grade 3 category, and within that category most fall within the grade IIIB- C classification. Grade IIIA sites are comparatively rare and are considered regionally important. Grade II sites are considered to be important within a provincial context while Grade I sites are considered to have national-international significance. The West Coast Fossil Park which is close to the project area is a Grade 1 heritage site.

Table 1: Grading of heritage resources (Source: Winter & Baumann 2005).

Grade	Level of significance	Description
I	National	Of high intrinsic, associational and contextual heritage value within a national context, i.e. formally declared or potential Grade 1 heritage resources.
II	Provincial	Of high intrinsic, associational and contextual heritage value within a provincial context, i.e. formally declared or potential Grade 2 heritage resources.
IIIA	Local	Of high intrinsic, associational and contextual heritage value within a local context, i.e. formally declared or potential Grade 3A heritage resources.
IIIB	Local	Of moderate to high intrinsic, associational and contextual value within a local context, i.e. potential Grade 3B heritage resources.
IIIC	Local	Of medium to low intrinsic, associational or contextual heritage value within a national, provincial and local context, i.e. potential Grade 3C heritage resources.

1.5 THE PROPOSED ACTIVITY

The proposed activity (Figure 1) is the construction of a crude oil storage facility. ArcelorMittal South Africa Limited (current property owner) and MOGS (future developer) have reached agreement on the sale of a portion of the Farm Os Fontein 194 Portion 0 (Remaining Extent), for the proposed development of a crude oil storage tank farm. The total size of Farm Os Fontein 194 Portion 0 (Remaining Extent) is 240 hectares and MOGS is in the process purchasing 52 hectares of this property for the proposed development.

The storage tank farm will consist of twelve (12) semi in-ground, truncated square concrete tanks with a capacity of 1.1 million barrels each. The total storage capacity of the new storage facility will be 13.2 million barrels, although the total maximum carrying capacity of the property will be approximately 15

million barrels of crude oil. These concrete tanks will be similar in design to the existing SFF tanks *although truncated and much smaller*. The concrete tanks will be retained by earthen embankments which will be planted with indigenous vegetation. The natural rehabilitation of the slopes will minimise the visual impact of these structures.

Associated infrastructure includes the following:

a. Underground pipeline for the transportation of municipal water to the storage facility. The pipeline will be less than 360mm in diameter.

b. Underground pipeline for the transportation of dangerous goods, i.e. crude oil to and from the storage facility (making use of the existing SFF pipeline for transport of product to and from the Portnet Terminal).

c. 11kV (kilovolt) distribution line from the Blouwater Substation located to the north of the storage facility.

d. An oily water treatment system i.e. oil/water separator and evaporation ponds for the treatment of water drained from the storage tanks. The evaporation ponds are lagoons lined with HDPE to prevent soil and groundwater contamination.

Access to the site is off the main road MR559 which links Langebaan with Saldanha. The existing SFF storage facility is visible from the road but surprisingly un-obtrusive given its size.

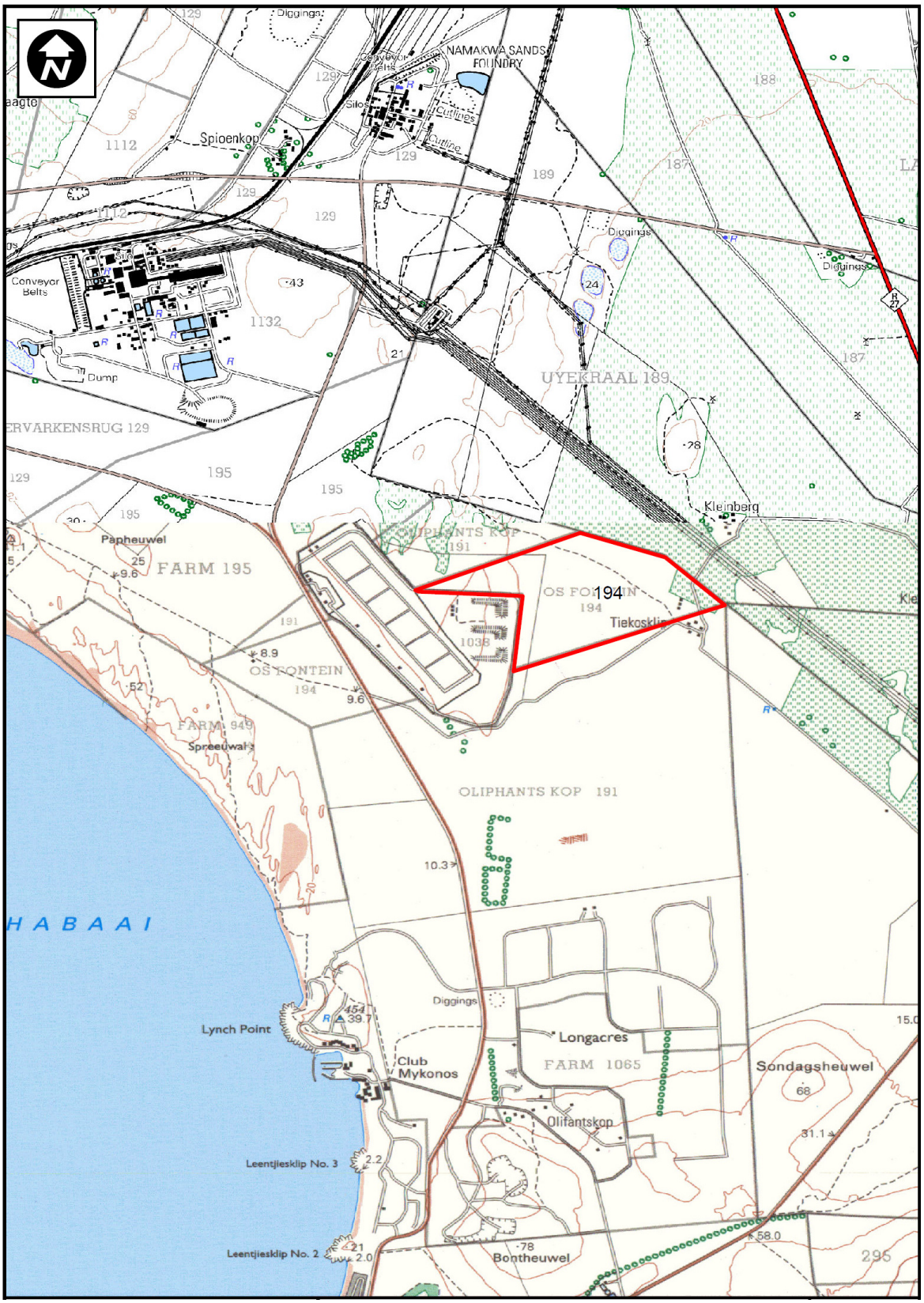

Figure 1 Location of the Remaining Extent of Farm Os Fontein 194. (Mapping data based on 1:50 0003218CA&CC Velddrif & 3317BB&3318AA Saldanha sourced from Chief Directorate Surveys and Mapping and prepared by WorleyParsons (Pty) Ltd).

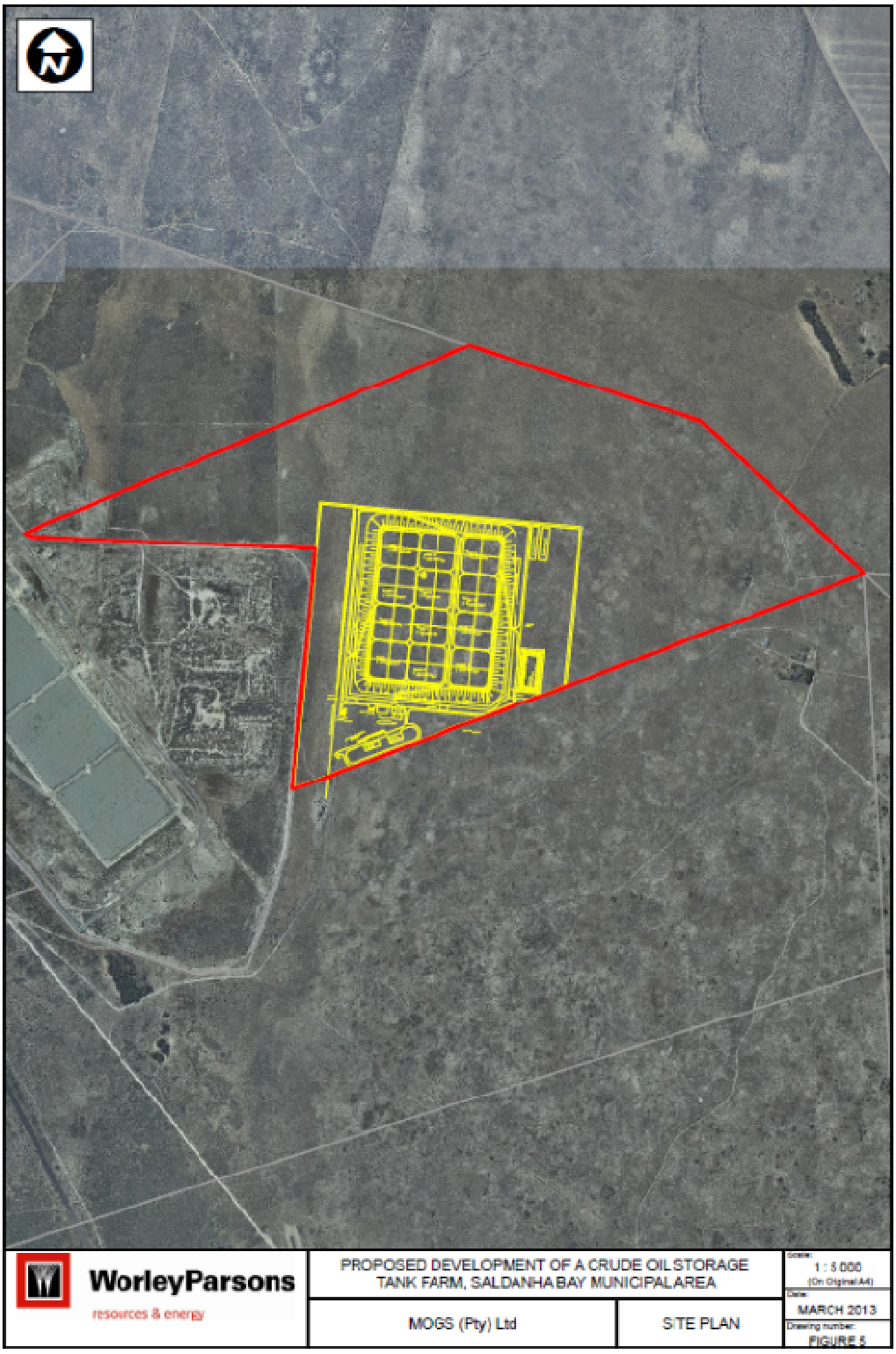

Figure 2 Location of the 52 hectare land on Remaining Extent of Farm Os Fontein 194, parcel to be used for the establishment of the crude oil storage facility (Mapping data based on 1:50 0003218CA&CC Velddrif & 3317BB&3318AA Saldanha sourced from Chief Directorate Surveys and Mapping and prepared by WorleyParsons (Pty) Ltd).

1.5.1 Alternatives

Two alternative sites have been supplied (figure 3) for assessment as to which will create the least impacts while different options for technical layouts have been provided for each alternative site. With respect to heritage the technical layouts are not of major concern as in this context they have no bearing on impacts, however the site alternatives are of relevance.

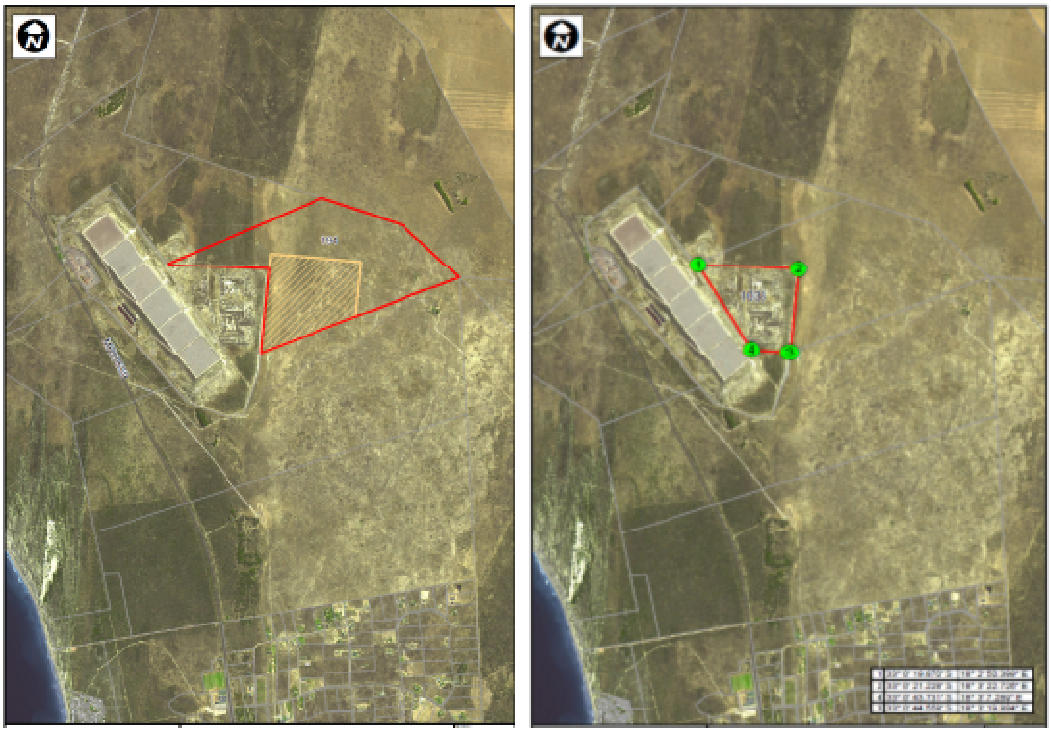

Figure 3 Proposed site alternatives 1 (left) and 2 (right). (After material provided by WorleyParsons (Pty) Ltd).

THE STUDY APPROACH

1.6 INFORMATION BASE

The information used to inform this study comes from a variety of sources. This has involved a review of literature of recent heritage related projects in the area, as well as drawing on the author's own personal experience. Tim Hart and members of his office (ACO) have been involved with work at Hoedjiespunt, Langebaanweg Fossil Park, Spreeuwalle as well as numerous smaller projects in the Langebaan area. Dr Deano Stynder is an expert on the fossil material derived from West Coast Fossil Park and other sites on the West Coast. Ms Pippa Haarhof (West Coast Fossil Park paleontologist and curator), has knowledge of the area and insights on operations at West Coast Fossil Park while prior work by palaeontologist John Pether is directly relevant to this study. Further information has been obtained by physically ground proofing those parts of the study area that will be affected by the proposed activity.

Persons and organisations consulted:

- Ms Pippa Haarhof (West Coast Fossil Park)
- Dr Graham Avery (Iziko Museums of Cape Town)
- Prof Richard Klein (University of Stanford)
- Heritage Western Cape (Notification of intent to develop submitted)

1.7 ASSUMPTIONS

The kinds of heritage resources assessed during this study are those defined as generally or specifically protected by the National Heritage Resources Act No 25 of 2000. It is assumed that fossil bearing deposits will be affected by the proposed activity which will involve bulk excavation – this assumption is based on good circumstantial evidence, and the testimony of persons who witnessed the finding of fossil material at the SFF oil storage facility when it was built in the 1970's.

1.8 LIMITATIONS

Assessment of land based archaeological and palaeontological heritage was based on surface observations only. No trial excavations were conducted, although previously existing trenches and borehole material were inspected. Fortunately the contents of borehole cores were on site at time of inspection. Surface visibility in most undisturbed areas was very good, and some sight of sub-surface conditions was afforded by a large eroded trench on site (2-3m deep). While reliable information was obtained about surface and near surface archaeology, the deeper sediments of the coastal plain which could contain palaeontological and archaeological are more difficult to assess without on-site trial excavation, however there is a body of existing knowledge about the area which assists in making an assessment. The details of comparative depths and content of geological formations within the proposed site are not known, the frequency of occurrence of palaeontological material is also not known but is anticipated based on well-studied sequences in the region.

.

1.9 METHODOLOGY

A detailed literature review took place 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 affected by new construction work. The survey undertaken by Hart and Stynder was comprehensive covering the entire study area and surrounds. The work was carried out with the visual impact assessor (Ms Emie Wiedeman from Aurecon) present to discuss issues of common interest on site. Ms Pippa Haarhof of West Coast Fossil Park, Prof Richard Klein (University of Stanford) and Dr Graham Avery (Iziko Museums of Cape Town) have been solicited for comment on the potential impact of the proposed activity on fossil material. Prior work by geologist/palaeontologist John Pether, who has written several reports which are directly relevant, has proved invaluable.

A full specialist report by palaeontologist Dr Deano Stynder is included as appendix A.

DESCRIPTION OF THE STUDY AREA, CONTEXT AND SETTING

Saldanha Bay is a large sheltered anchorage on the West Coast of South Africa some 120 km north of Cape Town. The southern and south western portion of the bay (Posberg Pensinsula) takes the form of a shallow estuary which is presently conserved within the West Coast National Park. The northern portion of the bay (Hoedjies Bay) now falls within the Port of Saldanha – a deep water harbour, industrial area and the port town of Saldanha Bay. On the eastern shore lies the resort town of Langebaan - a popular weekend holiday town for Capetonians.

Until the construction of the R27 provincial road in the 1970s, the bay was a relatively isolated area only accessible by road via a long and tedious drive from Cape Town via the towns of Malmesbury and Darling. The construction of the road and establishment of the deep water harbour have seen massive development take place. Langebaan has transformed from a sleepy coastal village to a development *mecca* complete with yacht harbour, resorts, casino and supermarkets. Similarly the Port of Saldanha has grown significantly absorbing much of what was until recently a bleak and deserted stretch of shoreline along the northern edge of the Bay. Despite the rampant development, there are still areas that retain the sense of wilderness that until recently characterized the area. Along the Eastern side of the bay (Spreeuwalle shoreline) are semi-stabilised lunate dunes, large tracts of Strandveld vegetation punctuated by granite outcrops which are a characteristic of this area.

Within the last 30 years, Saldanha Bay has been transformed from a minor fishing port into a significant center of heavy industry within the Western Cape. Since the construction of the bulk terminal and dredging of the bay to accommodate large bulk carriers in the 1970's, several other companies have developed large operations in the area, namely the Saldanha Steel smelter, and the Xxaro Smelter which both use the Port of Saldanha's general cargo facilities, as well as a host of smaller support industries. Thus, within a relatively short period of time the northern edge of the bay has been transformed from windswept wilderness into a near-industrial landscape.

The study area lies within land that has been identified in the local spatial development plan for industrial purposes (Saldanha Bay Municipality 2007). The proposed site lies immediately adjacent to the existing crude oil facility which was built by the apartheid government in the 1970's. This is linked by pipeline to the "ore jetty" which extends from the northern shore of the bay for a distance of some 4.3 km. While the jetty itself is primarily designed to handle iron ore, it is able to accommodate transfer of crude oil as well as general cargo. While the development of these heavy industries, has placed the development trajectory of the area firmly in the direction of continued industrial development, the broader area has a mixed bag of qualities – to the south lie the leisure resorts of Langebaan, and beyond the West Coast National Park – an important wildlife sanctuary and biodiversity area, while some 5 km to the north of the

study area is the internationally important West Coast Fossil Park, a Grade1 heritage site situated at a disused phosphate mine. The mine has been rehabilitated and now contains the world's largest known deposit of extinct Miocene fossils (Hendy, 1982).

The study area itself is flat and without any rocky foci or outcrops that may have attracted pre-colonial settlement. The dominant feature of the immediate area is the existing SFF crude oil facility. Aesthetically the land landscape is un-appealing and sparsely vegetated. Soil depths are shallow – fragments of calcrete litter the landscape (figures 5, 6). Just outside the eastern edge of the study area lies the small farm complex of Tiekosklip – a collection of farms buildings of varying ages.

1.10 HERITAGE CONTEXT

1.10.1 Palaeontology and early archaeology

In recent years the area has become famous for its fossil wealth – just inland of Langebaan is the largest Pliocene-Miocene (5-6 million years old) fossil deposit in the world, parts of which are open to the public at West Coast Fossil Park, Langebaanweg. 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 sea level changes. 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 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. 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. A further find at Spreeuwalle between Paradise Beach and the ore terminal has been investigated by Dr Graham Avery and Mr. Dave Halkett, but unfortunately most of the material lies below sea level as the site dates to a time when sea levels were lower than that of today (Parkington *et al* 2004, Avery *et al.* 2008).

1.10.2 Pre-colonial heritage

Later Stone Age (LSA) material relating to the heritage of Khoisan groups is widely distributed in the area and sites can be found in most areas in association with landscape features (rocky shorelines, rock shelters and outcrops) or close to any place that provided natural shelter. The latter is particularly evident at Kasteelberg 10 km northwest of Vredenburg and other smaller granite hills on the Vredenburg Peninsula (Sadr *et al.* 2003; Smith 2006; Smith *et al.* 1991). A recent survey that covered extensive tracts of land around the Kasteelberg Hill revealed rare isolated artefacts and very few meaningful concentrations of artefacts in open areas away from rocky outcrops (Webley *et al.,* 2010). Another survey just east of the current study area yielded no surface archaeological material (Hart & Pether, 2008), while a survey at the northern end of Saldanha Bay located just two ephemeral LSA sites (Hart, 2003). Further south towards the vicinity of Club Mykonos there were a number of shell middens associated with the rocky promontories of Lynch Point and Leentjiesklip. Several middens have been excavated revealing the typical cultural finds associated with coastal shell middens (Hart, 2001; Hart & Gribble, 1998; Hart & Jerardino, 1998). These finds included stone artefacts, ostrich eggshell beads and shell scrapers. The nearest of these rocky points with shell middens is some 6 km from the southern end of the proposed project. In 2011 Jayson Orton (ACO) conducted a detailed survey of the farms Uyekraal 189/1 and Langeberg 187/4 which lies neighbour the study area to the north and shares similar physical characteristics. Despite an extensive search, no archaeological material of any kind was located on the surface (Orton, 2011).

Since its discovery by Europeans Saldanha Bay (named by the Dutch after Antonio de Saldanha who visited the Cape in the early 1500's) was used as a safe anchorage by virtually every sea going nation who had trading interests in the east. The bay shores were never permanently settled in any meaningful way until quite late in the history of the Cape. The Dutch East India Company VOC *(Vereenigde Oostindische Compagnie)* chose Table Bay as their favoured location to establish a permanent re-victualing station even though the anchorage of Table Bay was far inferior and much more dangerous than that of Saldanha. The reason for this is that Table Bay had permanent water, arable land, supplies of wood and was generally well suited to land based settlement. (The lack of water at Saldanha impeded its development until a permanent water supply was constructed by the military engineers at the beginning of World War 2). Being anxious to maintain a presence at Saldanha Bay, the VOC established a small garrison on the Posberg Peninsula in 1666. The handful of men equipped with one or two small cannons kept a watch on shipping as the French who were frequently at war with the Dutch used the bay with alacrity, even invading the tiny Dutch garrison. Being many days journey from Cape Town the tiny Dutch garrison was plagued with difficulties. At times the local Cochoqua (a local Khoikhoi group) were in conflict with the VOC forcing the abandonment of the garrison between 1673 and 1677 (Shire, 1993). The bay remained in Dutch hands until the first British occupation of 1795. Development of the area was restricted to sparse farms and fishing which was centered at the small hamlet of Hoedjiesbaai. Strategically, being an undefended bay, Dutch shipping was trapped and taken by British forces on at least three separate occasions between 1781 and 1806. Without adequate defenses, Saldanha Bay became a trap rather than a safe anchorage in times of conflict – a factor which further inhibited its development. In 1820 a group of Irish settlers were landed at Saldanha Bay and lived there for a period of time before moving inland where they established the town of Clanwilliam in the Olifants River Valley where they were allocated land (Dickinson, 1973). In the early 20th century whale fisheries were established at Donkergat and Salamander Bay which saw increased growth of the hamlet with the installation of jetties and coaling facilities. By the late 1930's the whaling industry had collapsed. Several ex-whale catchers were converted for military service and served with distinction through World War 2; others were scuttled at Salamander Bay and Donkergat. A number of hulks were removed by the South African Navy in 1982 and dumped in deeper water off-shore (Militaria, 1993; Navy News, 1983; Van Der Waag, I., 2005).

In 1942 Saldanha Bay became a defended anchorage with boom defenses, a mine field and batteries on each side of the entrance to the bay. The bay itself was extensively used by convoys and warships alike. A permanent naval base was established and the area's water problems were at last resolved when military engineers established a water supply which was piped from the Berg River (Militaria, 1993; Navy News, 1983). The strategic importance of Saldanha Bay continues to grow with its status as the Cape's only deep sea Port.

1.10.3 History of the study area

The farm Os Fontein 194 for was originally part of a parent farm – an early land grant known as Oliphantskop with involved much of the northern portion of Saldanha Bay and interior. Os Fontein appears to have come into being in 1919 (figure 4). It was a long strip of land that stretched to the northern shore of the bay. Indications are that the land was used for stock farming rather than cultivation.

There are no indications that the land has been ploughed, and the general scarcity of archaeological material indicates that the area was too bleak to be favoured as a settlement site by pre-colonial people. The survey diagram for the property shows no indication of any dwellings or farm buildings, however it does indicate the presence of a large dune or calcrete hill roughly where the existing SFF storage facility is today. It would appear that the natural feature was used to provide the screening material for the existing oil tanks – evidently it was fossil rich. Part of the same farm was purchased for the construction of the SFF storage facility in the 1970's. It was during the excavations for this facility that an important palaeontological specimen – a fossil suid (bushpig) skull was handed over to the South African Museum. Eye-witness accounts (M. Patrick pers com) suggest that fossils were common on site and were collected as souvenirs by project staff.

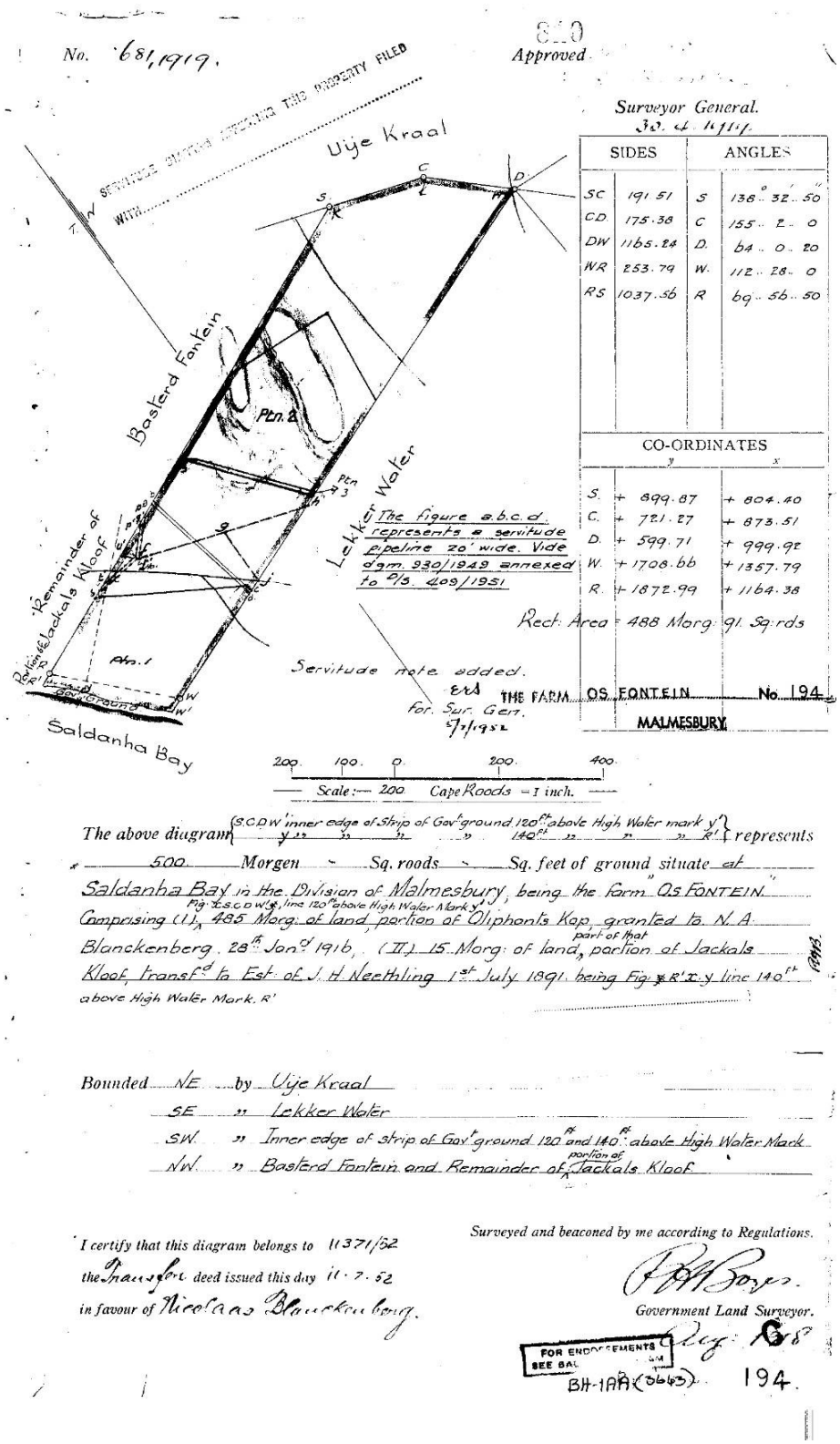

Figure 4 A 1919 land grant showing the complete farm of Os Fontein. Of interest is the clearly depicted dunes located roughly where the SFF facility is today (SG 681, 1919).

Figure 6 A general view over the study area looking southwards towards the existing SSF facility berms.

Figure 5 This deep excavation lies close to, but just outside the study area. No palaeontological material was noted in this trench which was 2-3m deep.

FINDINGS

1.11 PALAEONTOLOGY

The study area is characterized by a sequence of sediments that are variably fossil bearing. The general area is calcrete rich which provides an optimal chemical environment for the preservation of animal bone and marine faunas.

Pether (2018) has described the geological formations that characterise the study area as thus:

1.11.1 The Elandsfontyn Formation - fluvial/river deposits

Over much of the coastal plain of the southwestern Cape, the deeply weathered, late Precambrian-early Cambrian bedrock is overlain by the fluvial Elandsfontyn Formation (Rogers, 1980, 1982), which attains its greatest thicknesses in bedrock topographic lows and is never exposed. The deposition of these sediments is interpreted to relate to meandering rivers under humid climatic conditions (Rogers, 1980, 1982). The Elandsfontyn Formation sediments are considered to be derived from the deeply weathered, coastal-plain bedrock as "newly released, first cycle" material (Rogers, 1980, 1982, 1983). The Elandsfontyn Formation is overlain by the bone-bearing and well-dated, early Pliocene marine Varswater Formation.

Within the study area the Elandsfontein formation could be present, but it is likely to be deeply buried and will not be impacted by the proposed development activity.

1.11.2 The Varswater Formation

Phosphatic and bone-bearing estuarine and marine deposits of the Varswater Formation (Tankard, 1974b) overlie the Elandsfontyn Formation at the old mine that is now the Fossil Park at Langebaanweg. The extensive vertebrate assemblage indicates an early Pliocene age (Hendey, 1981a, 1981b).
The Varswater Formation has been correlated with the early Pliocene high sea-level 5-4 Ma, represented along the West Coast as a transgression to a maximum of ~50 m asl (the 50 m Package: Pether et al., 2000).

The Varswater Formation is possibly the most significant element in the Saldanha area with respect to palaeontological heritage in that it is the subject of the main find and exhibit at West Coast Fossil Park. Estimates are that it lies about 10 m below surface in the study area, however given that the proposed activity is not expected to exceed 5 m depth below surface, the likelihood is that impacts will not occur.

1.11.3 The Uyekraal Shelly Sand Formation

Between Langebaanweg and Saldanha Bay (Fig. 1), a plain averaging ~12 m asl is underlain by marine sediments named the Uyekraal Shelly Sand Formation (Rogers, 1983). Although the Uyekraal farm (which borders the study area) *is the "type area" of the Uyekraal Formation, there is no type section available and the Uyekraal Farm is known only from boreholes. Thus no detailed descriptions of*

exposures exist and the fossil content and age is not adequately established. It has a capping hardpan calcrete, beneath which is green-hued shelly, gravelly sand with phosphatic casts (steinkerns) of molluscs and shark teeth (Rogers, 1982, 1983). On the basis of sea-level and palaeoceanographic history, this extensive marine deposit is estimated to have been deposited in the mid-Pliocene 3.0-3.4 Ma (Pether et al., 2000), before the establishment of the modern, cool-upwelling Benguela regime and the extant fauna. Hendey & Cooke (1985) described a fossil suid skull (bushpig) found in the Skurwerug dune plume (now the site of the "fuel oil tank farm" just east of the ore terminal). The Skurwerug suid dates the aeolianite there to the early Pleistocene ~1.2 Ma. This provides a minimum age for the underlying marine deposits beneath the Skurwerug area.

There is a likelihood that impacts to this formation will occur, in which case extinct marine fossils are likely to be found.

1.11.4 The Velddrif Formation - marine beach and sub-littoral

According to Pether and Hart (2008) the Velddrif Formation accommodates the "raised beach" deposits that occur inland of the "Holocene High", often facing the sea as little cliffs and appearing as obvious "old beach" shells and sand. The shells are slightly powdery and somewhat bleached and in the top of the unit are often dissolved away, as a soil and associated immature calcrete has formed. Many of these outcrops are of late Pleistocene age and are attributed to the Last Interglacial (LIG), a warm period 128-118 ka BP when sea level rose several m above present level. For the West Coast, the type sections (reference outcrops) are around Velddrif, hence the name.

Exposure of this often fossil rich formation are evident in a quarried area at Blue Water Bay, however the study area may be too far inland to have been subject to the raised beach processes that saw the depositing of the shell and sediment rich layers of the Veldrift formation.

1.11.5 The Langebaan Formation

The geology that typifies the study area and is most visible immediately visible (calcrete-capped aeoleanites) is the Langebaan formation. *The Langebaan "Limestone" Formation most visibly includes the old aeolianites (dune sandstones), beneath a capping calcrete crust. These contain further calcretes and leached terra rossa soils at depth, attesting to reduced rates of sand accumulation, with soil formation showing the surface stability. At depth, the aeolianites overlie wind-deflation erosion surfaces formed on the underlying marine deposits, i.e. the Varswater, Uyekraal and Velddrif formations. At this stage the Langebaan formation includes various aeolianites of different ages and is an "amalgam" of the dune plumes that formed on the coastal plain, at differing places and times, during the last ~5 Ma (Pliocene to the late Pleistocene). The aforementioned fossil suid (bushpig) from Skurwerug dates that fossil dune-plume to the early Pleistocene (after Pether, 2008).*

Although usually not very fossiliferous, aeolianites do have a fossil content. Most of the fossils in the aeolianites are associated with old, buried stable surfaces (palaeosurfaces). The common fossils include shells of landsnails, fossil tortoises, ostrich incl. egg fragments, sparsely scattered bones etc. Concentrations of bones of antelopes and carnivores may occur in the lairs of hyaenas. Since overhangs

and crevices were used as lairs, these bone concentrations are usually "superimposed" into an older, cementing aeolianite. "Blowout" erosional palaeosurfaces may carry fossils concentrated by the removal of sand by the wind. Hollows between dunes (interdune areas) are the sites of ponding of water seeping from the dunes, leading to the deposits of springs, marshes and vleis. These are usually muddy, with plant fossils, but being waterholes, are usually richly fossiliferous. Buried Early and Middle Stone Age archaeological sites may occur within the aeolianite, particularly in its upper part.

The Langebaan formation will be impacted by the proposed activity and in all likelihood will make up the formation that will be most affected. This formation is also young enough to contain both palaeontological and archaeological material. The frequency of finds is "patchy" and difficult to predict as occurrences of fossil bone tend to form clusters depending on the agents of accumulation. Early hyena lairs tend to be isolated occurrences, however when they are exposed the produce a large amount of bone representing a "spread" of the variety of animal species that were on the landscape. Importantly fossil bone containing the rare remains of early humans (hominids) can occur. A fossil hyena den found at Hoedjiespunt has produced human bone of Pleistocene age.

1.12 ARCHAEOLOGICAL HERITAGE

The field survey of the site revealed no evidence of any archaeological material. This is consistent with Ortons (2011) survey of the neighboring farm Uyekraal where no surface archaeological material was identified. Indications are that the proposed activity will not result in any physical impacts to heritage of colonial and pre-colonial inhabitants.

Similarly service pipelines and transmission lines across this landscape are not expected to result in impacts.

Pether and Hart (2008) has hypothesized that there is a possibility that earlier kinds of archaeological material pertaining to the Middle and Early Stone Age may be found cemented in the aeolianites and calcretes of the Langebaan formation. This is a possibility; however none was identified in the single deep exposure presently on site or within any of the calcrete rock outcrops inspected. The difficulty is that the presence of such material is almost impossible to detect from surface observations as it is typically buried, and if it is present on site, will only be manifested when impacted by the process of bulk excavation. Indications are that the probability of an impact occurring is low; however a find would not be unexpected.

1.13 LANDSCAPE

Saldanha Bay is an area that has undergone enormous change in the last thirty years. It is no longer a small fishing port remotely situated on a desolate shoreline within a mainly rural context. The natural landscape qualities of the area have been irrevocably compromised by not only massive suburban and resort development but also several major industries that have effectively transformed the area from a near wilderness into a recent dominantly industrial landscape. The proposed activity takes place within a

designated zone for industrial development, which is consistent with the provisions of the local structure plan (Saldanha Bay Municipality, 2007).

The construction of below surface pipelines will not cause any landscape impacts.

The construction of an 11 kV transmission line to the Blue Water substation will not result in significant aesthetic impacts as the landscape in this area is “littered” with electrical infrastructure supplying current to other industrial enterprises.

The most significant heritage site in the area is the West Coast Fossil Park which lies roughly 5 km north east of the study area. This is a Grade 1 site of national heritage significance. The proposed oil storage facility is likely to be visible from the edge of the Park as a low feature in the distance, however given that the proposed facility will be situated immediate in front of the existing oil tanks in line of site, the impact will not be significantly different to that that which exists today. “E” quarry which contains the fossil exhibit is well within the Park and therefore will not experience any visual impact (figure 11).

The independent visual impact assessment of the proposed site (Aurecon, 2012) has determined that although the proposed facility will be widely visible in the flat landscape of the coastal plain, its presence will be commensurate with the existing uses of the surrounding landscape resulting in an overall medium – low level of impact.

1.14 BUILT ENVIRONMENT, OTHER GENERALLY PROTECTED HERITAGE

There are no structures of significance within the study area. The 52 hectares purchased for the proposed activity excludes the farm buildings at Tiekosklip (Grade IIIB-C). This farm contains elements (barn, kraals and outbuildings) that may be considered generally protected heritage, however the structures are not considered worthy of inclusion on the provincial heritage register and lie outside of any urban conservation area (figures 9,10). No direct impacts will occur as the buildings are situated well clear of the proposed activity.

Figure 8 Dwelling house and farm buildings at Tiekosklip

Figure 7 Barns and calcrete kraal walls at Tiekosklip. Tiekosklip will not be affected by the proposed activity.

Figure 9 The proposed site relative to West Coast Fossil Park heritage site (wikimapia)

ASSESSMENT OF IMPACTS

1.15 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.

1.15.1 Palaeotology

Palaeontological material is vulnerable to destruction by bulk earthmoving operations during the construction phase. 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 summary, 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 its past environments.

Depending on which formations are penetrated during bulk excavation fossil occurrences are expected to be sporadic if excavations are less than 5 m deep. If excavations penetrate to depths of up to 10 m below surface, the frequency of impacts may be substantially higher, particularly if formations such as the Varswater Formation are impacted. The depth of this formation on site has been estimated at about 10 m below surface; however it must be considered that the depth, dip and strike of the formation can change from place to place.

Table 1: Summary of impacts to palaeontological material

NATURE OF IMPACT: Impacts to palaeontological material could involve displacement or destruction of material during bulk excavation.		
	Without mitigation	**With mitigation**
EXTENT	Local	Local
DURATION	Permanent	Permanent
MAGINITUDE	Medium	Medium
PROBABILITY	Possible	Possible
SIGNIFICANCE	Medium	Medium
STATUS	Negative	Positive
REVERSIBILITY	Non-reversible	Non-reversible
IRREPLACEABLE LOSS OF RESOURCES?	Yes	No
CAN IMPACTS BE MITIGATED?	Yes	
MITIGATION: Monitoring and collection program during excavation. Material to be curated at West Coast Fossil Park.		
CUMULATIVE IMPACTS: The sub-surface extent of the palaeontological resources is unknown but anticipated to be locally widespread. Cumulative impacts are not expected to be extensive.		
RESIDUAL IMPACTS: n/a		

1.15.2 Archaeology

Archaeological sites (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, however benefit can be gained if exposed material which would otherwise not be seen is sampled and recorded during excavation. The greatest damage to archaeological resources typically takes place during the construction phase.

No archaeological material was observed in the proposed project area. There is a possibility that buried Pleistocene archaeology may be exposed during bulk excavation.

Table 2: Summary of impacts to archaeological material

NATURE OF IMPACT: Impacts to archaeological material could involve displacement or destruction of material during bulk excavation.		
	Without mitigation	**With mitigation**
EXTENT	Local	Local
DURATION	Permanent	Permanent
MAGINITUDE	Minor	Minor
PROBABILITY	Very improbable	Very improbable
SIGNIFICANCE	Low	Low
STATUS	Negative	Neutral - positive
REVERSIBILITY	Non-reversible	Non-reversible
IRREPLACEABLE LOSS OF RESOURCES?	Yes	No
CAN IMPACTS BE MITIGATED?	Yes	
MITIGATION: No sites requiring mitigation were encountered, however monitoring during bulk excavation must include monitoring for archaeological material.		
CUMULATIVE IMPACTS: Cumulative impacts are not expected.		
RESIDUAL IMPACTS: n/a		

1.15.3 Built environment and setting

Impacts to built environment and qualities of heritage landscapes are not expected.

Table 3 Summary of the impacts to built environment and the quality of heritage landscapes.

NATURE OF IMPACT: Buildings can be affected by poorly considered changes and alterations, landscapes with have aesthetic and or historical value will be damaged by new intrusive or ill-considered developments.		
	Without mitigation	**With mitigation**
EXTENT	Local	Local
DURATION	Permanent	Permanent
MAGINITUDE	Minor	Minor
PROBABILITY	Very improbable	Very improbable
SIGNIFICANCE	Low	Low
STATUS	Neutral	Neutral
REVERSIBILITY	Non-reversible	Non-reversible
IRREPLACEABLE LOSS OF RESOURCES?	No	No
CAN IMPACTS BE MITIGATED?	Yes	
MITIGATION: Aesthetic issues can be handled by good landscape around the facility and restitution of vegetation.		
CUMULATIVE IMPACTS: Cumulative impacts are not expected.		
RESIDUAL IMPACTS: n/a		

1.15.4 Ranking of alternatives

There are no compelling reasons to suggest that site Alternatives 1 and 2 hold substantive differences in merit, however the fact that site alternative 2 utilises land that has been previously disturbed goes some way to lessening the possibilities of negative impacts to both archaeology and palaeontology.

Site Alternative 2 is favoured marginally over Site Alternative 1, however if other technical and environmental considerations favour Site Alternative 1, this would be considered acceptable.

With respect choice of tanks forms, the decision to utilise circular or truncated square tanks or a combination of both will have no bearing on heritage impacts.

MITIGATION

1.16 GENERAL RECOMMENDATION

It has been estimated that mining activities destroyed between 70% and 80% of the fossils that originally occurred in the Varswater Formation at 'E' Quarry at West Coast Fossil Park. Thus, it is suggested that full-time monitors, preferably palaeontology/archaeology students, be employed to oversee excavations for the foundations for the storage tanks. Monitors could be employed in shifts of one or two weeks at a time. In addition, all on-site construction personnel should be given a short course on how to recognize fossils. This way there will be more eyes on the ground, which would be vital given the extent of proposed excavations. It is also recommended that a professional palaeontologist visits the site once a month (or more regularly if abundant/important fossils are found), to oversee monitoring activities and look through fossil material. When dense areas of fossils are uncovered, construction activities should stop in the locality of the find and a professional palaeontologist called in to set up a controlled excavation.

- Monitoring for fossil occurrences turned up during bulk excavation is desirable and therefore recommended. Archaeological and/or fossil vertebrate material is sporadic in occurrence and the likelihood of its rescue is greatly improved by regular observation of excavation works. The collect of material could be done by staff at senior student level, with oversight provided a professional palaeontologist (or archaeologist if needed).

- It is improbable that palaeontological finds will require declarations of permanent "no go" zones. At most a temporary pause in activity at a limited locale may be required to allow the palaeontologist to remove the finds.

- It is very Important to have the co-operation (and enthusiasm) of the people on the ground, such as personnel in supervisory/inspection roles (the project manager, engineers, surveyors, site foremen), whom are willing and interested to look out for occurrences of potential heritage/scientific significance and alert a paleontologist to conduct an immediate site inspection. West Coast Fossil Park could be used as a venue for setting up a short course.

- If a major bone concentration is encountered, the best procedure would be to remove as much as is feasible in encased blocks of calcrete and if necessary shift large disturbed samples by excavator and truck from the site to West Coast Fossil Park where the material could then be stored/stockpiled for sieving and further preparation. An experienced palaeontologst must provide oversight of this process.

- Discussions have been initiated with West Coast Fossil Park with a view to forming a future working relationship. The West Coast Fossil Park has agreed to provide storage for fossil material retrieved/excavated from the site of the new oil storage tank farm. It is recommended that fossil material be taken to the storage at the fossil park each evening. If this is not possible, a dedicated temporary storage facility should be provided on site. Fossils should however not be allowed to accumulate on site for more than a week. In addition to providing funding for monitors, storage facilities and materials, it would also be advisable to enable employment for one or two people from the local community to curate material prior to storage at the Fossil Park. Consideration should be given to setting up a dedicated exhibit at the Park if the material found is suitable.

1.16.1 A note on human remains

Human remains can occur anywhere on the landscape. They are found commonly close to archaeological sites; they may be found in "lost" graveyards, or occur sporadically anywhere as a result of prehistoric activity, victims of conflict or crime. If any human bones are found during the course of excavation work then they should be reported to an archaeologist and work in the immediate vicinity should cease until the appropriate actions have been carried out by the archaeologist. If the bones are found upon examination to be part of a burial then they would need to be exhumed. Depending on their age, this would need to be done under a permit from either HWC (for pre-colonial burials) or SAHRA (Burials later than about AD 1500).

CONCLUSION

The proposed activity is considered acceptable in heritage terms.

There are no fatal flaws.

In terms of the proposed site alternatives, Site Alternative 2 is marginally favoured over Site Alternative 1. In terms of the layout and selection of tank designs, this will have no influence on heritage impacts.

Indications are that impacts to generally protected heritage will be minimal, while the potential effect of the project in terms of the discipline of palaeontology is potentially beneficial if mitigation of carried out effectively. New knowledge will be generated which through West Coast Fossil Park who have offered

co-operation, will find its way to educational enrichment of the populous - academic and general public alike.

REFERENCES

Avery, G., Halkett, D., Orton, J., Steele, T. & Klein, R. (2008). The Ysterfontein 1 Middle Stone Age Rockshelter and the evolution of coastal foraging. South African Archaeological Society Goodwin Series 10: 66-89.

Dickason, G.B. 1973. Irish settlers to the Cape: history of the Clanwilliam 1820 settlers from Cork Harbour. Cape Town: A.A. Balkema.

Hart, T.J.G. & Jerardino, A.M. 1998. Phase 2 archaeological sampling of Late Stone Age archaeological sites at Paradise Beach, Club Mykonos. Unpublished report prepared for CML Developers. ACO. UCT.

Hart, T.J. G and Gribble J. 1998. Phase 2 archaeological sampling of Late Stone Age middens, Leentjiesklip 2, Langebaan. Unpublished report prepared for Langebaan Waterfront Pty Ltd. ACO. UCT.

Hart, T. & Pether, J. (2008). Phase 2 expansion of the Sishen - Saldanha Iron Ore Export Corridor, Saldanha Bay, Western Cape: heritage impact assessment (part 1), palaeontological impact assessment (part 2). Unpublished report prepared for Transnet. University of Cape Town: Archaeology Contracts Office.

Hendey, Q.B. 1981a. Palaeoecology of the Late Tertiary fossil occurrences in "E" Quarry, Langebaanweg, South Africa, and a re-interpretation of their context. Annals of the South African Museum 84: 1-104.

Hendey, Q.B. 1981b. Geological succession at Langebaanweg, Cape Province, and global events of the Late Tertiary. South African Journal of Science 77: 33-38

.

Hendey, Q.B. and Cooke, H.B.S. 1985. Kolpochoerus paiceae (Mammmalia, Suidae) from Skurwerug, near Saldanha, South Africa, and its palaeoenvironmental implications. Annals of the South African Museum 97: 9-56.

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

Orton, J 2011, Heritage Impact Assessment for the proposed Uyekraal Wind Energy Facility at Saldanha Bay. Report prepared for Savannah Environmental Pty Ltd.

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.

Parkington, J.E. and Poggenpoel, C.E. 1987 Phase 1 archaeological assessment of Club Mykonos, Langeebaan. Unpublished report prepared for Club Mykonos, Langebaan.

Parkington J.E., Poggenpoel, C.E. and Hart, T.J.G 1988, Report on the first phase of excavations at Lynch Point, Langebaan. Unpublished report prepared for Club Mykonos, Langebaan.

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, Oxford University Press, New York*. No. **40**: 33-55.

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

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.

Sadr, K., Smith, A., Plug, I,. Orton, J. & Mutti, B. (2003). Herders and foragers on Kasteelberg: interim report on excavations 1999-2002. South African Archaeological Bulletin 58: 27 – 32.

Saldanha Bay Municipality 2007, Draft Zoning Scheme update. Prepared by Urban Dynamics Western Cape, Town and Regional Planners.

Schire, C., Cruz-Uribe, K. & Klose, J. 1993. The site history of the historical site at Oudepost I, Cape. *South African Archaeological Society Goodwin Series* **7**:21-32.

Smith, A.B. (2006). Excavations at Kasteelberg and the origins of the Khoekhoen in the Western Cape, South Africa. Oxford: BAR International Series 1537.

Smith, A.B., Sadr, K., Gribble, J. & Yates, R. (1991). Excavations in the South-Western Cape, South Africa, and the archaeological identity of prehistoric hunter-gatherers within the last 2000 years. South African Archaeological Bulletin

Militaria. 1993 SA Navy Anniversary Issue 22/1

Navy news. 1983 Deel 11 No 5 1983

Van der Waag, Ian. 2005 A brief military history of the Saldanha Bay. Military History Department, University of Stellenbosch. http://academic.sun.ac.za/mil/mil_history/saldanha.htm

Webley, L., Orton, J. & Hart, T. 2010 Heritage impact assessment: proposed West Coast One Wind Energy Facility, Vredenburg District, Western Cape. Unpublished report prepared for Savannah Environmental. St James: ACO Associates.

Appendix A

Specialist report by Deano Stynder (Palaeontology)

Palaeontological assessment of the Varswater Formation– new crude oil storage tank farm, Saldanha

Introduction

The construction of the new crude oil storage tank farm on the remainder of the Farm Os Fontein 194 (33 00'49.08"S, 18 03'35.86"E) will very likely uncover fossil-rich horizons, the richest of which should be found approximately 10 meters below the current land surface in the Varswater Formation (Roberts, 2006; Roberts *et al.*, 2011). The Varswater Formation and its fossil content are best known from exposures at the nearby Langebaanweg 'E' Quarry fossil site (32°58′S, 18°7′E), located north-east of the proposed tank farm (Fig. 1). This locality is world-renowned for its exceptionally well-preserved vertebrate faunal remains that date to the terminal Miocene/earliest Pliocene (Approximately 5 Million years ago).

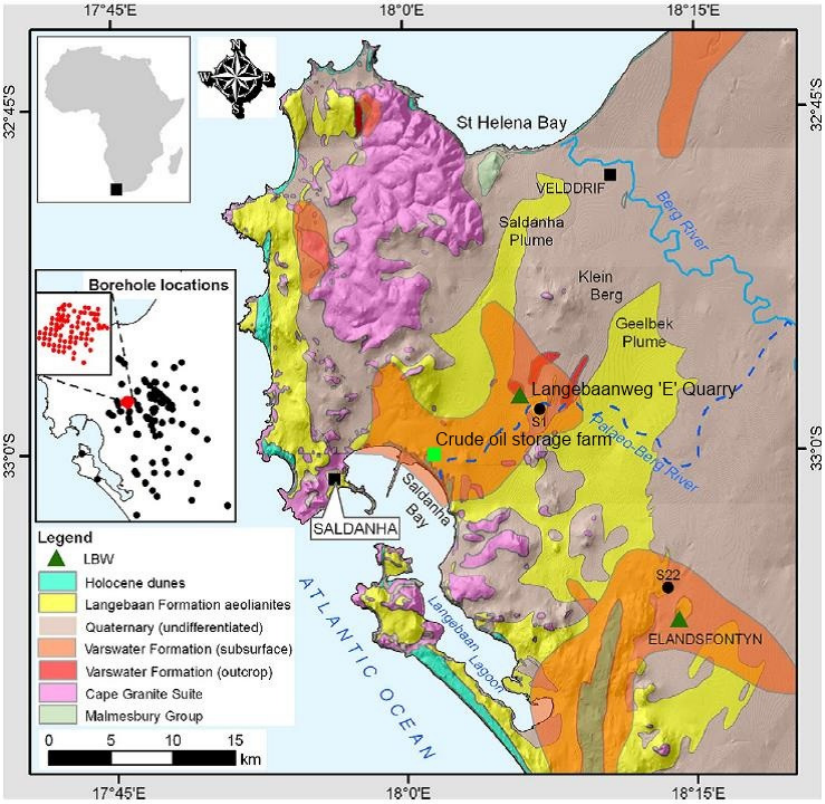

Figure 1: Geological map of the Langebaan/Saldanha region. The locality of the new crude oil storage tank farm (green square) is identified in relation to the subsurface distribution of the Varswater Formation. Map adapted from Roberts *et al*. 2011.

The Varswater exposure at Langebaanweg

The region around the west coast railway siding of Langebaanweg (Fig. 2) is generally rich in phosphates, and it was through phosphate mining activities that vertebrate fossils were first discovered at Baard's Quarry in 1943 (Fig. 2). Phosphate mining activities eventually moved to 'C' and 'E' Quarries in the 1960's, leading to further fossil discoveries. While these localities have attracted the interests of scientists since the first fossil discoveries, their true importance and age were only realised by scientists in 1961, when the Baard's Quarry fossils were initially described (Singer 1961; Hendey 1978). It was the older, more prolific bone beds of 'E' Quarry though that soon established Langebaanweg as a fossil-rich region of world importance.

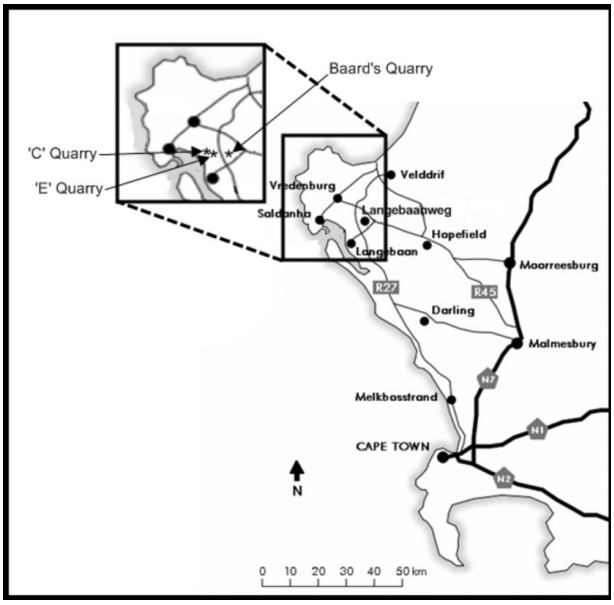

Figure 2: Locations of Baard's Quarry, Langebaanweg 'C' Quarry and Langebaanweg 'E' Quarry.

From the 1960s until the late 1980s, Langebaanweg 'E' Quarry was a major focus of research at the South African Museum (now Iziko South African Museum). Museum Quaternary palaeontologist, Brett Hendey, published many articles during this time period, both on the remarkable fossil fauna and the geology of the region (Hendey 1974, 1981, 1982, 1984). While research on the site's fauna continued, formal excavations ended at 'E' Quarry in 1976 (Fig. 3). In the 1990s, research on the site's fossil material dropped off considerably. More recently, since the establishment of the West Coast Fossil Park (the educational, research and tourism institution that incorporates the Langebaanweg palaeontological site) in 1998, research at Langebaanweg 'E' Quarry has revived. The actual mining site was rehabilitated

and controlled excavations were established to expose patches of the fossil bed for tourism and educational purposes.

Figure 3: Site of the final excavation carried out by Hendey at 'E' Quarry in 1976 while phosphate mining was still in operation. Inlay of the skull of the bear *Agriotherium africanum* discovered at this particular locality.

Langebaanweg 'E' Quarry is possibly the most faunally diverse Mio-Pliocene site in the world. As noted above, the vast majority of this site's fossils derive from the Varswater Formation, about 10 meters below the surface. Four members are recognized in the most recent lithostratigraphic review of this formation: the early Late Miocene Langeenheid Sandy Clay Member (LSCM) and Konings Vlei Gravel Member (KVGM), and the Late Miocene/Early Pliocene Langeberg Quartzose Sand Member (LQSM) and Muishond Fontein Pelletal Phosphate Member (MPPM) (Roberts, 2006) (Fig. 4). The LQSM and the MPPM are extremely rich and have thus far produced the bulk of the 'E' Quarry fossils. The LQSM is construed as primarily a floodplain and salt marsh deposit, while the MPPM is interpreted as primarily a river channel deposit (Hendey, 1982; Roberts, 2006). Two river channels, beds 3aS and 3aN, have been identified. While the temporal relationship between these two beds remains unclarified, bed 3aS appears

to be the earlier of the two (Hendey, 1981, 1984). In any event, both river channels are thought to reflect a progressive northward shift of the lower course of the proto-Berg River (see Fig. 1).

Sandveld					Group
Varswater				Langebaan	Formation
Langeenheid Clay	Konings Vlei Gravel	Langeberg Quartz Sand	Muishond Fontein Pelletal Phosphate	Diazville	Member
Early Late Miocene [~10 Ma?]		Late Miocene [~5 Ma]		Pliocene [2Ma?]	Age

Figure 4: Division of the geological members of the Varswater Formation (modified from Roberts, 2006).

Researchers from all over the world come to South Africa to work with these collections at Iziko, particularly as they provide important context for interpreting and dating similarly aged sites in other parts of Africa. In fact, Langebaanweg has been an important site for understanding the emergence of our own hominin lineage, as some of the earliest fossil hominins in eastern Africa come from sites with comparable assemblages and ages.

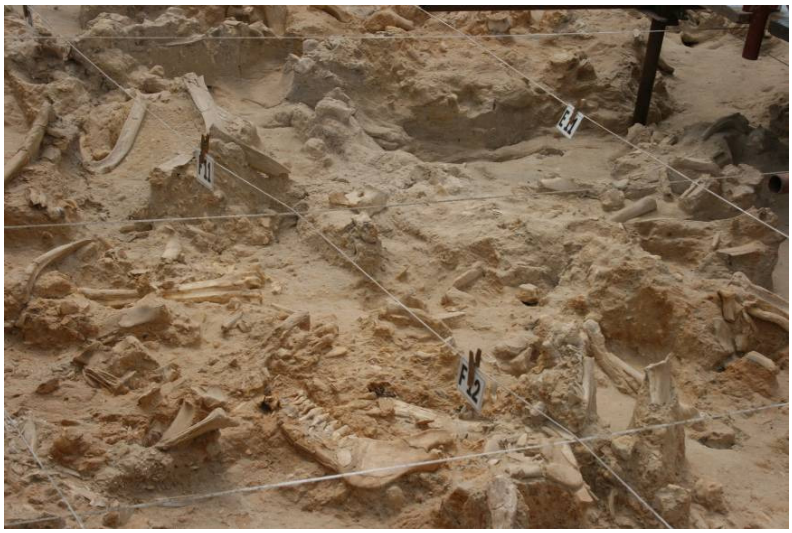

Figure 5: Bone-bed uncovered during relatively recent excavations.

During recent controlled excavations at the site, scientists were able to clarify aspects of the depositional history of the bones. The spatial distribution of bones suggests that they probably originated from animals that may either have drowned or been hunted along the Proto-Berg River by various carnivores. Carcasses or remains of carcasses then floated down-river (towards the sea). Not all made it to the open sea though, as is evinced by the concentration of bones at the site. It is likely that a substantial number of carcasses came to rest in shallow pools on the side of the Proto-Berg River or were obstructed from flowing further by phosphate boulders lying in the path of the river (Fig. 5).

Interesting and important animal specimens that have been recovered from the site include a giant extinct bear, *Agriotherium africanum*, the first bear to be found in Africa south of the Sahara, carnivores such as sabre-toothed cats and the megatooth shark, and a fascinating diversity of herbivores such as the double-tusked gomphotheres, three-toed horses and short-necked giraffes. The animals are an interesting combination of ancient and emerging taxa. Many of the newer taxa were more adapted to open grassy/shrubby habitats than to closed habitats. Interestingly, pollen evidence suggests that Fynbos was already present in the environment during the Mio-Pliocene (Tankard and Rogers 1978; Coetzee and Rogers 1982; Scott 2005). The Pliocene was a time of global cooling after the warmer Miocene. The cooling and drying of the global environment may have contributed to the extensive spread of open habitats during this time (Cerling 1992, 1993).

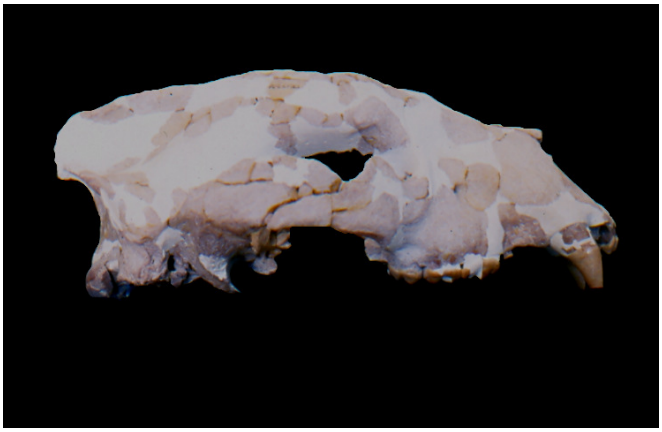

Figure 5: Bear skull (*Agriotherium africanum*) from Langebaanweg.

The onset of drier conditions severely reduced the amount of wooded habitats. During this period our early hominid ancestors, like all other animals with which they shared the environment, had to adapt physically and behaviorally to survive. In order to remain effective in gathering food, hominids had to travel relatively long distances with food or tools, thus making quadrupedalism extremely inefficient. Some have suggested that bipedalism (walking upright) developed both as an adaptation to facilitate movement across the grasslands and as a way to give early hominids use of their hands for food cultivation and tool use since they were no longer needed for locomotion. While not everyone accepts that environmental drying may have led to bipedalism, there is little doubt that dryer environments had to have had an influence on how our early ancestors evolved. Langebaanweg as one of the few Mio-Pliocene sites in Africa is an important window into environmental change at a time when our lineage just started to emerge. Fossils found during foundation excavations at the site of the new oil storage tank farm would have similar value.

Palaeontological mitigation

It has been estimated that mining activities destroyed between 70% and 80% of the fossils that originally occurred in the Varswater Formation at 'E' Quarry. Thus, it is suggested that full-time monitors, preferably palaeontology/archaeology students, be employed to oversee excavations for the foundations for the storage tanks. Monitors could be employed in shifts of one or two weeks at a time. In addition, all on-site construction personnel should be given a short course on how to recognize fossils. This way there will be more eyes on the ground, which would be vital given the extent of proposed excavations. It is also recommended that a professional palaeontologist visits the site once a month (or more regularly if abundant/important fossils are found), to oversee monitoring activities and look through fossil material. When dense areas of fossils are uncovered, construction activities should stop and a professional palaeontologist called in to set up a controlled excavation.

The West Coast Fossil Park has agreed to provide storage for fossil material retrieved/excavated from the site of the new oil storage tank farm. As they currently have a shortage of space, they have requested that funding be made available to build or upgrade existing storage facilities. The Fossil Park should be contacted directly with regards to the amount of funding needed for storage facilities, but obviously this would depend on the quantities of fossils retrieved. Funding should also be made available for boxes and bags in which to store fossil material. It is recommended that fossil material be taken to the storage at the fossil park each evening. If this is not possible, a dedicated temporary storage facility should be provided

on site. Fossils should however not be allowed to accumulate on site for more than a week. In addition to providing funding for monitors, storage facilities and materials, it would also be advisable to provide funding for one or two people from the local community to curate material prior to storage at the Fossil Park.

References

Cerling T.E. 1992. Development of grasslands and savannas in East Africa during the Neogene. *Palaeogeography Palaeoclimatology Palaeoecology* 97: 241–247.

Cerling T.E. 1993. Expansion ofC4 ecosystems as an indicator of global ecological change in the late Miocene. *Nature* 361: 344–345.

Coetzee JA and Rogers R. 1982. Palynological and lithological evidence for the Miocene palaeoenvironment in the Saldanha region (South Africa). *Palaeogeography Palaeoclimatology Palaeoecology* 39: 71–85.

Hendey QB. 1974. The late Cenozoic carnivora of the south-western Cape Province. *Annals of the South African Museum* 63: 1–369.

Hendey QB. 1978. The age of the fossils from Baard's Quarry, Langebaanweg, South Africa. *Annals of the South African Museum* 75: 1–24.

Hendey QB. 1981. Geological succession at Langebaanweg, Cape Province, and global events of the late Tertiary. *South African Journal of Science* 77: 33–38.

Hendey QB. 1982. Langebaanweg. A record of past life. South African Museum, Cape Town.

Hendey QB. 1984. Southern African late Tertiary vertebrates. In: Klein RG. (Ed.), *Southern African Prehistory and Palaeo-environments*. AA Balkema, Rotterdam, pp. 81–106.

Roberts DL, Matthews T, Herries AIR, Boulter C, Scott L, Dondo C, Mtembi P, Browning C, Smith RMH, Haarhoff P, Bateman MD. 2011. Regional and global context of the Late Cenozoic Langebaanweg (LBW) palaeontological site: West Coast of South Africa. *Earth-Science Reviews* 106:191–214.

Scott L. 1995. Pollen evidence for vegetational and climatic change in southern Africa during the Neogene and Quaternary. In: Vrba ES, Denton, GH, Partridge TC and Burckle LH (Eds.), *Paleoclimate and Evolution with Emphasis on Human Origins*. Yale University Press, New Haven. pp. 65–76.

Singer R. 1961. The new fossil sites at Langebaanweg (South Africa). *Current Anthropology* 2: 385 – 387.

Tankard AJ and Rogers J. 1978. Late Cenozoic palaeoenvironments on the west coast of southern Africa. *Journal of Biogeography* 5: 319–337.

***