DRAFT PALAEONTOLOGICAL IMPACT ASSESSMENT

NEW BORROW PITS FOR ROADWORKS

PORT NOLLOTH – RICHTERSVELD MUNICIPALITY

By

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PROJECT DESCRIPTION

The Richtersveld Municipality intends to apply for 2 Mining Permits for the excavation of 2 borrow pits, to provide material (clay) for road-building purposes in the Port Nolloth area.

This document has been prepared at the request of Irmé van Zyl of Van Zyl Environmental Consultants, Upington, the environmental management consultant conducting the EIA processes for the Richtersveld Municipality, including possible heritage impacts.

A Quote was requested for a Palaeontological Impact Assessment (PIA) for the area where the borrow pits will be located. This draft PIA explains the nature of palaeontological mitigation and informs about the basis of the Quote. It serves as the basis for discussion about the agreed Terms of Reference for the palaeontological heritage impact management part of the project.

Palaeontological Heritage Management

Unlike archaeological mitigation, the sampling or rescue of fossils cannot usually be done prior to the commencement of excavation operations.

Although fossil shells may be exposed in the vicinity of the sites, in this case the intention is to describe the *in situ*, pristine stratigraphic sections exposed within the borrow pits and sample the *in situ* fossil content.

These palaeontological interventions thus happen once the EIA process is done, approvals have been obtained and excavation of the borrow pits is quite advanced.

The action plans and protocols for palaeontological mitigation must therefore be included in the Environmental Management Plan (EMP) for the borrow pits.

Palaeontological mitigation is a longer-term process and does not impede the project.

On the contrary, the “windows” into the subsurface provided by borrow pits and other excavations, such as made by diamond mining, have been invaluable to the science of fossils and geological history. They provide an opportunity to see the hidden pages of the landscape.

In this sense, large holes in the ground can be an asset beyond their economic/material motivation, provided that the information they show is interpreted and appropriately communicated to citizens and visitors (part of the EMP).

The main purposes of this assessment are to:

- Outline the nature of possible palaeontological heritage resources in the subsurface of the borrow pit area.
- Suggest the mitigatory actions to be taken during the quarrying of material at the sites with respect to the occurrence of fossils.

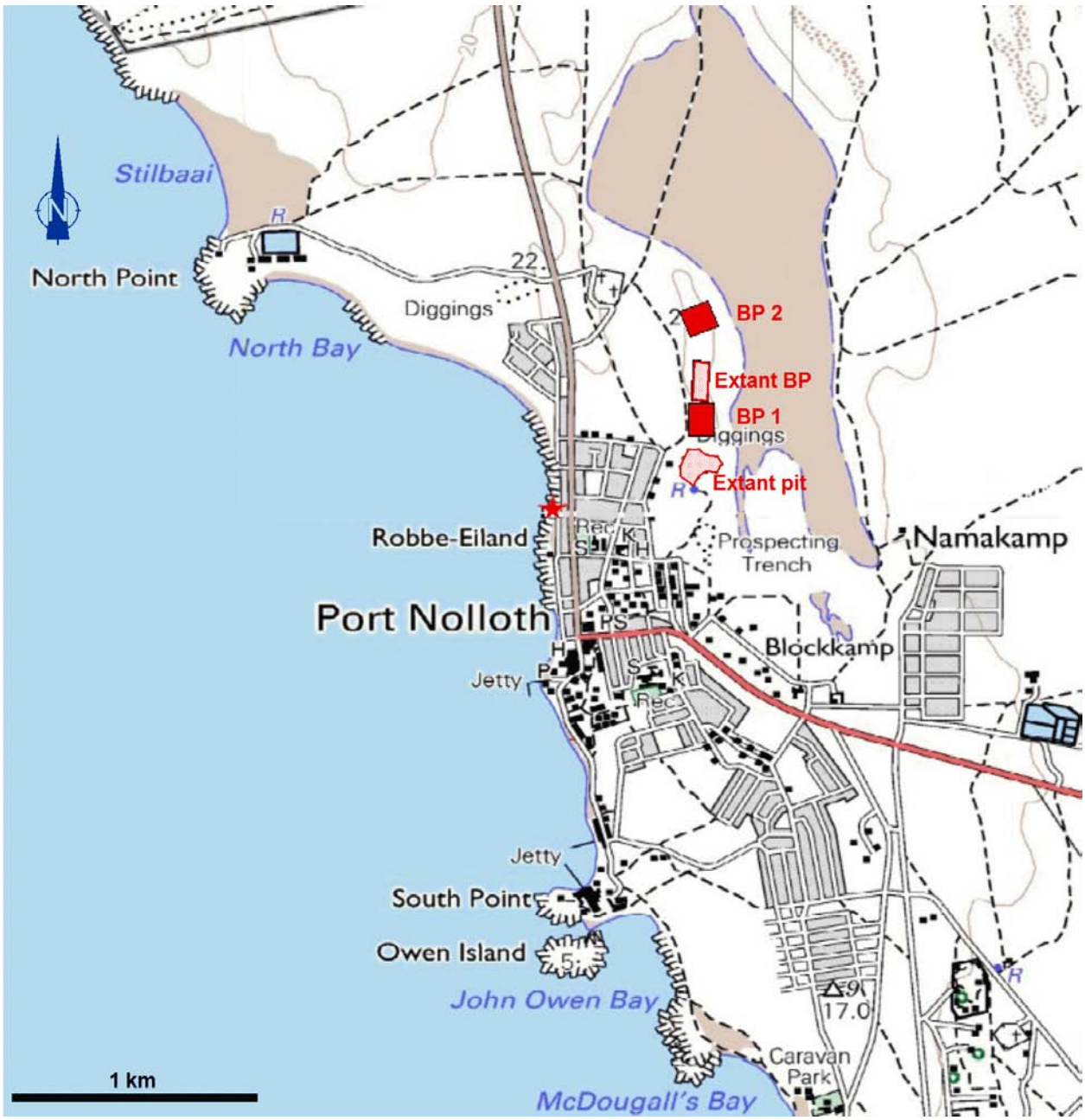
SETTING

The sites of the two proposed new borrow pits, each 1.5 ha in extent, are in the north-eastern part of Port Nolloth town environs, ~150 m from the edge of the residential area of the town (Map 1). The area is badly degraded and is situated next to a seasonal salt pan/wetland which is also badly degraded. There are existing pits to the north and south of Borrow Pit 1 (BP 1, Map 1). The pits are positioned on a dune ridge that flanks the salt pan. The salt pan is situated within a bedrock depression outlined by the ~8 m asl. bedrock contour (Keyser, 1972)

The writer has not inspected the various pits and prospecting trenches around Port Nolloth and is thus not familiar with the specific geology exposed in these pits. The following description of the expected geology is therefore of a general nature, based on knowledge of the broader stratigraphy of the West Coast.

The bedrock to the east of Port Nolloth is overlain by a marine formation called the 30 m Package or the Hondeklip Formation. This formation is of mid-Pliocene age (3.0-3.4 Ma) and relates to a major sea-level transgression which reached ~30 m asl. Beach and shoreface deposits then built out seawards from the ~30 m asl. transgressive maximum, forming the regressional 30 m Package. The formation extends to near the present day shoreline, where it is overlain by much younger deposits relating to a ~15 m high sea level.

The Hondeklip Formation is the youngest formation that has warm-water shells, particularly fossil oysters. However, large volumes have been affected by decalcification and pedogenic reddening, superficially



MAP 1. Location of the proposed borrow pits (BP 1 & BP 2).

(Extract of 1:50000 maps 2916BA_BB and 2916BD, 2003, Chief Directorate Surveys & Mapping, land Affairs, RSA.)

causing it to resemble terrestrial deposits. Also, a considerable portion of its upper part has been eroded by wind and this erosion surface is overlain by windblown sands.

The seaward edge of the Hondeklip Formation has been truncated by marine erosion that took place during much younger highstands of sea-level reached during the Quaternary Period.

As in the southwestern Cape, the most prominent of these deposits are the younger Last Interglacial (LIG) and the mid-Holocene deposits.

Very little descriptive information is available for these Quaternary "Recent Emergence Terraces", the 8-12 m Package, the LIG 4-6 m Package and the mid-Holocene 2-3 m Package, along the Namaqualand coast.

The older, 8-12 m Package could relate to a prominent middle Pleistocene interglacial called Marine Isotope Stage 11 (MIS 11) ~400 ka ago. Alternatively, it is been argued on the basis of vertebrate evidence that this old shoreline is early Pleistocene, about 1.2 Ma (Hendey & Cooke, 1985).

Given that all of the pre-LIG Quaternary highstands evidence is “subsumed” in the “8-12 m Package” deposits, at this stage, it quite feasible that the poorly-known “8-12 m Package” deposits could include units of differing age at various localities.

It is clear that the record of Quaternary high sea levels is very condensed along the West Coast, with each highstand largely destroying deposits of the previous highstand. Low sediment supply for progradation and slow or negligible uplift contributed to this situation. However, it also seems that few later Quaternary highstands exceeded present sea level (Siddall *et al.*, 2007). Other complications are evidence of brief high spikes in sea-level during interglacials 5e and 11 (Siddall. *et al.*, 2007).

Given the elevations of the lower-lying areas adjacent proposed pit sites (12-15 m asl. to the west and 8-10 m asl. on the saltpan, estimated from Google Earth), it seems that underlying marine deposits could be the “8-12 m Package” and possibly Hondeklip Formation deposits at depth. The map in Keyser (1973) shows “Lower Terrace” deposits (i.e. Quaternary deposits) underlying the southern part of the salt pan and the sites.

Furthermore, the low-lying nature of the coastal bedrock at Port Nolloth holds the possibility that a more complete stratigraphic record of the Quaternary might be preserved, possibly including evidence for a LIG spike in sea level. The sites are too high for direct sea-level impingement during the Holocene high, but high water-table effects may have occurred.

As the stated purpose is to excavate „clay“ for use in road building, presumably the upper dune sands are underlain by a “clayey” deposit. This could be older dune or marine sands in which soil-formation has taken place, producing a clay content. A pedogenic or groundwater calcrete could be developed. Alternatively, it could be clays deposited or formed in a more extensive pan or lagoonal environment in the past.

Comment aside

Any information, such as drilling logs or geotechnical data acquired during the feasibility study for the borrow pits, could be useful at this stage.

Has an archaeological impact assessment been done?

ASSESSMENT: EXPECTED GEOLOGY/PALAEONTOLOGY

The borrow-pit sites are expected to be immediately underlain by a thickness of dune and/or sandsheet deposits. Beneath this is some unknown combination of older deposits including possible aeolian, pan, lagoonal or open-marine palaeoenvironments, with probable pedogenic horizons.

It is expected that fossil shells and bones in the uppermost windblown sands and “weak” soil will very likely be in an archaeological context *i.e*. due to man. The upper parts of the borrow pits may intersect human burials. Occurrences of such archaeological material are not within this brief and must be dealt with by an accredited archaeologist.

The deeper deposits will reveal possible fossil shell concentrations and other features of palaeontological and scientific importance. The fossil content very likely also includes invisible microfossils, such as foraminifera, ostracods, diatoms, pollen and spores.

In addition to shells, scattered bones may occur in the dune, beach and shoreface deposits, but are much more rare. For example, bones of whales, dolphins, seals, seabirds *etc*. occur in marine deposits. Some of these end up in adjacent dune sands, where terrestrial animals also occur, *e.g*. antelopes, hyaena, jackal, ostrich.

Rescuing these bones is very important. They need not necessarily represent species that we would expect nowadays. Also, modern analytical techniques such as stable isotopic analyses can reveal indications of diets and environmental conditions of the past.

IMPACT ASSESSMENT

Significance

The first recorded references to the fossil shells in the raised beaches of Namaqualand are in the journals of the explorers R.J. Gordon and W. Paterson. In 1779, en route to the “Great River” (Orange/Gariep), they passed near Port Nolloth and headed towards the Holgat Rivier in search of water. There they noted the presence of fossil marine shells in marine deposits on top of the cliffed shoreline. This is the earliest known mention of a fossil occurrence in South Africa. They also made the distinction between raised

beach deposits and shell middens of anthropogenic origin (Forbes & Rourke, 1980; Raper & Boucher, 1988).

Historically, Port Nolloth is famous for being nearby the site of the initial definite discovery of diamonds on the Namaqualand coast. This was in 1925, when Jack Carstens investigated basal marine gravels exposed in an abandoned and dune-blocked channel of the Kamma Rivier, about 9 km south of Port Nolloth and ~1 km from the shore, near the Oubeep boundary. The early prospects near Port Nolloth were examined by Wagner & Merensky (1928) and Haughton (1928, 1932) described the fossil faunas. Much later, Keyser (1972) summarized the results of an extensive drilling and trenching campaign by the State Alluvial Diggings (now Alexkor), which included the Port Nolloth area.

Although the coastal deposits of Namaqualand have attracted considerable scientific attention in the past, there is little information in the public domain that is specific to the Port Nolloth area. Unpublished observations from diamond-prospecting excavations, although significant, nevertheless tend to lack the necessary detail of description and sampling required for palaeoecological interpretations from the viewpoint of modern perspectives in the palaeontological and sedimentological fields.

Many scientific opportunities provided by the excavations made in the course of prospecting and mining have been missed, as an ongoing scientific monitoring presence has never been funded. Now that the fossil/scientific record is included in EIAs as a heritage resource, the circumstance arises to co-operatively remedy the missed opportunities within a more formal framework. Thus, opportunities to examine the subsurface geological and fossil record in the area continue to be vital. The Port Nolloth borrow pits have potential as a record of higher sea-levels during the Quaternary Period.

In summary, the significance of such samples/documentation involves:

Significance in the history of sea-level change and coastal evolution.

Record of changes in faunal communities with time.

For future radiometric and chemical dating purposes (rates of coastal change).

Preservation of fossils for future palaeo-oceanographic research *e.g*. stable isotope/palaeotemperature analysis *etc*.

Preservation for the application of yet unforeseen investigative techniques.

There is a significance to fossils beyond their conventional academic/scientific importance that is more firmly in the realm of cultural aesthetics. Fossils are part of the physical strata of the landscape and inform the appreciation of its space-time depth and its biota, living and extinct. Such realizations are inspired by encounters with fossils. Ultimately this heritage resource must be rendered known and accessible to the wider community via educational programmes emanating from *e.g*. museums, sponsorship, NGOs. The first priority, however, is to rescue fossils and attendant information that would otherwise be lost.

Nature of the Impact

Extents

The physical extent of impacts on potential palaeontological resources relates directly to the extents of subsurface disturbance during quarrying.

In the longer term, the depleted pits may become largely “sterilized” wrt. their palaeontological resource potential, as the pits might be turned to other purposes, such as landfill sites or perhaps mariculture ponds.

Duration

This is the duration of the quarrying activity (not supplied). This provides a “time window” for palaeontological mitigation that is relatively long (medium term 1-5 years?).

Intensity

The impact of development and mining on fossil resources is high in the absence of mitigation. This is because fossils are rare objects, often preserved due to unusual circumstances. This is particularly applicable to vertebrate fossils (bones), which tend to be sporadically preserved and have high value wrt. palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources and loss of the opportunity to recover them and their contexts when exposed at a particular site is irreversible.

Probability

The likelihood of impact is definite. The area is known to have considerable fossil potential, being in the coastal region of significant fossil occurrences. Specifically, the existing excavations in the nearby area show that fossils are readily evident.

Confidence

The level of confidence of the nature and degree of impact is medium to high. Existing information has been assessed and the author has made observations in the wider area.

Status of the impact

Fossils will definitely be lost in the absence of management actions to mitigate such loss.

There remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. Machinery involved in excavation may damage or destroy fossils, or they may be hidden in "spoil" of excavated material.

The status of the potential impact for palaeontology is not neutral. From the point of view that the "windows" into the coastal plain depository, that provide access to fossils, would not exist without excavations being made, the impact is positive for palaeontology. However, some fossils will be lost and destroyed, in spite of efforts at mitigation.

RECOMMENDED MANAGEMENT - MITIGATION

For the future borrow pits, it is suggested that an acceptable degree of mitigation, entailing both monitoring and a detailed inspection of excavations (primary fieldwork), be carried out. The monitoring of excavations whilst they are being made is aimed mainly at recovering the sporadic, but important bone fossils. The primary fieldwork is to document the exposures and establish their stratigraphic and palaeoenvironmental contexts, with sampling of fossiliferous beds. A management framework for the mitigation process is proposed.

Firstly, any exposed fossil occurrences threatened by construction should be mitigated by description and sampling. The author is familiar with the general features of the area and it can be safely assumed that pre-excavation mitigation is unnecessary.

It is not possible to predict the buried fossil content of an area other than in general terms. Fossil bones are sparsely scattered in coastal deposits and much depends on spotting them as they are uncovered during digging i.e. by monitoring excavations. 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 during primary fieldwork.

Monitoring

The monitoring of excavations for fossils takes place while the excavations are being dug. It is an exercise in optimism, with the object of spotting the more rare fossils, such as bones, as they are turned up. This depends on a regular presence.

Are the excavations going to be monitored by an archaeologist? The latter should also spot fossil bones and report such to the palaeontologist.

Since it is impractical to have all excavations constantly monitored by a professional during the quarrying, it is very desirable to have the co-operation of the people on the ground. By these I mean personnel in supervisory/inspection roles, engineers, surveyors, site foremen, *etc*., who are willing and interested to look out for occurrences of potential heritage/scientific significance. This particularly applies to more unexpected finds, such as bones.

To aid this process, some background information is useful. The PIA should be circulated to site management persons.

There should also be guidelines for potential finds and a reporting/action protocol in place when finds are uncovered. A draft protocol is appended.

Primary mitigation

The primary mitigation task entails the specialist documentation and sampling of the pits.

This activity should coincide with the time of maximum exposure of the faces of the excavations, for best cost-effectiveness. This depends on the programme for quarrying; how the pits are to be excavated and the planned stages.

The main aim is to coincide periods of Primary Mitigation fieldwork with times when best exposure of the stratigraphic section is available, preferably to the maximum planned depth.

When the excavations are near or at completion:

The excavation faces must be inspected for fossil content.

Key vertical sections representative of the exposures must be identified.

These must be described in detail sedimentologically (logged), photographed and sampled.

Representative samples of fossils must be collected. In the case of shelly beds, bulk samples should be taken. If material is delicate/poorly-preserved, it should be removed within blocks of the enclosing sediment, reinforced if required by encasement.

The mitigation process makes some logistical demands. To this purpose I would need to establish liaison protocols with a suitably-placed persons with respect to scheduled excavation planning and the progress being made, in addition to the aforementioned reporting/action protocol when finds are uncovered during excavation monitoring.

THE REPORT

At the end of the task a detailed report will be submitted. This report is in the public domain and copies of the report must be deposited at the IZIKO S.A. Museum and Heritage Resources Western Cape. It must fulfil the reporting standards and data requirements of these bodies.

The report will be in standard scientific format, basically:

A summary/abstract.
Introduction.
Previous work/context.
Observations (incl. graphic sections, images).
Palaeontology.
Interpretation.
Concluding summary.
References.
Appendices

A prescribed data requirement is adequate 3D spatial referencing. For this I would require the assistance of the surveyor wrt. coordinates and base maps, to plot the locations of finds during monitoring, the measured sections, samples and other observations. Preferably, this would be in georeferenced digital format *e.g*. a CAD dxf file or ESRI GIS shape files.

The draft report may be reviewed by the client, or externally, before submission of the Final Report.

ADDITIONAL NOTES

Enhancement

The client might desire a display/exhibition of findings and features: out of a combination of interest, public-mindedness and to demonstrate diligence wrt. heritage/science resources. This would have to be at a location and under conditions approved under the auspices of the IZIKO S.A. Museum and the Heritage Resources Authority Western Cape (*e.g*. at the Fossil Park). (Costing of such was not included in the submitted budget.)

Application for a Palaeontological Permit from Heritage Western Cape

It is required to obtain a palaeontological permit from the relevant Provincial Heritage Resources Authority in order to carry out the work. The application for this needs details of the registered owners of the sites, their permission and a site-plan map. Currently palaeontological permits for the Northern Cape are issued by SAHRA. A permit fee of R150 is operative.

All samples of fossils and sediments must be deposited at a SAHRA-approved institution.

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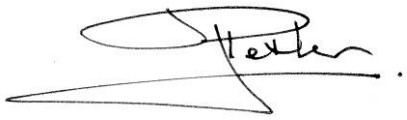

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