THE ARCHAEOLOGICAL SURVEY OF THE ZULTI NORTH MINING LEASE

FOR RICHARDS BAY MINERALS

DATE: 20 JANUARY 2007

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INTRODUCTION

Umlando undertook monthly surveys in the Richards Bay Minerals Zulti North mining lease during 2006. This is in accordance with the KwaZulu-Natal Heritage Act of 1997, and the policy that both Rio Tinto and RBM have for heritage sites in their mining leases.

A monthly report is submitted to RBM and Amafa KZN. These reports include the site record forms as well as a general description of each site. This report is a summary of the annual findings and excludes the site record forms. All of the information is data based in a spreadsheet and updated on a monthly base. These files are handed to RBM and to Amafa annually for their records.

Several new sites were recorded, sampled, and/or excavated. The amount of sites recorded this year is fewer than previous years; however, this is partly a result of the mines moving slowly northwards. These mining plants were MPC, MPD, and MPE. This resulted in less open areas being uncovered because of the large, and high, sand dunes.

One of the more significant finds was our second hunter-gatherer site near MPD. Other sites yielded a few human skeletons, and these were treated accordingly.

Umlando also undertook additional work relating to the heritage management program. These included:

- A Geographical Information Systems (GIS) project
- The RBM intra-web page
- Phase 1 of the upgrading of the Mananga Heritage Centre.

SURVEYS

Our survey method has been documented in previous reports and is not repeated in this report.

The surveys are undertaken on a monthly basis. Each mining pond is visited and the cleared areas in front of the mine-face are surveyed. We occasionally survey ahead along the mining exploration paths, however, this is dependant on the general safety issues.

MINING POND ALPHA

MPA35

This small site has been exposed by bulldozer activity. A few fragments of pottery, brown mussel, and one upper grinding stone were observed. The site is of an indeterminate age, but probably dates to the LIA (Late Iron Age) or HP (Historical Period).

The site is of low significance and no further mitigation is required.

MPA36

MPA36 is located on a very narrow, and steep, dune, of which some is still underneath vegetation. Only one pottery sherd and several fragments of brown mussel were observed. The site is of an indeterminate age, but probably dates to the LIA or HP.

The site is of low significance and no further mitigation is required.

MPA37

The site is located on top of the dune cordon, on a slightly raised area, and covers ~50m2. The site is an extensive scatter of artefacts that probably date to the Late Iron Age.

These include:

- Upper grinding & hammer stones
- Small fragments of slag
- Large bovid bone
- Large aquatic mammal bone
- Tuyére fragments
- Scatters of brown mussel.

The site is currently of low-medium significance and will be monitored in 2007.

MINING POND CHARLIE

MPC86

The site is a scatter of sherds and shells on the top of a small dune over a ±30m radius. The pottery is undecorated and consists of inverted and everted rims. The lips of these vessels are flat. The shell consists mostly of brown mussels and oyster. Fragments of two upper grinding stones were observed.

The site is of low significance and no further mitigation is required. The site was sampled.

MPC87

This site is located between the first and second dune cordons from Lake Nhlabane. A track cutting has minimally exposed the site. The site consists of a relatively in tact shell midden that occurs over a 10m x 10m radius. We presume that more of the site occurs under the vegetation on either side of the road.

The midden consists of black mussels in an archaeological deposit. Medium-large bovid bones were observed as well as thin-walled pottery. This suggests that the site dates at least to the Late Iron Age or Historical Period.

The site is of medium significance and some mitigation is required. We intend to sample the site by a small test-pit excavation in the near future. This will require the road to be closed for the duration of the excavation.

MINING POND DELTA

MPD79

The site is located on the left-hand side of the road (driving south) after the helicopter landing area near MPD. The site is on a small dune that does not appear to have been mined: the in situ midden suggests this.

One large in situ midden with brown mussels, limpets, and oyster was observed along the road cutting. More of the midden occurs underneath the sand. This midden is at least 1m below the current surface. Other scatters of shell occur along the top of the dune. Many bone fragments were observed. These are mostly from bovid and fish. Several upper grinding stones and white beach sandstone fragments (i.e. lower grinding stones) were noted. The site has several pieces of slag and iron ore.

The pottery from the midden appears to date to the Mzonjani Phase (approx. 200 AD – 400 AD), while the upper parts of the site appear to date to the Late Iron Age.

We also recorded several Late Stone Age (LSA) stone tools at either end of the dune. These stone tools included scrapers and utilised flakes. This is the second LSA site to be recorded in the dunes. Unfortunately, there is no other LSA material at the site. These stone tools are the first formal tools to be recorded at the site. The site differs to Shark Tooth Midden, as STM does not have any formal tools dating to the Late Stone Age.

The site is of medium significance and some mitigation is required. The site is continuously monitored and sampled. Excavations are not an option as most of the site has a lag deposit; that is the three main time periods have all collapsed into one layer due to the soft nature of the sand.

MINING POND ECHO

Only one new site was recorded at MPE throughout the year. MPE has been mining a large dune and thus dune clearance has been at a minimum for most of the year.

MPE62 was partially exposed by bush clearance and probably extends more into the bush itself. The site consists of various artefacts that have been scattered by dune clearance.

These artefacts include:

- Thin-walled pottery (with an everted rim)
- Brown mussel and oyster fragments
- Lower grinding stones
- Large and medium sized bovid bones

The site is of low-medium significance and will be monitored in 2007.

AMS

AMS7

AMS7 was first recorded in 2006 and was monitored throughout 2007. The site has been mostly disturbed by bulldozer activity and no features were observed.

In 2007 several more decorated pieces of Group 6 & 7 pottery, slag, bone, and shell were sampled. We will continue to monitor and sample the site in 2007.

AMS8

Most of AMS8 had been mined, however the small dune face is exposing a few artefacts, and we thus revisit the site. One upper grinding stone, one bone (possibly human), and a large lump of clay that a hole in the centre (function unknown).

The site is of medium significance and some mitigation is required. We monitored the site.

AMS9

AMS9 was originally recorded in February 2006, when human remains had slumped down the dune face. The human remains had been left in a small pile at the base of the dunes by the AMS company. We have revisited the site on every survey, as we want to obtain a more precise date to the skeleton, by means of the decorated pottery. A second skeleton was removed later in the year.

The pottery can be described as follows:

- 1 lid
- inverted rim
- everted rim
- triangular comb stamping: diagonal lines between two horizontal lines
- everted rim with semi-circular lip notching
- lip notching on the interior and exterior of the everted lip. Semi-circular comb stamping at the shoulder-neck junction. Red burnish on the shoulder-body.
- Triple row of rectangular comb stamping
- Everted rim with flat lip and double row of comb stamping on the rim.
- Near complete pot with lip notching on everted rim
- Circular impressions on body
- Lip notching on flat lip, single horizontal groove on shoulder. Rim is burnished
- Triangular lip notching on everted rim
- Random lip notching
- Comb stamping on the body: horizontal lines
- Comb stamping on the body: horizontal and diagonal lines

We also sampled bovid remains, pottery, shellfish, daga flooring, metallurgical artefacts, and grinding stones.

These decorations belong to the Groups 6 and 7 of pottery styles, and thus date between c. 1300 AD to c. 1500 AD. The site clearly now dates to the early to middle of this millennium. We are waiting for new radiocarbon dates that may give a more precise date to this type of pottery. The site, and thus the associated human skeleton, thus predates the arrival of Zulu-speaking people in this area.

We have continuously monitored AMS9 since it was first recorded in the beginning of the year. We have done this at it has yielded a high concentration of artefacts as well as on human skeleton. There have been suggestions of another human skeleton to the north of the first skeleton; however, we have not been able to locate its exact location. Alternatively, the bones that we have observed belong to the original skeleton. Nonetheless, this site has been continuously monitored and sampled.

We will continue to monitor this site, and intend to undertake test-pit excavations in the near future. Unfortunately, much of the site has been disturbed by bulldozer activity

AMS10

The site is on a high dune in the middle of the dune system. A Human cranium was recovered form sieves of the AMS mining activity. We walked up the sides of the mine face, and did not observe any material on either side. The central mine face was not accessible due to dense vegetation. This had created a problem for the assessment of the skeleton. We could not initially access the site (i.e. up the front of mine face) as it was considered an unsafe act according to RBM safety standards1. We surveyed the area at a later stage and noted ephemeral scatters of shell and pottery. These artefacts date to the late Iron Age or the Historical Period.

No material is directly associated with the skeleton, however, the preservation of bone suggests at least last 500 years.

HUMAN SKELETAL REMAINS

AMS 9

RBM Rehab. Department informed us about a skeleton that was exposed during the dry mining operations at AMS (north) on Thursday, 9th February. We

[1] The mine face is unstable and can collapse at any time, and this can lead to a fatality.

assessed the skeletal remains on the Saturday. The site is referred to as AMS9. It consists of a high density of artefacts and human remains. Most of the site had been disturbed by the bush clearance phase.

Most of the skeletal remains had slumped down the dune. We recovered several limb bone fragments and phalanges on the slope of the dune. The right leg, both feet and a fragment of the left pelvis were in situ and visible in the dune cutting. These were removed. The cranium is mostly missing and only the maxillae and mandible were recovered (at the base of the dune). Both femora and tibia were recovered, as well as the patellae, ~25% ribs, pelvis, sacrum, and ~8 vertebrae. The rest of the remains had either disintegrated since internment, or lost when the skeleton slumped. We estimate that we recovered ~60% of the skeletal remains.

The person was buried in a sitting position facing the interior (i.e. west). The hands were not underneath the feet, and thus were possibly flexed against the chest.

The age and sex of the skeleton can only be estimated at this point. The wisdom teeth had erupted and the molars were much worn. The epiphysis on the few long bones had fused. The pelvis was too fragmented to assess for biological sex. The mandible had a pronounced jaw. These suggest that the person was an adult male of at least 30+ years.

The decorated pottery and degree of preservation of the faunal remains suggest that site (and thus skeleton) are more than 200 years old, possible more than 400 years. We will continue to monitor this area so that we can obtain a larger sample of pottery and thus possibly narrow the age of the skeleton.

A second skeleton was observed during a subsequent survey of this site in October 2006. The cranium, parts of the forearm and vertebrae had been exposed when the dune had subsided. The rest of the remains were in situ, albeit poorly preserved. The remains were very soft, fragile, and wet during the excavations. The remains had also been moved, or compressed, by bulldozer activity and dune slumping. The pelvis had split open, and thus the femora, tibia and fibulae had moved and/or rotated. Furthermore, it appears that the forearms had been realigned with post-depositional movements, and occurred along the "sides" of the skeleton.

The remains originally faced southeast (towards sunset) and in a kneeling position. The foot bones (metapodials) appear to have been extended backwards, with the pelvis resting on the calcanium / astragalus (ankle and heel of each foot). Only a few of the metapodials were located, and we presume the rest had disintegrated though time. It also appears that the forearms had been in a flexed position. Only one forearm was in situ and it was in a flexed position from the elbow towards the heart/chest area.

In general, the human remains are part of the general burial practice observed amongst Nguni-speaking people in KZN. The "uniqueness" of this burial is that the feet were extended backwards. Other human burials in the area tend to have the feet flexed and facing the same direction as the face.

AMS 10

RBM contacted Umlando in May 2006 to recover the human remains retrieved at the new AMS plant, near MPC. Part of a human cranium had been observed in the sieves of the mining operation.

We inspected the area where the cranium occurred but did not observe any other archaeological material. The dune face was the most likely area for archaeological material to be exposed; however, this is an unsafe area for work.

We could thus not access the area from the base of the dune (i.e. the mine working area)

The cranium of AMS10 was well fairly preserved and notable for a receding forehead.

STM

Shark Tooth Midden was constantly monitored in 2006. We intend to undertake the next excavations in early January 2007, and again in March-April 2007. The first excavations will be to continue excavating the living area. The second excavations will concentrate on the both the living are and the shell midden that is in the bush track.

This site is important in that it was the first hunter-gather site in the dunes to be recorded and excavated. It has a radiocarbon date of ~3 500 years ago. We have finished excavating the main shell middens and are now currently excavating the living area. We hope to be able to map the artefacts and thus get an idea of the layout of the site. This map will then be reproduced for the Mananga Heritage Centre.

The second shell midden to be excavated appears to be below the main shell midden that we have already excavated. Thus, it may predate the ~3 500 year radiocarbon date.

STM has a potential second living area to the south of the main midden. We will place exploratory excavations in this area in the future.

STM is important in that it is the first coastal hunter-gather site to be excavated in KZN, and that it has both a living and discard area. One of the aims of the excavations would be to see if the living area would be visible from the artefacts that have been recorded.

RADIOCARBON DATES

We have submitted several samples for radiocarbon dates in January 2006. We are still waiting for the results. These dates consisted of a shell sample and/or a bone/charcoal. This was undertaken to increase the sample size, and thus attempt to work out a correlation between marine shell and terrestrial animals in terms of their radiocarbon dates. This method was detailed in the 2005 report, and is work we are undertaking in conjunction with the CSIR.

CURATION OF MATERIALS

A room dedicated to the storage of the archaeological remains was finalised in early 2006. Only the Rehab. Dept. supervisor has access to the keys for this room. The archaeological storeroom has been equipped with shelving for the storage of archaeological material. We minimally curate the material into a systematic manner according to box and site numbers.

Our new curation technique will be to document material in the following manner:

- Human skeletal remains will be selectively photographed for our record. This will accompany the material sent to Amafa KZN.
- Archaeological artefacts will be selectively photographed
- Artefacts will be stored according to the site, and not artefact type.
- All boxes and their contents are recorded. One copy is left in the storeroom and we keep the other copy.
- Stored items will remain in the storeroom until there is enough material to deliver to Amafa KZN, Pietermaritzburg.

GIS PROJECT

RBM funded the Geographical information Systems project in mid-2006. This consisted of hiring someone who is competent in both GIS and archaeology. The report is attached in Appendix A. The images produced with the GIS software are too large to reproduce in this report, and they have been handed to RBM in DVD format. The images have formed part of the RBM web page and the Mananga Heritage Centre.

The aim of the project was threefold.

First, we needed to consolidate the archaeological information in digital format that was compatible with various systems. We use WGS84 in our GPS system and RBM uses the Cape system. This results in the sites not corresponding with the two systems of co-ordinates, and this effects the ultimate X & Y co-ordinates. We also wanted to have a basic database that will be user friendly in terms of data capturing. A standardised spreadsheet would thus suffice.

Second, we wanted to provide a database that might explain the various archaeological sites visually: i.e. graphics without text. We continuously mention the spatial and geographical components of the various types of sites recorded in the dunes. However, this is difficult to envisage without a graphical presentation. The GIS project takes all of our information and produces an easy to read/understand display. These results can be updated as the work progresses, if someone with GIS knowledge is available. In this way RBM expertise and personal have been included in the displaying the heritage information.

Third, we wanted to see if the GIS could provide data of the various types of archaeological sites through geographical space and chronological time. This is the research aspect of the project. While the results are a Phase 1 of the greater research project, some tentative results do occur. However, as we find results, we also noted aspects that were omitted, in hindsight, from the original map capturing (or TIN models). Our main problem area is that the contours on the map are too large: they need to be indicate elevations of 5 – 10 m. This is, however, not possible to indicate, as RBM's cadastral maps are no in these contours, and the Ms Coetzee (who undertook the GIS project) was not asked to display the maps in such small contours.

RESULTS

Ms Coetzee worked with the data she was given and produced a very informative database. There were/are some problems with the results and these are only visible in hindsight. These are discussed in detail in Appendix A. in summary they are as follows:

- Multi-component sites, i.e. sites with more than one type of pottery style, are difficult to display. For example, many of the EIA sites have 2-4 types of pottery styles. However, when pottery styles are displayed on the maps, they are displayed by site, and not pottery type, as most sites single occupation sites. The alternative is to create a new symbol that indicated combinations of pottery styles, or slightly change the co-ordinates of the site to display a semi-overlapping graphic. An example of this is that the maps do not show any Group 3 (or Ndondondwane Phase) pottery as these have been subsumed within sites that have more pottery. That is the pottery style with the highest concentration of pottery has been displayed.
- The scale of the mining lease area creates a visual problem. Since the area is so large, and since there are so many sites, one needs t develop a very large map (in terms of megabytes). This allows one too zoom in to the areas of interest. Visually this means that any display of the sites, or aspects of them, will be blurred at the general level.

- The scale of the contour lines may need to be reassessed. The main difference between sites at different Periods is their location on the dune system. The GIS system should have been done on 5 – 10m contours. These contours were not available at the time of the project.
- The last problem area is that one needs to create a database that may indicate a very wide range of aspects. We concentrated only on specific artefact types, or pottery styles (and thus time periods). A future project should include a combination of these. For example, it would be interesting to note what type of pottery styles are associated with metalworking and where they occur on the dune system. Another correlation for the future would be the size of a site in relation to its age and position on the dunes.
- There are visible gaps in the graphic display. This is a result of the mining paths (past and present) and that the archaeological project only started in 1994. In other words, we need to be careful in the interpretation of the results that may reflect the results of the mining paths as opposed to the location of all of the sites. If an area does not indicate any sites, it may be because
- Aspect was one of the main features. The problem is that aspect (or slope) is viewed in terms of current slope, and not the slope of the dune when it was occupied.

The above problem areas can be rectified if the project is taken to a second stage. This would involve correcting the errors mentioned above and adding more data.

Despite the problems mentioned above, positive aspects came out of this project.

The following tentative results occur from the GIS project:

- LIA sites occur more often, followed by HP, EIA and the IA sites.
- Metal working activities tend to occur on the Lake Nhlabane side of the dune system.
- Shell middens occur all over the dune system.
- EIA:
  - Sites tend to occur in valleys, except of the small sites and a large metal working site. These occur on the top of the dunes.
  - EIA burials occur on top of dunes. However, the only EIA burials recorded were on top of dunes and this is thus a sampling problem.
- LIA:
  - Most of the sites are located on the east and south east of the dune system
  - Some LIA pottery also occurs on the western and northwestern sides of the dune.
  - Metal working sites occur on the eastern, southern and south-eastern sides of the dunes
  - One of the more notable aspects is that Group 7 pottery tends to occur on the hinterland side of the dune system. At first we thought that this was related to mining paths, however the pattern is reproduced south of the Nhlabane River where the dune cordon is narrower. A similar tendency occurs for the Historical Period sites.
- Historical Period
  - Sites with faunal remains tend to occur on the northwestern side of the dune along the southern half of the area. In contrast, sites with faunal remains tend to occur on the southeastern side of the dune along the southern half of the area.
  - Iron smelting tends to occur on the eastern and south-eastern slopes

- Shell middens occur on the eastern, southeastern, and northwestern sides of the dunes.
- In general, HP sites tend to face southeast or northwest.

The GIS results also indicate a preference of altitude for sites of a specific period. The EIA sites tend to be in the larger flat valleys, while the LIA and HP sites are higher up on the dunes. While we knew this was the case, the project shows this clearly. It also shows a few irregularities such as EIA sites on the top of the dunes. Unfortunately, the results do not show that these sites are substantially smaller than the sites of the same age that occur in the open valleys.

WEB PAGE

We were requested to assist in the RBM intraweb page. This involved writing the background text to our work. This text explained the terminology, method, and processes involved in site survey and analyses. The text is in Appendix B.

In addition to the text, we added several photographs for the web page. Each photograph had an explanatory note.

The information on this web page forms part of RBM's data capturing of heritage sites. That is, the results of the archaeological surveys and excavations are stored at RBM (as well as at Amafa KZN and Umlando's offices) and made accessible to RBM employees via the web page.

MANANGA HERITAGE CENTRE

We were requested to provide a schedule for the updating of the Mananga Heritage Centre (MHC). We revisited the MHC and noted what changes had to occur in order to make it more presentable to the public. The MHC had deteriorated over time, and the displays were dilapidated. The

We proposed a phased approach to the upgrading of the MHC, and this is described below.

Phases for Mananga Heritage Center

The Mananga Heritage Centre requires an upgrade. This can be undertaken in two ways:

1. Undertake a total revamp of the centre in one session.
2. Undertake the revamp in a Phased approach

We prefer the phased approach for various reasons. The main reason is that targets can be set for specific tasks at specific times. Another reason is that a budget for the entire revamp would probably not be covered for the 2006 financial year.

The revamp of the Mananga Heritage Centre should be undertaken in several phases. These details of these phases should be read in conjunction with the original plans for the MHC in Appendix C

Phase 1:

- Redo the current displays that are hanging on the walls
    - We have estimated that there should be ~15 display boards in total – or 5 per room.
    - The display would be pictures and text. The pictures would be in the background whilst the text in the foreground. A copy of this will be sent to RBM shortly.

Phase 2

- Display are cases needed for the display of artefacts

- A total of 5 display cases are envisaged
- These display cases would include artefacts from the dunes
- The appropriate text for each artefact will be included.
- Display cases will be on a stand and have a 'door'; so that artefacts may be changed in the future.

Phase 3:

- The Muthi Garden (including all botanical plants)
  - The muthi garden needs to be weeded, trimmed, and re-arranged.
  - A sign for each type of plant is needed at the base of the plant
  - The information about the value of the plant needs to be displayed
  - We should also included to other trees/plants that are linked to 'the ancestral spirits': pincushion euphorbia and the coral tree.
  - The muthi garden should display plants that are used in this specific area, and perhaps we should consult with an inyanga, if one exists in the area.
  - The muthi garden does not need to be confined in one area but may also be placed in non-used areas of the centre.
  - The signage of the "Shakan Bananas" needs to be replaced. It also needs to be stated that this specific Banana tree was recognised as being ancestral to one of the original trees in the eSikhaweni area.

Phase 4:

- Display of the GIS project
  - GIS project involved the results of the mapping of the various aspects of the archaeological on computer

  - The results show e.g. human remains, iron working, different types of sites/pottery, etc. in relation to their position in the dunes system
  - These show how the landscape is used, and changed through time
  - This display would go into Room 1, above the current display cabinet. The current display cabinet will then make more sense when viewed with the GIS data\

Phase 5:

- Map of the settlement pattern for the only hunter-gatherer, or San, site in the dunes.
  - This will show how people lived, where they did certain actins, etc.
  - Show how we use indirect evidence to infer behaviour
  - Ties in with the shell middens
  - Shows how organic materials may be used to as tools, e.g. making hide-working tools from Donax spp. (the white clam)
  - May be viewed in a comparison to a Late Iron Age site. We excavated a Late Iron Age site a few weeks before MPE started to mine, and an entire family dwelling was recorded and mapped.

Phase 6:

- Finalise the details of Room 1
  - Add any extra features that may be needed

Phase 7:

- Finalise the details of Room 2
  - Work on the text and display of the smelter
  - Explain how the basics of iron smelting have not changed through time, but only the machinery used.
  - Revamp/update any text/graphics

Phase 8:

- Finalise the details of Room 3
    - Ensure that organic material will not decay
    - Make sure enough text/pictures describe the various artefacts
    - Choose specific items for explanation and move other items away, or in storage
    - Display of the beer pots
    - Make this room the “sitting room” for meetings
    - Have an area with current tasks for children
        - Scholars should be encouraged to go home and record their family history
        - Perhaps this should be data based as the living history of the local community
        - Educational task should be set out in pamphlets so that scholars can take them home and/or deliver them to the centre.

Phases 1 -4 are currently underway and should be finished in early 2007.

CONCLUSION

The archaeological survey for 2006 recorded several new sites. Some of these sites were sampled and/or excavated, and noted for further monitoring. We were requested to observe skeletal remains or other finds during the course of the year. These trips were outside of our budget allocated for the year. The 2007 budget has included additional trips.

Some of the sites will be monitored, sampled, and/or excavated in 2007. These sites are

- MPA37

- MPD60
- MPD76
- AMS7
- AMS9
- STM

MPC is also entering the area adjacent to the MPD mining Path. Several sites were recorded along this path between 1995 – 2003. This will be monitored.

The excavations at Shark Tooth Midden will continue this year. The aim will be to complete the one living area and a possible older shell midden. If time allows we will begin the exploration of a second living area.

The Mananga Heritage Centre will be upgraded according to the various phases we proposed.

APPENDIX A
GIS REPORT[2]

[2] The report was submitted in pdf format and the figures referred to did not copy into MS word format. They are thus omitted from our report

RICHARDS BAY MINERALS

GEOGRAPHIC INFORMATION
SYSTEMS REPORT

SPATIAL MODELLING & ANALYSIS OF THE ARCHAEOLOGICAL TERRAINS AT RICHARDS BAY MINERALS

JULY 2006

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INTRODUCTION

PURPOSE OF THE REPORT

This author has been contracted by Umlando: Archaeological Tourism & Resource Management, represented by Mr. Gavin Anderson, to undertake the spatial modelling and analysis of the archaeological terrains at Richards Bay Minerals, using Geographic Information Systems (GIS).

The aim of this project was to assemble a GIS Database with the intention of:

- compiling a comprehensive spatial model of all the archaeological terrains on the premises of Richards Bay Minerals;
- enhancing the level of abstraction through applying analytical functions of GIS software to act as an investigative mechanism; and
- producing cartographs to aid as visual display mediums.

BACKGROUND

The vast number of definitions pertaining to Geographic Information Systems (GIS) presents a glimpse of the complexity thereof. From a generic perspective, GIS is a digital database in which a common spatial coordinate system is the primary means of reference. GIS comprise of the following functions:

- Data input derived from maps, surveys and remote sensing.
- Data storage, retrieval and processing.
- Data transformation, analysis and modelling, including spatial statistics.
- Data reporting through maps, reports and plans.

Geographic Information Systems secede from other database applications in that all information in a GIS is linked to a spatial reference. Other database software may contain locational information, but a GIS database uses geo-references as the primary means of storing and accessing information. Nevertheless, the true supremacy of a GIS lies in its ability to integrate information and to assist in decision-making processes.

Spatial modelling using Geographic Information Systems (GIS) become increasingly attractive to archaeologists owing to the flexibility and inclusiveness of the analytical tools available. GIS has the potential to retrieve information that could not otherwise be systematically obtained and which may help to support or contradict theoretical landscape approaches (Llobera, 2003). Archaeologists, for example, can analyse geographic data within a single layer, or the relationship between multiple layers to examine how environmental variables like topography, soil type, or distance to water affect site location (Arcgis, 2002).

In spite of its “map-like” appearance, Geographic Information Systems is able to derive information which extends beyond what can be represented and derived using traditional distribution maps (Llobera, 2001). The insight offered to archaeological research by GIS analysis is emphasised by the confirmation of spatial relationships, incorporation of temporal aspects, inclusion of uncertainty, and greater prominence on cognitive aspects of space (Fry et al., 2004). Additionally, GIS is increasingly used to develop theory and to test alternative interpretations of spatial activity in historic and pre-historic cultures.

GEOPHYSICAL SETTING

STUDY AREA

The study area is situated within the perimeter of Richards Bay Minerals. The Mine is situated on the coastal dunes that extend approximately 17 kilometres in a two kilometre wide strip just north of Richards Bay. Refer to Figure 1.

STUDY AREA

FIGURE 1: The Study Area. Derived from Google Earth (2005).

CLIMATE

The climate of the study area is humid with rainfall exceeding 1 000mm per annum. Mean annual temperatures for January are 25°C and July approximately 17°C (Low & Rebelo, 1998).

VEGETATION

According to Low & Rebelo (1998) this vegetation type can be classified as Coastal Bushveld-Grassland (23) or Coastal Forest and Thornveld (A1).

FIGURE 2: Coastal Bushveld/Grassland vegetation. Derived from Google Earth (2005).

Remaining forest patches are characterised by species such as: Forest Iron Plum *Drypetes gerrardii, Umzimbeet Millettia grandis*, White Ironwood *Vepris undulata, Protorhus longifolia, Trichilia emetica, Brachylaena spp., Celtis spp., Chaetacme aristata* and *Mimusops obovata* (Low & Rebelo, 1998). These forest patches also contain a large number of species of woody lianas (Low & Rebelo, 1998).

Closer to the seashore, evergreen thicket occurs on littoral dunes. The canopy on the seaward side exhibits the typical clipped appearance of wind-pruning as a result of constant exposure to salt-laden easterly winds (Low & Rebelo, 1998). The following canopy species can be found: Coast Red Milkwood *Mimusops caffra*, Dune Jackalberry *Diospyros rotundifolia*, Natal Guarri *Euclea natalensis*, *Brachylaena discolour* and *Apodytes dimidiata*. Secondary woody vegetation is patchy and often characterised by Sweet Thorn Acacia karroo, Scented Thorn *A. nilotica* and Splendid Thorn

A. robusta (Low & Rebelo, 1998). The grassy matrix includes species such as *Ngongoni Bristlegrass Aristida junciformis, Eragrostis spp., Sporobolus spp., Hyparrhenia spp., Digitaria spp., Setaria spp., and occasionally Themeda triandra* (Low & Rebelo, 1998). The vegetation often has a scrubby appearance, due to the many dwarf geoxylophytes, including *Diospyros galpinii*, Dwarf Mobola *Parinari capensis* *subsp. Incohata*, Veined Medlar *Pachystigma venosum, Eugenia albanensis, E. capensis, Ancylobotrys petersiana* and *Salacia kraussii* (Low & Rebelo, 1998).

METHODOLOGY

OBJECTIVES & GENERAL APPROACH

As indicated above, the aim of this project is to develop tools for modelling the spatial distribution of the archaeological terrains on the premises of Richards Bay Minerals. The main objectives were identified as follow:

• A GIS Database must be assembled to create a comprehensive spatial model of all the archaeological terrains.

• On a higher level, the GIS Database will be applied to enhance the level of abstraction. GIS can offer insight into aspects that is vague and relational in the data.

• The GIS Database must be easy to update and user-friendly.

• Ultimately the GIS will aid as a visual display medium. As the main output of any GIS is in a cartographic format, this aim implies that the data must be presented in an unambiguous, colourful format, easily interpretable by various age groups, while yet gaining scientific credibility.

Taking the above objectives into consideration, a phased approach was decided upon, namely

data preparation and conversion, data layout, and spatial modelling and analysis.

GIS SOFTWARE

The software used to create the GIS Database is ArcMap® 9.0. ArcMap is part of the ArcGIS family and is currently one of the most powerful GIS products available. “ArcMap is the premier application for desktop GIS and mapping and gives you the power to:

• Visualise: seeing geographic patterns you couldn't see before, revealing hidden trends and distributions, and gaining new insights.

• Create: ArcMap provides all the tools you need to put your data on a map and display it in an effective manner.

• Solve: Working geographically lets you answer questions such as "Where is...?," "How much...?," and "What if...?" Understanding these relationships will help you make better decisions.

• Present: Displaying the results of your work is easy. You can create quality maps and interactive displays that link reports, graphs, tables, drawings, photographs, and other elements to your data. Communicating geographically is a powerful way to inform and motivate others.

• Develop: The ArcMap customisation environment lets you tailor the interface to suit your needs, build new tools to automate your work, and develop standalone applications based on ArcMap mapping components." (ESRI, 2005)

PHASE 1 – DATA PREPARATION & CONVERSION

The first phase dealt primarily with preparing the database on which the GIS spatial modelling was to be based. This proved to be a prolonged task, yet the most important as any GIS is only as good as the data it is derived from.

Considering that the database must be user-friendly, additional categories were added to describe the artefacts unearthed at the various archaeological terrains. This change was necessary as ArcMap® 9.0 queries the database using rows in a column and not keywords. The following categories were added: Pottery, Midden, Surface, Skeleton, Shell, Faunal Remains and Other Artefacts. The information used for these categories were derived from the column Description of Sites". Refer to Table 1 for an example of the categories.

TABLE 1: Categories created for the GIS database.

Recorder's

Site Number

Pottery Midden Surface Skeleton Shell

Faunal

Remains

Other
Artefacts
AMS1 x -x ----
AMS2 x -x x x -Stone. Slag
AMS4 x -x -x -Stone
AMS5 x x --x x Stone
AMS6 x ---x x Stone. Iron

As mentioned above, ArcMap® 9.0 queries a database using rows in a column and not keywords. This fact is significant as it limits the amount of detail that can be entered in each category. For that purpose and where feasible, only an “x” was used to indicate the presence of a given category at an archaeological terrain. This approach however was not appropriate to envelop the various entries in the category “Other Artefacts”, such as: iron ore, iron slag, grinding stones (upper and lower), pebbles, wooden structures, glass, porcelain, beads, various ceramics, etc., given the amount of archaeological terrains (approximately 220). To make this category more straightforward, entities were grouped together and assigned with one name. For example, the entry “stone” can imply the following: grinding stones (upper or lower), pebbles or beach sandstone. This notably restricted the phrases that could be queried during the next phase.

The next step in this phase was to convert the GPS coordinates from Degrees/Minutes/Seconds (D/M/S) to Decimal Degrees (DD. DDDD). Decimal Degrees are displayed as the degrees in normal value, with both minutes and seconds in decimal format. This conversion was necessary to display the GPS points in the GIS map. The following expression was used for the conversion:

$$DD = D + (M/60 + S/3600)$$

Where DD = Decimal Degrees, D = Degrees, M = Minutes and S = Seconds.

For example:

TABLE 2: Conversion from Degrees/Minutes/Seconds (D/M/S) to Decimal Degrees (DD). The Decimal Degrees for the respective sites are indicated as negative Y (Latitude) and positive X (Longitude).

Site Number	Site Coordinates	D	M	S	Y	D	M	S	X
AMS 1	S 28° 33’ 58.6’’ E 32° 20’ 20.2’’	28	33	58.6	-28.56628	32	20	20.2	32.33894
AMS 2	S 28° 33’ 59.2” E 32° 20’ 25.7”	28	33	59.2	-28.56644	32	20	25.7	32.34047

When using Decimal Degrees it should be considered that the format of latitude would be negative or positive, while longitude could also be negative or positive (CSG, 2006). This is derived from the quadrasphere designation, such as N, S, E or W, which is based on the equator and the prime meridian (CSG, 2006). Refer to Figure 3. In this instance the Decimal Degrees would be portrayed as follow: Latitude: -28.56628 (S) and Longitude: 32.33894 (E). The Southern latitude is assigned a negative value given its position in relation to the equator (CSG, 2006). The Eastern longitude is positive east of the prime meridian. Refer again to Table 2. It is imperative to emphasise that the quadrasphere designation will change according to the geographic reference used (CSG, 2006).

FIGURE 3: Quadrasphere designation. Derived from CSG (2006).

Lastly, the database file was converted from an Excel Spreadsheet to a DBFIV (Database IV) file, which can be imported into the GIS software ArcMap® 9.0 by applying the function: “Add XY Data”.

PHASE 2 – DATA LAYOUT

With the fundamentals of the database put into place during the first phase, the actual data layout could commence.

The archaeological terrains were primarily placed in context with height above sea level, as the spatial data describing the geophysical environment was severely constrained by data availability. Datasets describing the vegetation, soil types and geology of the study area were not available. Subsequently, correlations could not be drawn between the archaeological terrains and the vegetation, soil types and geology.

Moreover, a pre-requisite to the spatial modelling was inter alia the use of pre-mining contours as a source of elevation. This was problematic as the pre-mining data derived from RBM was inadequate for spatial modelling. The pre-mining data had no spatial reference or actual elevation values, which reduced the data to an image, at best. Spatial referencing is the most important element of a GIS and can result in serious projection and analysis errors if a data file has a different spatial reference than the rest of the data in a GIS, or worse, no spatial reference at all. Considering the above restrictions, an alternative elevation data source was obtained from the Surveyor General. Regrettably the elevation intervals were set to 20 meters, which is a very coarse generalisation for spatial analysis purposes.

The final stage of this Phase was to change the spatial reference of all the datasets to WGS'841.

The transformed datasets include the following: contours, drainage lines, coastal line, rivers,

inland water areas and river areas.

PHASE 3 – SPATIAL MODELLING & ANALYSIS

In the final phase the main objective was spatial modelling of the archaeological terrains with

regards to predefined temporal periods, slope angle and slope aspect.

The archaeological terrains were divided into temporal periods and predefined categories. The

temporal periods are: Late Stone Age (LSA), Early Iron Age (EIA), Indetermined Iron Age (IIA),

Late Iron Age (LIA) and Historic Age (HIS). Each of these temporal periods was then further

divided into the following categories: Middens, Surface Scatter, Burials, Faunal Remains, Metalworking, Pottery, Shell and Stone. Other selective categories included Porcelain & Glass,

Beads, Ceramics, Ivory and Wooden Structures.

Motivation for this transformation will be discussed below in the section "Problems Encountered".

Middens and Surface Scatter are related to the distribution and quantity of shell. If the shell found at an archaeological terrain was fragmental and surficial, the site was classified as a "scatter of shell", however a large quantity and predominant occurrence of shell on a terrain was categorised as a "shell midden". Burials include all sites where either fragments of human remains were discovered or a definite grave. Faunal Remains indicate the archaeological terrains where bone, teeth or shell of faunal origin were unearthed. Metalworking relates to iron ore, iron slag or metal found on site. Pottery can be either undecorated or decorated pottery and belonging to a specific typology (classes 1 to 10). Under the category "stone", archaeological terrains can exhibit upper or lower grinding stones, pebbles or beach sandstone. With regards to the Porcelain & Glass, the following was found on certain terrains: a maroon rimmed white plate, white glazed porcelain with red rim, bottle glass and opaque glass from a jar. The following Beads were found on some LIA and HIS terrains: beads of Nassarius, glass beads in white, red and lime-green, as well as several glass and porcelain beads of various colours. A clay smoking pipe and a possible ivory bangle were found on two respective terrains. And finally, the wooden structures either refer to houses or fence poles found at archaeological terrains.

The above temporal periods and predefined categories were additionally displayed on a TIN (Triangulated Irregular Networks) elevation model, slope angle and slope aspect to attain topographic analysis. TIN datasets can be used to display and analyse surfaces (ESRI, 2005). They contain irregularly spaced points that have x,y coordinates describing their location and a z-value that describes the surface at that point (ESRI, 2005). The surface could represent elevation, precipitation or temperature. A series of edges join the points to form triangles (ESRI, 2005). The resulting triangular mosaic forms a continuous faceted surface, where each triangle face has a specific slope and aspect (ESRI, 2005). The representation of the elevation in the Archaeological GIS Database is a TIN surface.

From the TIN model, surfaces describing slope angle and slope aspect were created. This was achieved by first converting the TIN slope to a raster format. This step can be omitted, however this author aimed at creating a realistic three dimensional surface, which could help with visualisation and interpretation. From the raster surface the “3D Analyst” function was used to create the following surfaces: slope, aspect and hillshade. Before continuing with the description of the methodology, it is important to elaborate on the differences between raster and vector data formats.

Within a Geographic Information System, a distinction can be drawn between raster and vector representations of datasets. Raster based formats display, locate and store geographical data by using a matrix of cells (Foote & Huebner, 1996). A unique reference coordinate represents each pixel either at a corner or at the centroid (Foote & Huebner, 1996). Each cell or pixel in a raster dataset has discrete attribute data assigned to it (Foote & Huebner, 1996). Refer to Figure 4.

FIGURE 4: Raster Representation of Reality. Derived from Foote & Huebner (1996).

Vector data formats, however, display graphical data as points, lines or polygons (Foote & Huebner, 1996). Cartesian coordinates (x and y) and computational algorithms of the coordinates define points in a vector system (Foote & Huebner, 1996). Lines or arcs are a series of ordered points (Foote & Huebner, 1996). Areas or polygons are also stored as ordered lists of points, but by making the beginning and end points the same node the shape is closed and defined (Foote & Huebner, 1996). Refer to Figure 5. The advantage of vector datasets are that they require less disk space and the graphical output more closely resembles hand-drawn maps (Foote & Huebner, 1996). Raster datasets on the other hand are compatible with remotely sensed or scanned data and require simple spatial analysis procedures (Foote & Huebner, 1996).

FIGURE 4: Vector Representation of Reality. Derived from Foote & Huebner (1996). With regards to the slope and aspect surfaces, the following results were obtained:

FIGURE 5: TIN Representation of a Slope Surface.

FIGURE 6: Raster Representation of a Slope Surface draped over Hillshade.

Generally vector datasets are preferred above raster datasets because the graphical output of raster data depends on the pixel size and the result might be less pleasing. Nevertheless the objective of this author was to create a three dimensional surface of slope angle and aspect, for which the raster datasets were ideal. The three dimensional effect was obtained by draping the slope angle and/or aspect surfaces over a hillshade surface. Hillshading results from the GIS program evaluating the aspect and slope of the terrain relative to the sun's azimuth (the sun's location on the horizon) and the sun's altitude (Mossman, 2001). The shadowing effect of adjacent terrain is also used in generating a hillshade (Mossman, 2001). Regardless of the colours applied to the hillshade theme, when a hillshade is used as a brightness theme for another theme (in this instance slope angle and aspect) to produce a relief map, the hillshade is applied with greyscale values (Mossman, 2001). Greyscale values range from 255 for white to 0 for black with grey making up the middle values (Mossman, 2001). To complete the process, the transparency of the draped surface (slope angle and aspect) was set to 40 percent and this combined with the underlying hillshade, produced the three dimensional illusion as demonstrated in Figure 6.

PROBLEMS ENCOUNTERED

Some problems were encountered during the three phases of the project and will be discussed at length below.

1) Data Availability:

The first problem encountered was data availability. Datasets describing the vegetation, soil types and geology of the study area were not available. Subsequently, correlations could not be drawn between the archaeological terrains and the vegetation, soil types and geology. This problem remained undefeated and might provide a basis for future improvements of the GIS database.

2) Data Quality:

Two obstacles were encountered under data quality, namely the quality of the pre-mining contours as a source of elevation, and the Excel Spreadsheet or Database containing the Archaeological information. As mentioned above the pre-mining dataset derived from RBM had no spatial reference or actual elevation values, which made the contours inadequate for spatial modelling. Considering these restrictions, an alternative elevation

data source was obtained from the Surveyor General. This elevation source however is set to intervals of 20 meters, which is a very coarse generalisation for spatial analysis purposes.

The second obstacle necessitated some change to the layout of the Database in order to make it compatible with the GIS software ArcMap® 9.0. This software queries a database (or attribute data) using rows in a column and not keywords, which is significant as it limits the amount of detail that can be entered in each category.

Therefore, extra categories were added to describe the artefacts unearthed at the various archaeological terrains. Refer to Phase 1 for a complete description of the method applied and the underlying logic.

3) Accuracy VS Precision:

It is vital to distinguish from the start, the difference between accuracy and precision:

• Accuracy is the degree to which information on a digital database matches true or accepted values. Accuracy is an issue pertaining to the quality of data and the number of errors contained in a dataset (Foote & Heubner, 1995). Within a GIS database, it is possible to consider horizontal and vertical accuracy with regards to geographic position, as well as attribute, conceptual, and logical accuracy.

i. The level of accuracy required for particular applications varies greatly.

ii. Highly accurate data can be difficult and costly to produce and compile

• Precision is the level of measurement and exactness of description in a GIS database. Precise locational data may measure position to a fraction of a unit, or precise attribute information may specify the characteristics of features in great detail. It is however noteworthy that precise data – no matter how carefully measured – may be inaccurate. Surveyors may make mistakes or data may be entered into the database incorrectly.

i. The level of precision required for particular applications varies greatly.

ii. Highly precise data can be very difficult and costly to collect. Thus, high precision does not indicate high accuracy nor does high accuracy imply high precision.

Positional error2 is often of great concern in GIS and was also encountered during this project. Positional accuracy and precision apply to both horizontal and vertical positions. During Phase 2 – data layout – it became apparent that three archaeological terrains (MAP01, MPD70 & MPE06) experienced positional errors. Two of these sites were located within the ocean and one too far inland. The positional errors may have resulted from the inaccurate measuring of data or from errors arising through data processing. Inaccurate measuring may originate from the relevant accuracy of the GPS at that specific location. Various factors can influence the accuracy of a GPS measurement, such as satellite alignment, multipath (caused by the density of the vegetation canopy and reflective surfaces) or user mistakes, to name a few. Processing mistakes may also have resulted in the positional errors given the amount of people who participated in assembling the Excel Database. Processing errors are generally the most difficult errors to detect in a GIS. This is alarming since processing errors may also influence the accuracy and precision of the attribute data3.

2 Error encompasses both the imprecision of data and its inaccuracies.

3 Attribute data describes the characteristics of a feature, e.g. the attribute data of the archaeological terrains in the GIS describe what was found at each terrain, the record number of respective sites, etc.

The positional errors were overcame by changing the relevant GPS coordinates of each terrain to fit with either the relevant description of the site's location, or by using an approximation of the terrain's position with reference to its closest neighbour.

Consequently, these archaeological terrains have high precision, but not necessarily high accuracy.

It is vital to investigate the accuracy and precision of the attribute data in the database. Various typing and spelling errors were detected, which may provide an indication as to the presence of more distressing attribute errors. Data quality4 in any database is critical as a GIS is only as reliable as the data it is based on.

4) WGS‘84 and Lo33 Transformation:

Due to software limitations, the transformation from WGS‘84 (World Geodetic System of 1984) to the Cape datum (Lo33) could not be attained. ArcMap®9.0 is only capable of transforming shapefiles and selected United States datums, such as NAD27, NAD83 and selected local island datums from the Virgin Islands. Consequently, the coordinate system of the GIS database was set to WGS‘84 to coincide with the current referencing system of the GPS points.

In general, transformation of GPS points to the Lo33 projection can be obtained by using either software to transform ASCII coordinate files or by applying equations/algorithms available from the Survey General. This would require coordinates of common control points in both datums, of which the 29,000 trigonometrical beacons and 22,000 Town Survey Marks serve this purpose (Wonnacott, 1997). The accuracy, however, of the transformation parameter not only depends on the size of the project, but also the proximity to sufficient control points. This transformation of the GPS points of the archaeological terrains might not be as easily achievable though, due to incomplete data. At present, only a small fraction of the GPS points have altitude values, which will impede accuracy verification with reference to the proximity to control points. Moreover, it would also be advised that the GPS points of the archaeological terrains are recorded in both datums to ensure the accurate projection thereof.

In this author’s opinion transformation of the GPS points to the Cape Datum is not advised. The Cape Datum has served its purpose well over the last century, but proved to be inadequate to meet future needs (Wonnacott, 1997). Because of computational limitations, there are many distortions in the Cape Datum coordinates (Wonnacott, 1997). The achievable accuracies of GPS are negated when GPS based surveys are applied to old distorted coordinate systems (Wonnacott, 1997). Conversely, the WGS‘84 reference system applied to this GIS Database is well positioned in the universal sense, making the system compatible with the GPS reference frame. The WGS‘84 is also the most widely used referenced system.

Data quality refers to the relative accuracy and precision of a particular GIS database.

5) Visual Variables and Scale:

Given the advent of desktop mapping software available and the symbol libraries inherent in the software’s functionality, it was crucial to meticulously consider the colour, shape and size of the respective symbols. This was achieved by applying the basic principles of symbol selection in Cartography to the GIS results (Ramroop, 1998). Cartographers have seven types of variations (called visual variables) which are used in the construction of symbols, namely position, form, orientation, colour, texture, value and size (Ramroop, 1998). The visual variables applied to this GIS include position, form, colour and value.

• Position – refers to the x, y and z values of the information being mapped which determines the feature’s location on the map (Ramroop, 1998). All symbols used in GIS (or any map) make use of this visual variable and therefore, position has to be used in conjunction with one or more visual variables (Ramroop, 1998). The position visual variable is applicable to point, line and polygon (area) features (Ramroop, 1998).

• Form – refers to the symbols which differ only in shape (Ramroop, 1998). Form is applicable to point, line and area symbols, yet relating to the line and area symbols, form refers to the individual elements with which the symbol is constructed and not the overall form of the line or area feature (Ramroop, 1998). For example, the form visual variable was an important determinant in drawing a distinction between perennial and non-perennial rivers in the GIS. Perennial rivers were indicated using a solid line with a width of 1.00 pt. Non-perennial rivers though were indicated using an intricate dash line with a width of 0.50 pt. The aim of the visual differences between the rivers was to indicate and emphasise the ranking that is associated with the degree of consistency of the respective stream flows. Moreover, form was also an important consideration where the GPS points, depicting the archaeological terrains were concerned. In view of the small scale of the project and the amount of GPS points, a basic circle point-feature was selected to represent the archaeological terrains. This selection was also motivated by the fact that the GPS points were displayed in context with line- and area features, which accentuates the importance of the dataset (the archaeological terrains) pertaining to the exclusivity of the form.

• Colour – is the most powerful and most frequently used visual variable in symbol design (Ramroop, 1998). Colour is applicable to point, line and area features (Ramroop, 1998). The colour applied to the archaeological points received particular consideration because the points were displayed on the bright surfaces of elevation, slope and aspect. Furthermore the colour of the archaeological points must avoid confusing affiliations (such as the colour blue indicating a water feature) and must take into account colour blindness. Therefore, the colour selected for points displayed on the elevation surface is either white or bright yellow. These two colours are not represented in the elevation surface and will not be difficult to distinguish such as blue or red colours on green, which proves complicated for people with colour blindness. On the red and yellow degree slope surface, the colour of the archaeological points is black, which is easy discernable. Black was also selected for the archaeological terrains depicted on the aspect surface, because of the array of colours used to indicate orientation.

The colour of the elevation surface was selected not only to simulate the natural colours of the landscape (such as greens, browns, orange and beige), but also to indicate value. The darker colours such as the dark greens and dark browns have a lower elevation value than the lighter colours such as orange / peach and beige. Thus the elevation value increases with reference to the percentage hue of colours. The same approach is applicable to the hillshade surface, where greyscale values range from 255 for white (high) to 0 for black (low) with grey making up the middle values.

• Value – refers to values on the grey scale ranging from white to black (Ramroop, 1998). Therefore, value is measured in terms of the ability to reflect light, and can also be applied to the colour visual variable. The elevation and hillshade surfaces described above serve as examples of the value variable. Users of today's computer technology, are bombarded with an array of fonts, colours and arbitrary symbol libraries, which if not used systematically can create maps which inefficiently and inaccurately communicate spatial information (Ramroop, 1998).

INTERPRETATION OF RESULTS

The interpretation of the results, based on the GIS Database and maps created, will be discussed at length in an article to be published in the future. This section requires the contribution of Mr. G. Anderson.

CONCLUSION

This author assumed the spatial modelling and analysis of the archaeological terrains at Richards Bay Minerals. This was achieved by assembling a comprehensive Geographic Information Systems (GIS) database and applying analytical methods from which deductions could be drawn with regards to the elevation, orientation and slope angle of the archaeological terrains. The final results were produced in cartographic format, which will be interpreted by Mr. G. Anderson.

The interpretation of the results will be discussed in an article to be published in due course.

The aim of this report is to describe the approach and methodology followed in assembling the GIS database, as well as to delineate the problems encountered during the project and how these problems were eradicated.

The following suggestions are made concerning the future of the project:

- The datasets should be updated on a regular basis. This will restrict data availability obstacles as experienced with regards to the elevation, soil, geology and vegetation datasets.
- It may prove significant to capture datasets for soil, geology and vegetation for the purpose of displaying the archaeological terrains in context thereof.

• In this author’s opinion, it will be astute to invest the required time and money to properly train an individual/s in Geographic Information Systems.

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APPENDIX B
TEXT FOR THE RBM INTRAWEB PAGE

Background to the archaeological sites.

General information:

The archaeological surveys at RBM began in 1995 when RBM approached the Natal Museum and the then KwaZulu Monuments Council (KMC) to undertake an assessment of the heritage of the area. It became apparent that many sites occurred in the area and that there was great potential for a heritage salvage program. Gavin Anderson (then with the Natal Museum) began the archaeological work, and the KMC began the oral history project in 1995. Since 2004, Umlando (run by Gavin and Louise Anderson) works in conjunction with KZN Heritage (Amafa KZN) to monitor, assess, and mitigate the various archaeological sites.

Since then over 250 sites have been, most have been sampled, and several have been excavated. These results have yielded a wide range of information relating to the occupation of the coastal dunes in the mining leases for the last 3 500 years.

Below is a very brief summary of these people.

Archaeologists who study the Iron Age, in southern Africa, use pottery decorations to determine who stayed when and where. That is, different styles of pottery are related to different language and cultural groups. These pottery styles also change over time, and thus indicate how that specific society changes. For example, the decorations on a beer drinking pot will be different for a Shona-speaking person and a Zulu-speaking person. These differences will also occur over a time; that is, the decorations on a beer drinking pot from 100 years ago will be very different to those of pots used in the present. In this way, we can see who lived on the landscape at various times.

These pottery decorations occur at specific times in the past, and many sites have been radiocarbon dated. This has given archaeologists a very good idea of when certain types of people (or groups) lived. The more recent past (i.e. the last 900 years) is less well dated, and forms a major part of the work undertaken in the RBM mining lease.

The oldest site dates to 3500 years ago and is a living area of San Hunter gatherer. Other sites include the earliest farmers in KZN at 1700 years ago. These farmers arrived with a full farming, iron working and pottery technology. The pottery decorations on these pots date to specific times and we can notice the changes in these decorations through time. Approximately 900 years ago a new group of farmers arrived in KZN. They replaced the previous people and spoke a formative Nguni language. This Nguni language eventually became SiSwati, Zulu, and Xhosa. The pottery associated with these people is very different to the previous pottery suggesting that they had a different language and cultural system.

Terminology and dates:

I have given each period, or phase, a specific number, as these are easier to express in graphic terms in maps. These numbers are exclusive to this study and are not used elsewhere. The names used for the Early Iron Age refer to the archaeological sites where these types of pottery decorations were first recorded, and not to a language or other social group. The names I use in the Late Iron Age do refer to specific groups of people, which have been recorded as living historically in the area. Please note that the table is a general description of the history.

Period	Abbreviation	Estimated Age (years ago)	Pottery decoration	Pottery Number	Social Economy	Size of settlement
Late Stone Age	LSA	30 000 – 1 700	No pottery associated with this site	N/A	Hunter-gatherers	Small bands
Early Iron Age	EIA	1 700 – 1 500	Mzonjani	1	Farmers	Large village, mostly in valley bottoms
Early Iron Age	EIA	1 500 – 1300	Msuluzi	2	Farmers	Large village, mostly in valley bottoms
Early Iron Age	EIA	1 300 – 1 100	Ndondondwane	3	Farmers	Large village, mostly in valley bottoms
Early Iron Age	EIA	1 100 – 900	Ntshekane	4	Farmers	Large village, mostly in valley bottoms
Late Iron Age	LIA	900 – 800	Proto-Nguni pottery	5	Farmers	Family sized settlements mostly on higher grounds
Late Iron Age	LIA	800 – 700	Proto-Nguni	6	Farmers	Family sized settlements mostly on higher grounds
Late Iron Age	LIA	700 – 300	Northern Nguni-speaking people. Described as Thembi Tonga by the Portuguese in the 16th century	7	Farmers	Family sized settlements mostly on higher grounds
Late Iron Age	LIA	300 - present	Zulu-speaking people	8	Farmers	Family sized settlements mostly on higher grounds, but some on the lower areas

Late Iron Age	LIA	300 - present	Zulu-speaking people	9	Farmers	Family sized settlements mostly on higher grounds, but some on the lower areas
Indeterminate Iron Age	LIA	Probably Late Iron Age, but we cannot ascribe a specific date.	Pottery is undecorated	10	Farmers	Family sized settlements mostly on higher grounds, but some on the lower areas

Graphics

Pictures to be used

- Artefacts
  - Pottery styles: possibly all 7 types (many are at the Natal Museum)
  - Glass beads (at Natal Museum)
  - Metal Working (slag, tuyére, furnaces)
  - Shell middens
- Excavations
  - Excavation plans of different sites, e.g. smelting site, EIA village, LIA settlement, hunter-gatherer settlement
  - Excavation photos
- People at work
  - RBM people
  - Proper archaeologists!
- Mananga Centre
  - Outside general shot
  - Pic of 1st centre
  - Pic of 2nd centre
  - Pic of last centre
  - Muthi Garden
  - “Shakan Banana Trees”

To Add:

Annual reports (all?)

GIS project: Selected pics with descriptions

APPENDIX C
ORIGINAL PROPOSAL FOR MANANGA HERITAGE CENTER

The Mananga Heritage Centre requires an upgrade. Several of the original artefacts have been misplaced and/or disappeared, and have been gradually replaced by more modern artefacts, specifically, modern Zulu beer drinking vessels, mats and aprons. Other problems include spelling and grammatical mistakes in English and Zulu, incorrect statements regarding vegetation. There are other smaller mistakes and these were highlighted in an email sent to Sicelo Bhengu in August 2006.

We propose that each room is revamped and that parts of the outside area are changed or reworked.

The proposal is divided below into the following aspects

- Each room according to how it was originally envisaged
- Problems in that room
- Corrections needed
- Additions to the room

Room 1: Archaeology:

1. Original idea:

   1.1. This room was intended for the explanation and display of the archaeological artefacts and sites recovered from the dunes

2. Problems

   2.1. Posters/ Signs are old and “battered”

   2.2. The archaeological display in front of the shell midden poster is fine; however, the artefacts on the floor have been removed. These included pottery, shell, and slag. They have been replaced with modern designed Zulu beer drinking pots.

   2.3. Other artefacts such as the grinding stones are not in the room anymore.

3. Corrections:

3.1. Remove modern artefacts

3.2. Clean and replace/fix current posters

4. Additions

4.1. Place pictures of the results of the GIS project on a large poster with possible text

4.2. change poster by model and replace with GIS poster

4.3. Display drawings, pictures, or actual pots of each decorative style of pottery found in the dunes. This would require either a display cabinet or wall space. We would prefer the actual artefacts on display.

4.4. Keep the “what is a site” and “what is found in the dunes” displays. Add the spatial map for the hunter-gatherer site showing spatial patterns of living area. Spatial patters of Late Iron Age Village also available. Both show living and cooking areas, as well as rubbish dumps, skeletons, etc.

4.5. Add other artefacts such as slag, iron ore, etc.

4.6. **ALL** artefacts to be in glass cases

Room 2: Historical past

1. Original Idea

1.1. This room was to display the historical past. That is the history of the Mbonambi and Mthiyane people, as well as their oral history.

1.2. Included in this is the ‘Shaka Bananas’ and the iron smelting, specifically Mabodla’s story.

2. Problems:

2.1. the replica of the furnace has been removed

2.2. the area has been filled with modern Zulu pottery and other ceramics

2.3. Posters need cleaning and/or renewing

3. Corrections

3.1. Spelling mistakes in Zulu text

3.2. Spelling mistakes in English text.

3.3. Shakan bananas are not indigenous, as displayed.

4. Additions:

4.1. Have example of slag, iron ore, and metal objects.

4.2. Display picture of original furnace excavated

4.2.1. Request Natal Museum for the furnace that was excavated in 2000. The complete furnace was removed and stored at the Natal Museum. This is only if RB wants to display it and if there is space.

4.3. Display pictures of the oral history project

4.4. Have recordings of videos and/or tapes of the oral history. That is let people see/hear the original recordings

4.5. Mention Ntongande

Room 3: ‘Modern Room

1. Original Idea

1.1. This room was for the local community to display their cultural remains

2. Problems

2.1. Room is haphazard collection or store room

2.2. Artefacts on display have no explanation

3. Corrections and Additions

3.1. Add text to display of current artefacts

3.2. Comment on what different symbols and colours mean, e.g. triangles, squares. etc

3.3. Place oral history recordings in this room if there is no space in room 2

3.4. Have a modern history ‘idea section’ for scholars, e.g. how they can record their own history. Perhaps prepare area for display for the various recordings.

Muthi Garden

1. Original Idea
   1.1. Display some plants used in the area for traditional medicine
2. Problems
   2.1. Area overgrown
   2.2. no signage
3. Corrections/Additions
   3.1. Add more Muthi plans found in the area
   3.2. Add Coral Tree, (*Erithrena spp.*) as it is also used for demarcating graves/spiritual resting places.

General

1. Mphafa tree needs to be corrected. It was not only used for kings/chiefs, but for general people as well.
2. Perhaps use one of the corners to display a profile, or stratigraphy, of an archaeological site.