PGS

HERITAGE & GRAVE
RELOCATION CONSULTANTS

EXECUTIVE SUMMARY

PGS Heritage (PGS) was appointed by Terreco Environmental to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMPr) for the Proposed Nxaxo Water Supply in the Nxaxo and Cebe area Eastern Cape Province.

During the survey a total of 20 heritage sites were identified of which 19 were cemeteries or single graves, containing approximately 89 graves in total. A church building (**NX5**) constructed from corrugated iron sheet was also identified in close proximity to a proposed pipeline alignment. The following mitigation and direct management measures during construction will be required:

Heritage Structures

- The site should be demarcated and fenced during construction activity and a buffer of at least 10 meters around the site kept ;
- If the site must be impacted on due to development constraint a permit under Section 34 of the NHRA will be required for further mitigation work that must include consultation with the affected congregation, documentation through layout sketches and photographs as a minimum;

Cemeteries

- Adjust the alignments and demarcate grave sites with at least a 10 meter buffer.
- In the event that construction is to be done within 10 meters of a grave, the construction activity must be monitored by an archaeologist during work near such sites.
- In if the sites cannot be excluded from the pipeline foot print, a grave relocation process as described in Section 5 of this report needs to be implemented.
- The consultation with regards to construction close to graves and cemeteries needs to be done before construction starts, the agree on the process to be followed with the community, in the case that graves are damaged or work needs to be done very close to graves.

The grave relocation process must include:

- A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, which will be at least 60 days in length;
- Site notices indicating the intent of the relocation;
- Newspaper Notice indicating the intent of the relocation;
- A permit from the local authority;
- A permit from the Provincial Department of Health;
- A permit from the South African Heritage Resources Agency, if the graves are older than 60 years, or unidentified and thus presumed older than 60 years;
- An exhumation process that keeps the dignity of the remains and family intact;
- The whole process must be done by a reputable company that is well versed in relocations;
- The exhumation process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the development company.

Palaeontology

The study area of the Nxaxo Water Supply Project is mainly underlain by Permian aged rocks of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. Three sections are underlain by prominent Jurassic aged dolerite sills and numerous dolerite dykes cut the study area. A small section in the south east of the study area is underlain by Quaternary sand, dune sand and dune rock.

Due to the high fossiliferous potential of the Adelaide Subgroup strata, areas underlain by these units have been allocated a Medium palaeontological sensitivity. This may be upgraded to High following a Phase 1 PIA. The area underlain by Quaternary sand, dune sand and dune rock has also been allocated a Medium palaeontological sensitivity which may be either upgraded to High or downgraded to Low following a Phase 1 PIA. The areas underlain by dolerite have been allocated a Low palaeontological sensitivity as a result of their igneous nature.

Recommendations:

- The EAP as well as the ECO for this project must be made aware of the fact that the Adelaide Subgroup is extremely rich in fossil remains. Several types of fossils have been recorded from this subgroup in the Karoo Basin of South Africa.
- It is recommended that a Phase 1 PIA be undertaken by a qualified palaeontologist to assess and record the extent of erosion and outcrop of fossiliferous units, notably strata of the Adelaide Subgroup, which have been allocated a Medium palaeontological sensitivity rating within the study area.

General

Further to these recommendations the general Heritage Management Guidelines in Section 6.1 need to be incorporated into the EMP for the project.

The overall impact of the development on heritage resources is seen as acceptably low and impacts can be mitigated to acceptable levels.

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1 INTRODUCTION

PGS Heritage (PGS) was appointed by Terreco Environmental to undertake a Heritage Impact Assessment (HIA) that forms part of the Environmental Impact Assessment (EIA) and Environmental Management Plan (EMPr) for the Proposed Nxaxo Water Supply in the Nxaxo and Cebe area Eastern Cape Province.

1.1 Scope of the Study

The aim of the study is to identify possible heritage sites and finds that may occur in the proposed development area. The HIA aims to inform the EIA in the development of a comprehensive EMPr to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This HIA was compiled by PGS Heritage (PGS).

The staff at PGS has a combined experience of nearly 40 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where the staff has the relevant expertise and experience to undertake that work competently.

Wouter Fourie, the Project Coordinator and Heritage Specialist is registered with the Association of Southern African Professional Archaeologists (ASAPA) as a Professional Archaeologist and is accredited as a Principal Investigator; he is further an Accredited Professional Heritage Practitioner with the Association of Professional Heritage Practitioners (APHP).

Marko Hutten, Archaeologist for the project is registered with the Association of Southern African Professional Archaeologists (ASAPA) as a Professional Archaeologist and is accredited as a Field Director.

Dr Gideon Groenewald, the appointed external Palaeontologist for this project, has a PhD in Geology from the Nelson Mandela Metropolitan University (1996) and the National Diploma

in Nature Conservation from the University of South Africa (1990). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeontological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

1.3 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and the current dense vegetation cover. As such, should any heritage features and/or objects not included in the present inventory be located or observed, a heritage specialist must immediately be contacted.

Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. In the event that any graves or burial places are located during the development, the procedures and requirements pertaining to graves and burials will apply as set out below.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

i. National Environmental Management Act (NEMA), Act 107 of 1998
ii. National Heritage Resources Act (NHRA), Act 25 of 1999
iii. Mineral and Petroleum Resources Development Act (MPRDA), Act 28 of 2002
iv. Development Facilitation Act (DFA), Act 67 of 1995

The following sections in each Act refer directly to the identification, evaluation and assessment of cultural heritage resources.

i. National Environmental Management Act (NEMA) Act 107 of 1998
    a. Basic Environmental Assessment (BEA) – Section (23)(2)(d)
    b. Environmental Scoping Report (ESR) – Section (29)(1)(d)
    c. Environmental Impact Assessment (EIA) – Section (32)(2)(d)
    d. Environmental Management Plan (EMP) – Section (34)(b)
ii. National Heritage Resources Act (NHRA) Act 25 of 1999
    a. Protection of Heritage Resources – Sections 34 to 36; and
    b. Heritage Resources Management – Section 38
iii. Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
    a. Section 39(3)
iv. Development Facilitation Act (DFA) Act 67 of 1995
    a. The GNR.1 of 7 January 2000: Regulations and rules in terms of the Development Facilitation Act, 1995. Section 31.

The NHRA stipulates that cultural heritage resources may not be disturbed without authorization from the relevant heritage authority. Section 34(1) of the NHRA states that, "no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…" NHRA is utilized as the basis for the identification, evaluation and management of heritage resources and in the case of CRM those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through NEMA, MPRDA and the DFA legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments managing these Acts before any authorizations are granted for development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impacts Processes required by NEMA and MPRDA. This change requires us to evaluate the Section of these Acts relevant to heritage (Fourie, 2008):

The NEMA 23(2)(b) states that an integrated environmental management plan should, "…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage".

A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of

the impacts of the proposed activity on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken account of in the Regulations under NEMA is the Specialist Report requirements laid down in Section 33 of the regulations (Fourie, 2008).

1.5 Terminology and Abbreviations

Archaeological resources

This includes:

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

ii. rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;

iii. wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;

iv. features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a

change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

i. construction, alteration, demolition, removal or change in use of a place or a structure at a place;
ii. carrying out any works on or over or under a place;
iii. subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
iv. constructing or putting up for display signs or boards;
v. any change to the natural or existing condition or topography of land; and
vi. any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age between 700 000 and 2 500 000 years ago.

Fossil

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

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance

Holocene

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

Late Stone Age

The archaeology of the last 20 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 20-300 000 years ago, associated with early modern humans.

Palaeontology

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

ABBREVIATIONS	DESCRIPTION
AIA	Archaeological Impact Assessment
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
EMPr	Environmental management Plan
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

Refer to **Appendix C** for further discussions on heritage management and legislative frameworks

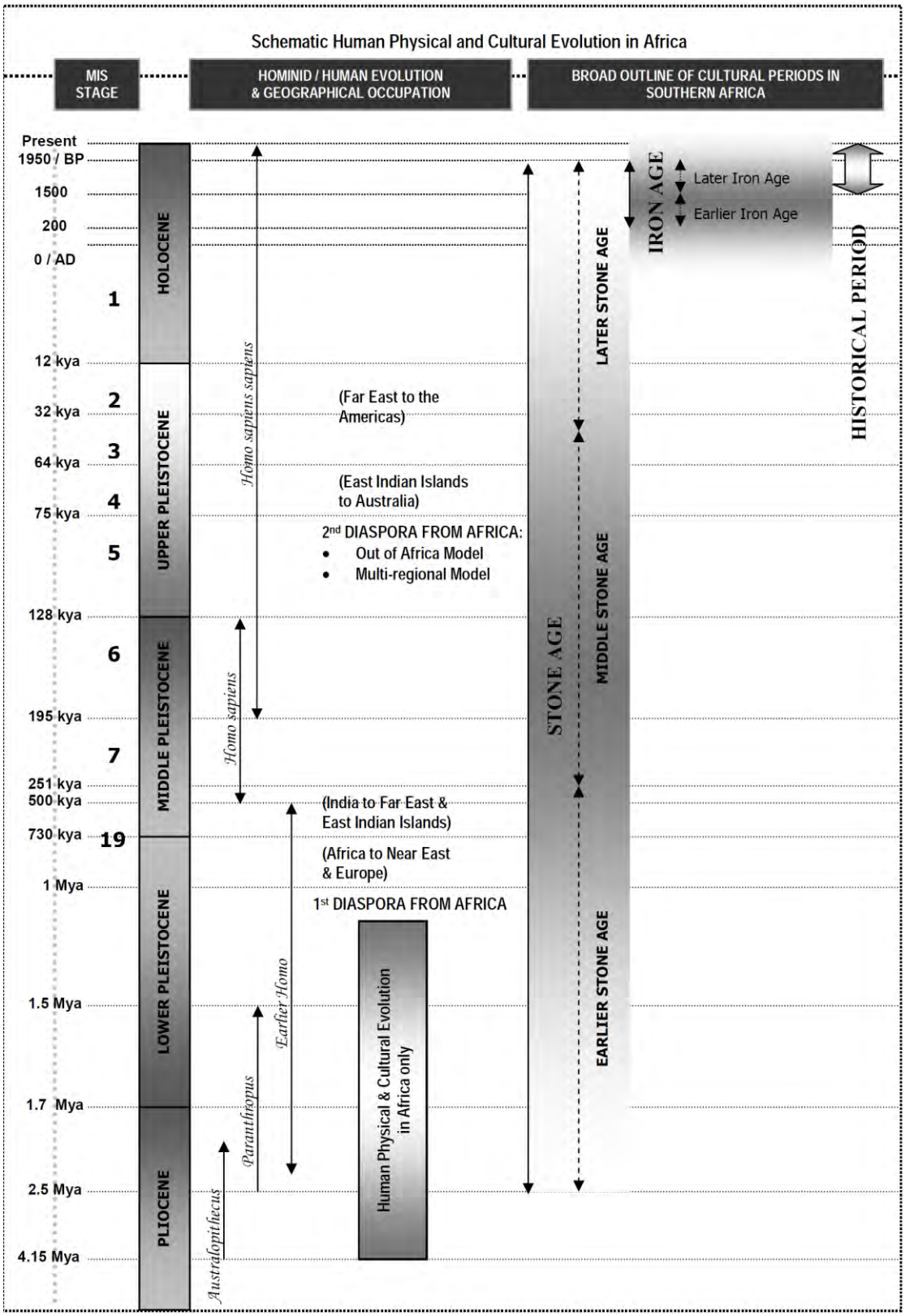

Figure 1 – Human and Cultural Timeline in Africa (Morris, 2008)

2 TECHNICAL DETAILS OF THE PROJECT

2.1 Site Location and Description

The Project is located in the Eastern Cape, about 30 km to the east of the town of Centani, and within the Mnquma Local Municipality. The Project area lies between the Qora River to the north and the Nxaxo River to the south. The Project area extends 27 km westwards from the coast between the Qora River and Nxaxo River. The westward extent of the area is roughly defined by the Nkonkwane, Centuyle and KwaNontshinga villages (**Figure 2**).

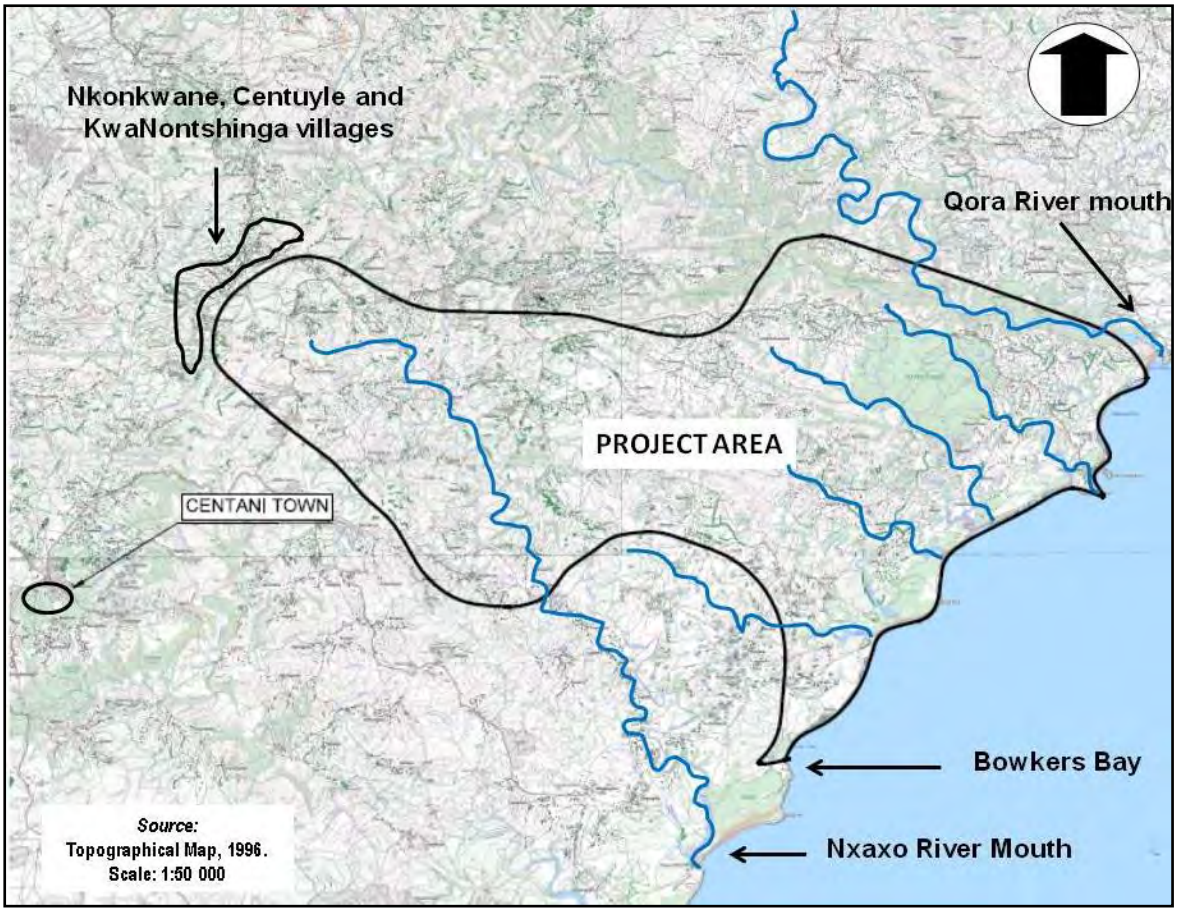

Figure 2 – Study area locality

2.2 Site Description

The Project is located in a rural environment with traditional villages scattered throughout the area. The topography of the area consists generally of undulating hills and valleys and the area is intersected throughout by numerous water courses and drainage lines. The Qora River to the north and the Nxaxo/Ngqusi River complex to the south are sensitive features. Between these two rivers, several smaller rivers drain to the coast. The general vegetation type for the Project area is Bhisho Thornveld inland and Transkei Coastal Belt along the coast. The Manubi State Forest is an important feature on the northern boundary of the

Project area. There are also isolated patches of Scarp Forest and Transkei Coastal Platform Forest along the northern and coastal boundaries. (**Figure 3**).

The northern section of the project has already seen some construction activity on the pipelines with the area classified as ***Phase 1*** subject to construction of reservoir R1 at an earlier stage (**Figure 4**). Current construction activity is on-going in the region of reservoir R11 in Phase 1 **(Figure 5**).

Figure 3 – General view of study area – rural landscape with low density settlement

2.3 Technical Project Description

The Project is located in the Eastern Cape, about 30 km to the east of the town of Centani, and within the Mnquma Local Municipality. The Project area lies between the Qora River to the north and the Nxaxo River to the south. The Project area extends 27 km westwards from the coast between the Qora River and Nxaxo River. The westward extent of the area is roughly defined by the Nkonkwane, Centuyle and KwaNontshinga villages.

Figure 4 – End point at one of reticulation alignments

The purpose of the Project is to construct bulk and reticulated water supply infrastructure for 7,914 households in 58 villages in a Wards 25, 26 and 27 of the Mnquma Local Municipality. The Wards consist entirely of rural communities and almost the entire population relies on informal sources of water which results in frequent health problems. The objective of the proposed Nxaxo and Cebe Water Supply Scheme is to deliver to these communities a "free, safe, basic" water supply that is aligned with RDP standards.

The Project design includes the construction of pump stations, a small Water Treatment Works (4Mℓ/day), bulk and secondary water supply pipelines (4.8 km), tertiary water supply pipelines (35km) and reticulation (364.9 km) to 861 village standpipes. Eight reservoirs, as well as 5km of gravel road to access the reservoirs, water treatment works and pump stations, and 5 km of electricity supply line to service the pumps, are included in the design. Stand-by generators will also be installed. Water will be abstracted from the Qora River downstream.

Figure 5 – Position of extraction point at PS1

Figure 6 – Proposed alignment in road reserve

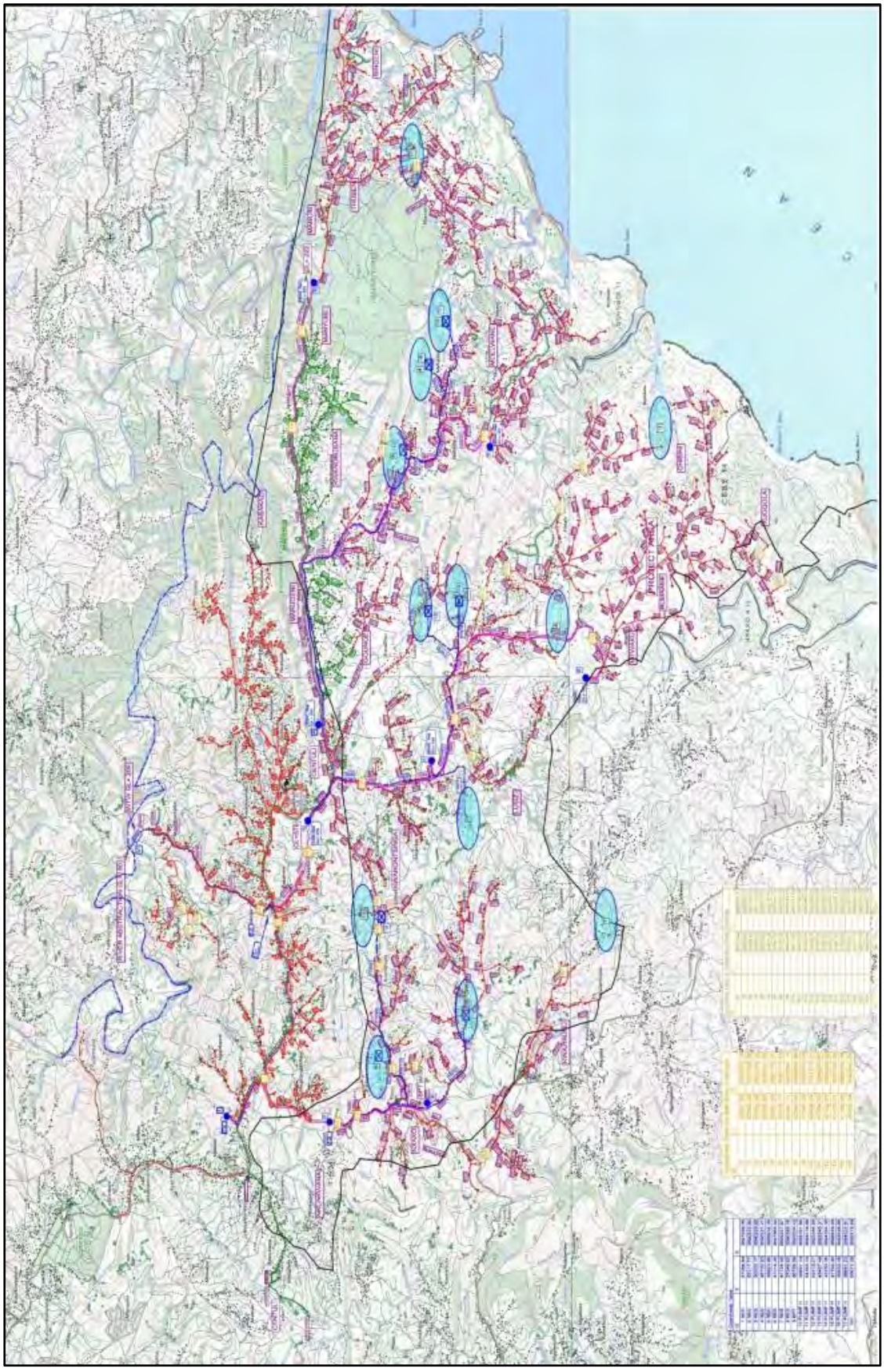

Figure 7 – Project layout

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site significance

This Heritage Impact Assessment (HIA) report was compiled by PGS Heritage (PGS) for the proposed Nxaxo Project. The applicable maps, tables and figures, are included as stipulated in the NHRA (no 25 of 1999), the National Environmental Management Act (NEMA) (no 107 of 1998). The HIA process consisted of three steps:

Step I – Literature Review: The background information to the field survey relies greatly on the Heritage Background Research.

Step II – Physical Survey: A physical survey was conducted on foot through the proposed project area by qualified archaeologists (June 2012), aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant archaeological resources, the assessment of resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

The significance of heritage sites was based on four main criteria:

- Site integrity (i.e. primary vs. secondary context),
- Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
    - Low - <10/50m2
    - Medium - 10-50/50m2
    - High - >50/50m2
- Uniqueness; and
- Potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;

B - Mapping of the site and controlled sampling required;

C - No-go or relocate development activity position;

D - Preserve site, or extensive data collection and mapping of the site; and

E - Preserve site.

Impacts on these sites by the development will be evaluated as follows:

Site Significance

Site significance classification standards prescribed by the SAHRA (2006) and approved by the ASAPA for the Southern African Development Community (SADC) region, were used for the purpose of this report.

Table 1: Site significance classification standards as prescribed by SAHRA.

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	-	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)	-	High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)	-	Medium Significance	Recording before destruction
Generally Protected C (GP.A)	-	Low Significance	Destruction

3.2 Methodology for Impact Assessment

In order to ensure uniformity, a standard impact assessment methodology has been utilised so that a wide range of impacts can be compared. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;

- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in **Table 2**.

Table 2: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	*Isolated site*	Incidental
2	LOW	*Study area*	Short-term
3	MODERATE	*Local*	Medium-term
4	HIGH	*Regional / Provincial*	Long-term
5	VERY HIGH	*Global / National*	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

3.2.1 **Significance Assessment**

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1000 km^2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed, the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given in Table 3 below.

Table 3: Description of the significance rating scale

RATING		DESCRIPTION
5	VERY HIGH	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	HIGH	Impact is of substantial order within the bounds of impacts which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	MODERATE	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	LOW	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	VERY LOW	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity is needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	NO IMPACT	There is no impact at all - not even a very low impact on a party or system.

3.2.2 **Spatial Scale**

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in **Table 4**.

Table 4: Description of the significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a regional scale (District Municipality to Provincial Level). The impact will affect an area up to 50 km from the proposed site.
3	Local	The impact will affect an area up to 5 km from the proposed site.
2	Study Area	The impact will affect a route corridor / site not exceeding the boundary of the site.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the site.

3.2.3 **Duration Scale**

In order to accurately describe the impact it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in **Table 5**.

Table 5: Description of the temporal rating scale

RATING		DESCRIPTION
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium term	The environmental impact identified will operate for the duration of life of the project.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

3.2.4 **Degree of Probability**

The probability or likelihood of an impact occurring will be described as shown in **Table 6** below.

Table 6: Description of the degree of probability of an impact occurring

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It's going to happen / has occurred

3.2.5 **Degree of Certainty**

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used, as discussed in **Table 7**. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 7: Description of the degree of certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact, or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.

3.2.6 **Quantitative Description of Impacts**

To allow for impacts to be described in a quantitative manner, in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

Impact Risk = (SIGNIFICANCE **+** *Spatial* **+** Temporal) X Probability

3 5

An example of how this rating scale is applied is shown below:

Table 8: Example of Rating Scale

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	LOW	Local	Medium Term	Could Happen	
Impact to heritage	2	3	3	3	1.6

Note: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 3 to give a criterion rating of 2.67. The probability (3) is divided by 5 to give a probability rating of 0.6. The criteria rating of 2.67 is then multiplied by the probability rating (0,6) to give the final rating of 1,6.

The impact risk is classified according to 5 classes as described in the table below.

Table 9:Impact Risk Classes

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	1	Very Low
1.1 – 2.0	2	Low
2.1 – 3.0	3	Moderate
3.1 – 4.0	4	High
4.1 – 5.0	5	Very High

Therefore with reference to the example used for air quality above, an impact rating of 1.6 will fall in the Impact Class 2, which will be considered to be a low impact.

4 CURRENT STATUS QUO

4.1 Archival findings

The archival research focused on available information sources that were used to compile a background history of the study area and surrounds. This data then informed the possible heritage resources to be expected during field surveying.

The findings can be compiled as follows:

As archaeological and heritage surveys deal with the locating of archaeological and heritage resources in a prescribed cartographic landscape, the study of archival and historical data, and especially cartographic material, can represent a very valuable supporting tool in finding and identifying such resources.

The historical background and timeframe can be divided into the Stone Age, Iron Age and Historical timeframes. These can be outlined as follows:

Stone Age

The Stone Age is divided into Early, Middle and Late Periods and refers to the earliest people of South Africa who mainly relied on stone for their tools.

- *Early Stone Age:* The period dates from ± 2.5 million yrs. - ± 250 000 yrs. ago. Acheulean stone tools are dominant.
- *Middle Stone Age:* Various lithic industries in SA dating from ± 250 000 yrs. – 22 000 yrs. before present.
- *Late Stone Age:* The period from ± 22 000-yrs before present to the period of contact with either Iron Age farmers or European colonists.

Iron Age

The Iron Age as a whole represents the spread of Bantu-speaking people and includes both the Pre-Historic and Historic periods. Similarly to the Stone Age, it can be divided into three periods:

- *The Early Iron Age:* Most of the first millennium (0 – 900 AD).
- *The Middle Iron Age:* 10th to 13th centuries (900 - 1200 AD)
- *The Late Iron Age:* 14th century to colonial period (1300 – 1500 AD).

Historic Timeframe

17th Century to present AD (1600 – 2000)

4.1.1 Culture and Heritage

Butterworth, formerly situated in Fingoland is a predominantly Mfengu Xhosa community. The Mfengu (meaning wanderers) were defeated and left landless by Zulu expansion under the rule of King Shaka (Mfecane 1815 – 1840). The Mfengu slowly started migrating into Xhosa territory and by the 1830's a centre of Mfengu settlement was established around the Methodist Missionary station in Butterworth where Reverend John Ayliff was stationed. By 1835 the relations between the Mfengu people and other Xhosa groups under the

leadership of King Hinsta became strained and they look to the Reverend J Ayliff as a source of political patronage. In 1835 Sir Benjamin D'Urban replied to the letter Reverend John Ayliff wrote him on behalf the Mfengu people. D'Urban accepted the Mfengu people as British subjects on 3 May 1835. The Mfengu would be granted land in accordance with Government notice No 14. On 14 May 1836 Mfengu leaders gathered at Peddie and in the presence of Reverend John Ayliff undertook the "Fingo Oath". They swore to obey God and listen to the missionaries, to be loyal to the government, and to educate their children. The Mfengu people became the first Nguni people to convert to Christianity and become subjects of the British Empire (*South African History Online, www.sahistory.org.za*). As subjects and military allies of the British Empire the Mfengu's became wealthy peasant farmers and provided some of the first Western-type political leaders among Africans in the Eastern Cape (*www.britanica.com/EBcecked/topic/379579/Mfengu*).

Kentani (Centani)

Was the site of the final battle of the Frontier Wars between Xhosa and settler in 1878. With the onset of the battle the Xhosa warriors were informed by their witchdoctor Xito that he had made them impervious to bullets. The Kentani fort, manned by less than a thousand colonial troops, were stormed by nearly 5000 Xhosa warriors and three thousand warriors died, with a loss of only two on the colonial force's side. After this battle the Xhosa chief surrendered and the area became the nucleus of the Transkei area (http://www.wildcoast.co.za/node/112).

Mazeppa Bay

Situated on the northern most stretch of the Nxaxo project Mazeppa Bay is a holiday destination named after the ship Mazeppa that ran aground in at this location in 1842.

Tribes of the area

A survey of the ethnic composition of the previous homelands of the Ciskei and the Transkei was conducted by A.O. Jackson in the early 1970's. The survey included a short and broad history of the settlement of tribes across the Ciskei and the Transkei.

The two regions were occupied largely by the Cape Nguni (to differentiate them from the KZN Nguni groups) which included the Xhosa, Thembu, Mpondo, Fingo and even some Sotho groups. These groups can be divided into various smaller groups and tribes who settled

across the region. The Xhosa group can be divided into four groups which included the Gcaleka tribes, Rarabe tribes, the pre-Gcaleka or pre-Rarabe tribes and the Gqunukhwebe.

Jackson identified the groups or tribes who settled in the study area as mostly belonging to the amaNgqika-tribe, but also with large elements of the amaJingqi-, amaGwelane and imiNgcangathelo-tribes. These tribes originated from the Ciskei and belonged to the Rarabe tribes.

In 1856/57 the Gcaleka chief Sarili and other Xhosa chiefs ordered their subjects to kill all their livestock and to destroy all their crops and grain supplies. This was according to the prophesies of Nongqawuse, a young girl, in an effort to overcome the powers of the Europeans. This had catastrophic effects on the survival of all the Xhosa groups. Colonial forces also conducted subsequent punitive actions to stop these chiefs and the cattle-killing.

In the Ciskei the Ngqika (Rarabe) chief Sandile lost both his territory and his life during the war with Colonial forces in 1877/78. By this time most of the Xhosa tribes were weakened and defeated. His people were dispersed and some settled in the Kentani area in the Transkei. The family genealogy of Chief Kona (amaJingqi-tribe) at Gqunqe provides an example of the displacement of these tribes (Jackson, 1975).

4.1.2 **Archaeology**

The Sinqumeni Caves which contain San Rock art can be found within the Dutywa area to the north of the current study area – unfortunately there no other resources can be found that mention these caves. The only information available was the short listing found in the Mbhashe municipality profile (*EC21 Mbhashe local municipality Idutywa* *www.mbhashemun.gov.za*).

There are no other recorded archaeological sites found near or in the immediate area of the study area during our literature survey. There are however several registered Early Iron Age sites east of the N2 highway near Elliotdale (Xhora) between the Mbhashe River and Mthatha River (Feely & Bell-Cross, 2011).

Early Iron Age. About 1000 years ago another group of people began to move into the Eastern Cape, who unlike the Stone Age People, were skilled in metal work. The most southerly of these sites is at Canasta Place, about 20kms south of East London on the Port Alfred road.

Kulubele, near East London, is also of interest since it is the most southerly settlement of Iron Age peoples. Kulubele was partially excavated and reported on by John Steele (2006). It is believed that these peoples did not settle further south of Kulubele because their crops required summer rainfall and East London/ Port Elizabeth area is considered the most south eastern limits of summer rainfall region (Steele, 2006).

4.1.3 **Palaeontology of the area**

The following section is an extract from the Palaeontological Desktop Study attached as **Appendix D**.

The study area is underlain by Permian aged sedimentary rocks of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup with three sections underlain by prominent dolerite sills and numerous dolerite dykes (**Figure 8**). There is a very small section in the South East of the study area that is underlain by Quaternary sand, dune sand and dune rock.

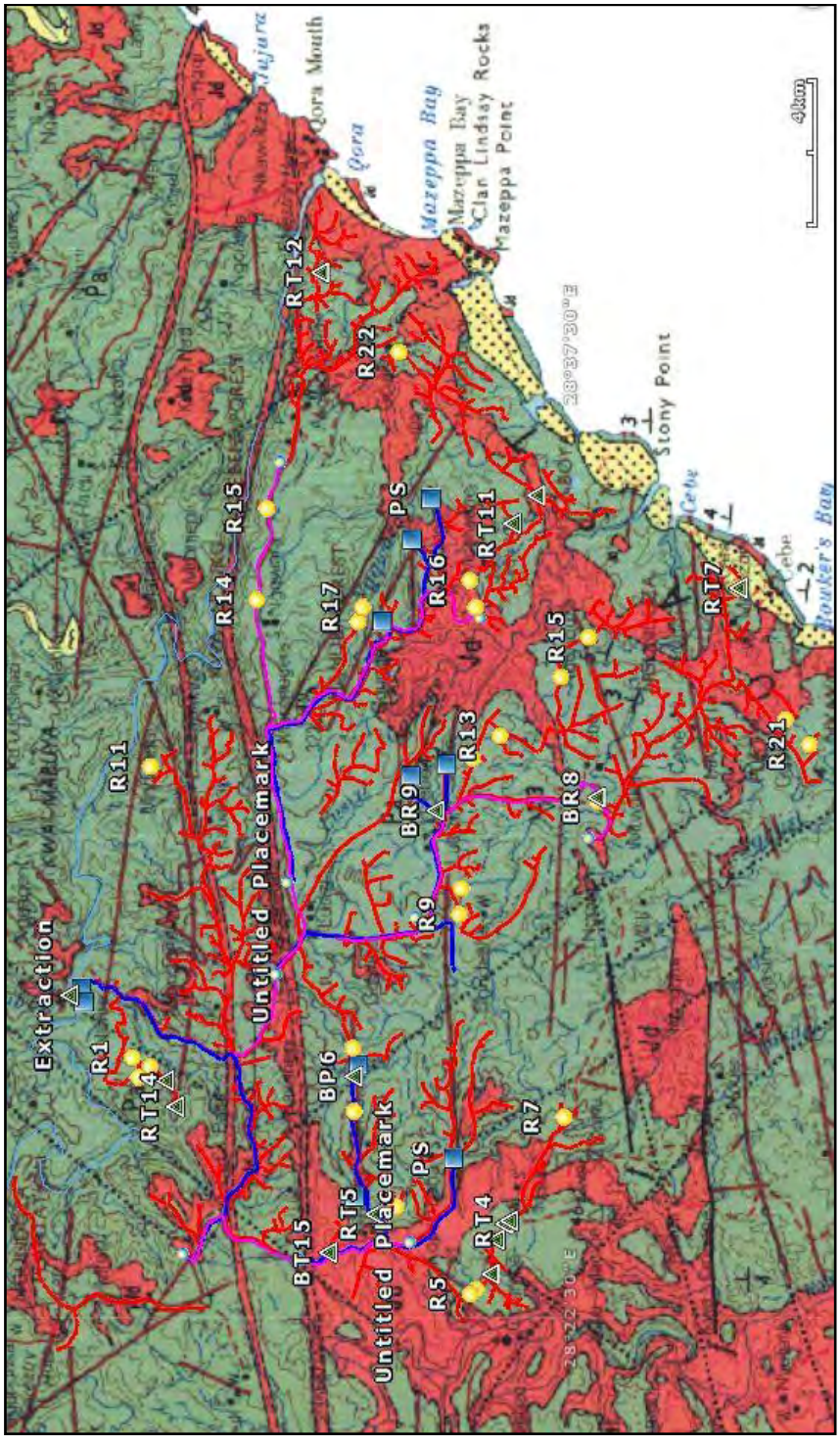

Figure 8 – Geology of the Nxaxo Water Supply Scheme

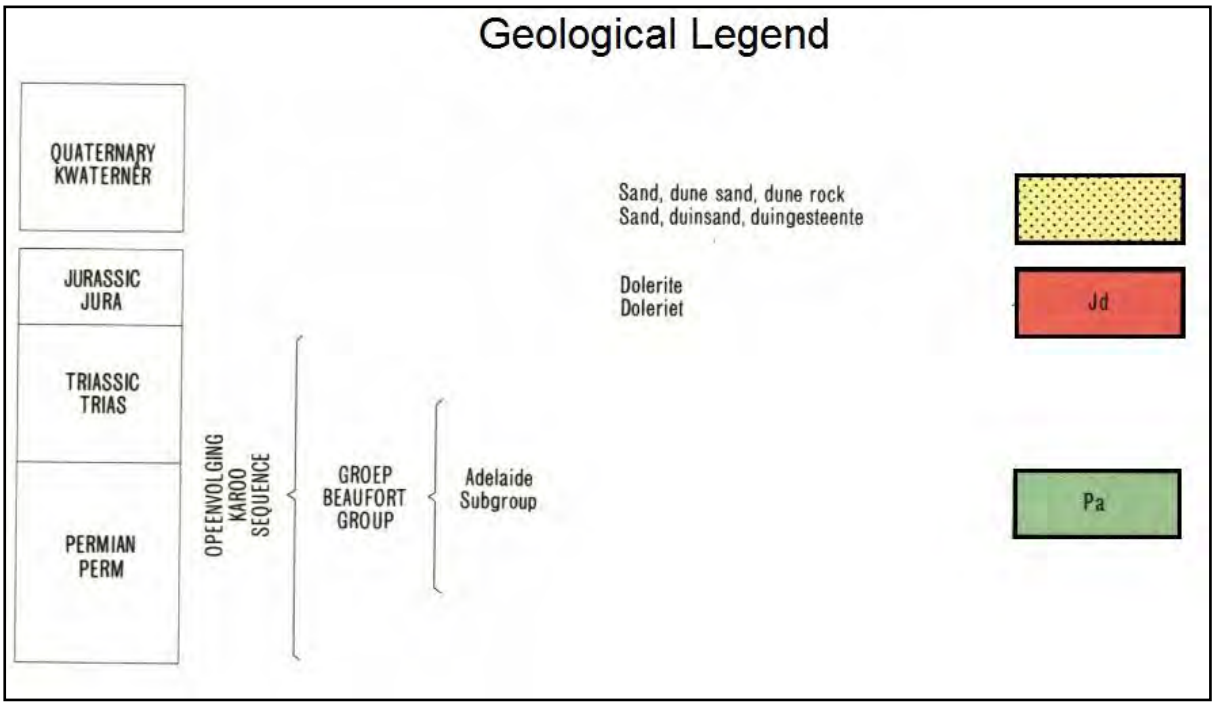

Figure 9 – Geological Legend for Figure 8

Adelaide Subgroup

Terrestrial vertebrate fossils are common in the Adelaide Subgroup. Fish remains, non-marine mollusks, invertebrate burrows and trails, silicified wood and stem impressions occur sporadically throughout the subgroup. Well preserved leaf impressions of mainly Glossopteris are common and in places the rock units contain a varied insect assemblage (Johnson et al, 2006). The Koonap Formation is associated with the Eodicynodon and Tapinocephalus assemblage zones (Rubidge, ed, 1995; Johnson et al, 2006) while the Middleton Formation is associated with the Pristerognathus, Tropidostoma and Cistecephalus Assemblage zones (Rubidge, ed, 1995, Johnson et al, 2006).

Dolerite

Due to the igneous nature of dolerite, no fossils will be found in the rock units.

Quaternary Sand

No record of fossils from the deposits in the study area was found, although fossils have been recorded from similar formations along the coastline of South Africa (Johnson et al, 2006).

4.1.4 **Palaeontological significance**

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 above. The Palaeontological sensitivity of the Geological units present within the study area is summarised in **Table 10** below.

The rock units of the Adelaide Subgroup have a high potential to yield fossils. The extent of erosion and outcrops of these units in the study area is not known. As result, areas underlain by rocks of the Adelaide Subgroup have been allocated a Medium Palaeontological Sensitivity, although this may be increased to High Sensitivity following a Phase 1 PIA of the study area, especially where the reservoirs and pump stations are proposed.

Although no record of fossils from the Quaternary deposits in the study area was found, there is a possibility that fossils might be present in this unit and areas underlain by Quaternary sand, dune sand and dune rock have been allocated a Medium palaeontological sensitivity, which will be either upgraded to High sensitivity or downgraded to Low sensitivity following a Phase 1 PIA study.

Due to the igneous nature of dolerite, no fossils will be found and areas underlain by dolerite have been allocated a Low palaeontological sensitivity.

Table 10 - Palaeontological Sensitivity of Geological Units on Site

Geological Unit	Rock Type and Age	Fossil Heritage	Vertebrate Biozone	Palaeontological Sensitivity
Sand	Sand, dune sand and dune rock QUATERNARY	None	None	**Medium sensitivity**
Jurassic dolerite	Dolerite JURASSIC	None	None	**Low sensitivity**
Middleton Formation	Red and Grey Mudstone & Sandstone PERMIAN	Vertebrate fossils of the *Therapsids* group e.g. *Gorgonopsian* and *Dicynodonts*. Plant fossils e.g. *Glossopteris* trees and	*Pristerognathus*, *Tropidostoma* and *Cistecephalus* assemblage zone	**Medium sensitivity**

		leaves.		
Koonap Formation	**Grey Mudstone, Sandstone and Shale PERMIAN**	***Vertebrate fossils of Eodicynodon* and *Tapinocephalus.* Plant fossils also recorded**	***Eodicynodon* and *Tapinocephalus* assemblage zone**	**Medium sensitivity**

4.2 Fieldwork findings

Due to the nature of cultural remains, with the majority of artefacts occurring below the surface, a controlled-exclusive surface survey was conducted over a period of 18 days on foot and by an archaeologist from PGS. The field work was conducted between 27 August and 20 September 2013.

The survey focussed directly on the proposed alignments of the pipelines as well as the reservoir and pump station positions as provided by the client (Error! Reference source not found.). Tracklogs were also recorded for the field work and is available on request from PGS.

During the survey a total of 20 heritage sites were identified of which 19 were cemeteries or single graves with a church site being the only other heritage feature found to be close to construction activities.

4.2.1 Heritage Structure - Church

The site is situated just to the side of the alignment at Cebe in of the project area. An old church building was identified at this location. The church was built with sheets of corrugated iron which covered the roof as well as the walls. The original structure measured approximately 20m x 12m and had a pitched roof. It had one door on the southern end and two smallish windows on the eastern side. A later extension was added on the western side to increase the size of the church to approximately 20m x 20m. The age of the structure was not known (**Figure 10**). The site is graded as Generally Protected A (GP.A).

Although the site falls outside the alignment of the proposed pipeline in its vicinity the site will require demarcation with a 10 meter buffer.

Table 11: List of Heritage Structures identified during the field work

Site	Description	Heritage Significance	S	E	Mitigation
NX05	Corrugate Iron Structure utilised as church	Medium	S32.52573	E28.52879	Demarcate and buffer Monitor during construction

Figure 10 – Corrugated iron structure utilised as church

Impact Evaluation:

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	HIGH	Isolated Sites / proposed site	Short-term	Unlikely	
Impact on heritage structures	4	1	2	2	0.93

Mitigation:

- The site should be demarcated and fenced during construction activity and a buffer of at least 10 meters around the site kept ;

- If the site must be impacted on due to development constraint a permit under Section 34 of the NHRA will be required for further mitigation work that must include consultation with the affected congregation, documentation through layout sketches and photographs as a minimum;

4.2.2 **Cemeteries**

During the fieldwork, 19 sites were identified as containing graves and cemeteries close to where construction activities will take place (see **Table 12**). Most of the smaller cemeteries and single grave are located within the fenced yards of the next-of-kin of the graves (**Figure 12**), although a few cases of single none fenced graves do exist (

Figure 11). All graves and cemeteries are graded as **Grade 3A and of high heritage significance**.

Table 12: List of cemeteries identified and verified during the field work

Site Number	Description	Number of	S	E
NX1	Cemetery	12 graves	S32.43242	E28.48570
NX2	Cemetery	3 graves	S32.43167	E28.49523
NX3	Grave	1 grave	S32.42087	E28.51844
NX4	Cemetery	20 graves	S32.42025	E28.51868
NX5	Church	Single corrugated structure	S32.52573	E28.52879
NX6	Grave	1 grave	S32.54819	E28.52404

NX7	Cemetery	2 graves	S32.53025	E28.56306
NX8	Cemetery	20 plus graves	S32.52815	E28.53942
NX9	Cemetery	4 graves	S32.47162	E28.52679
NX10	Cemetery	8 graves	S32.45265	E28.53440
NX11	Grave	1 grave	S32.47722	E28.60374
NX12	Cemetery	2 graves	S32.44661	E28.64046
NX13	Cemetery	3 graves	S32.50443	E28.55119
NX14	Grave	1 grave	S32.46441	E28.39146
NX15	Grave	1 grave	S32.47409	E28.42265
NX16	Cemetery	2 graves	S32.45780	E28.40230
NX17	Cemetery	4 graves	S32.45422	E28.39365
NX18	Grave	1 grave	S32.44352	E28.65954
NX19	Grave	1 grave	S32.42334	E28.47227
NX20	Cemetery	2 graves	S32.46274	E28.51627

Figure 11 – Unfenced graves at NX16

Figure 12 – Grave inside plot – Site MX10

Impact Evaluation

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
Negative	HIGH	Isolated Sites / proposed site	Permanent	Could happen	
Impact to graves and cemeteries	4	1	5	3	2.00

Mitigation:

- Adjust the alignments and demarcate grave sites with at least a 10 meter buffer.
- In the event that construction is to be done within 10 meters of a grave, the construction activity must be monitored by an archaeologist during work near such sites.
- In if the sites cannot be excluded from the pipeline foot print, a grave relocation process as described in Section 5 of this report needs to be implemented.
- The consultation with regards to construction close to graves and cemeteries needs to be done before construction starts, the agree on the process to be followed with the community, in the case that graves are damaged or work needs to be done very close to graves.

Refer to Appendix A for distribution maps of heritage sites.

4.2.3 **Palaeontology**

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 above. The Palaeontological sensitivity of the Geological units present within the study area is summarised in Table 2 below.

The rock units of the Adelaide Subgroup have a high potential to yield fossils. The extent of erosion and outcrops of these units in the study area is not known. As result, areas underlain by rocks of the Adelaide Subgroup have been allocated a Medium Palaeontological Sensitivity, although this may be increased to High Sensitivity following a Phase 1 PIA of the study area, especially where the reservoirs and pump stations are proposed.

Although no record of fossils from the Quaternary deposits in the study area was found, there is a possibility that fossils might be present in this unit and areas underlain by Quaternary sand, dune sand and dune rock have been allocated a Medium palaeontological sensitivity, which will be either upgraded to High sensitivity or downgraded to Low sensitivity following a Phase 1 PIA study.

Due to the igneous nature of dolerite, no fossils will be found and areas underlain by dolerite have been allocated a Low palaeontological sensitivity.

The following colour coding method is used to classify a development area's palaeontological impact as illustrated in **Figure 13**:

- Red colouration indicates a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops on the site/route and the chances of finding fossils during the construction phase are very high.

- Orange colouration indicates a possibility of finding fossils of a specific assemblage zone either in outcrops or in bedrock on the site/route. Fossils will probably be present on the site/route and the chances of finding fossils during the excavation phase are high.
- Green colouration indicates that there is no possibility of finding fossils in that section of the site/route development.

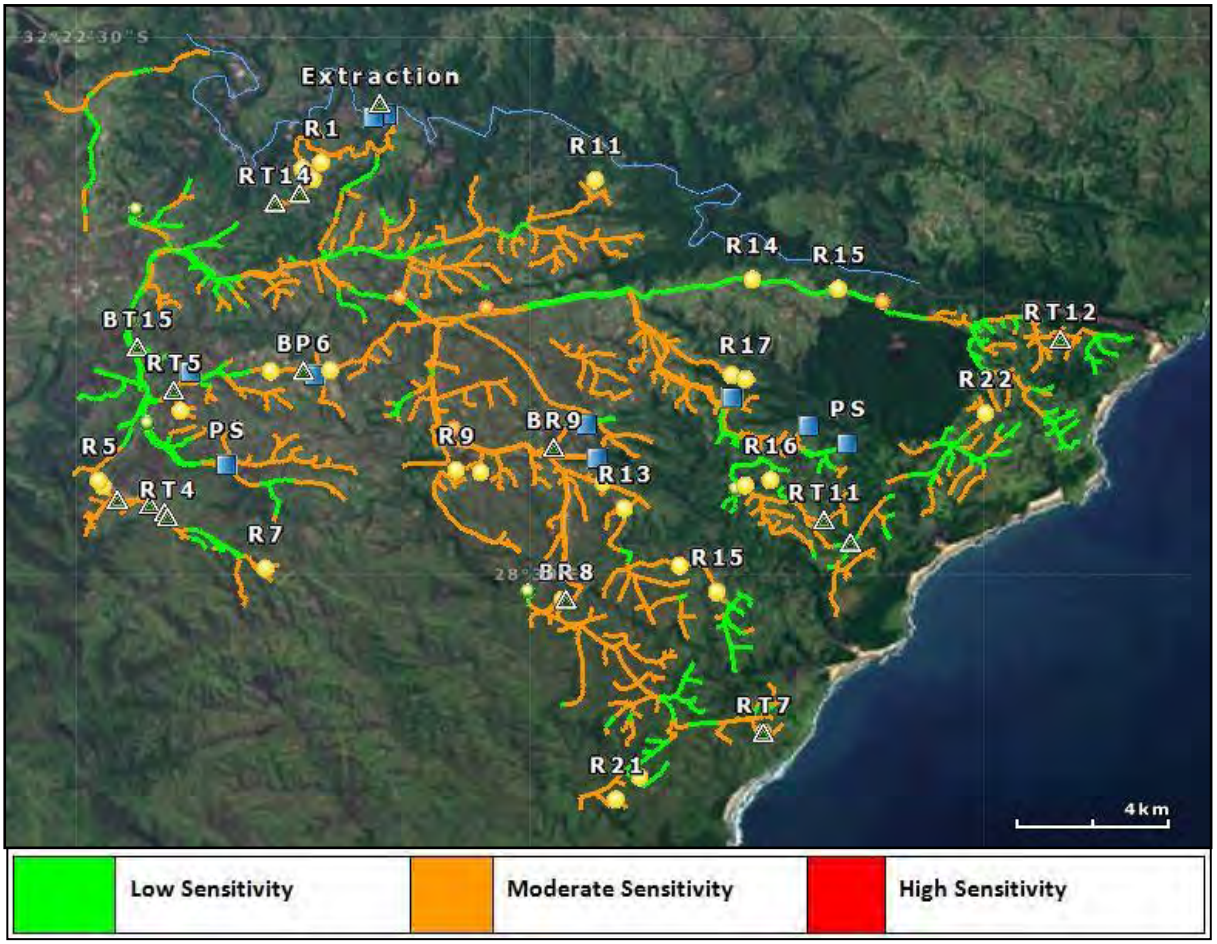

Figure 13 – Palaeontological Sensitivity

Impact Evaluation

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
Negative	MODERATE	Local	Permanent	Could happen	
Impact palaeontology	3	3	5	3	2.20

The desktop survey indicates that the entire development area and specifically some of the borrow pits have well defined significance for which, depending on the number of and quality of outcrops, a Phase I Palaeontological Assessment is recommended.

The sections of the pipelines and borrow pits (Pit 3, 4 and 5) that are coloured green has no potential for yielding any fossils.

5 CONCLUSIONS AND RECOMMENDATIONS

During the survey a total of 20 heritage sites were identified of which 19 were cemeteries or single graves, containing approximately 89 graves in total. A church building (**NX5**) constructed from corrugated iron sheet was also identified in close proximity to a proposed pipeline alignment. The following mitigation and direct management measures during construction will be required:

Heritage Structures

- The site should be demarcated and fenced during construction activity and a buffer of at least 10 meters around the site kept ;
- If the site must be impacted on due to development constraint a permit under Section 34 of the NHRA will be required for further mitigation work that must include consultation with the affected congregation, documentation through layout sketches and photographs as a minimum;

Cemeteries

- Adjust the alignments and demarcate grave sites with at least a 10 meter buffer.
- In the event that construction is to be done within 10 meters of a grave, the construction activity must be monitored by an archaeologist during work near such sites.
- In if the sites cannot be excluded from the pipeline foot print, a grave relocation process as described in Section 5 of this report needs to be implemented.
- The consultation with regards to construction close to graves and cemeteries needs to be done before construction starts, the agree on the process to be followed with the community, in the case that graves are damaged or work needs to be done very close to graves.

The grave relocation process must include:

- A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, which will be at least 60 days in length;
- Site notices indicating the intent of the relocation;
- Newspaper Notice indicating the intent of the relocation;
- A permit from the local authority;
- A permit from the Provincial Department of Health;
- A permit from the South African Heritage Resources Agency, if the graves are older than 60 years, or unidentified and thus presumed older than 60 years;
- An exhumation process that keeps the dignity of the remains and family intact;
- The whole process must be done by a reputable company that is well versed in relocations;
- The exhumation process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the development company.

Palaeontology

The study area of the Nxaxo Water Supply Project is mainly underlain by Permian aged rocks of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. Three sections are underlain by prominent Jurassic aged dolerite sills and numerous dolerite dykes cut the study area. A small section in the south east of the study area is underlain by Quaternary sand, dune sand and dune rock.

Due to the high fossiliferous potential of the Adelaide Subgroup strata, areas underlain by these units have been allocated a Medium palaeontological sensitivity. This may be upgraded to High following a Phase 1 PIA. The area underlain by Quaternary sand, dune sand and dune rock has also been allocated a Medium palaeontological sensitivity which may be either upgraded to High or downgraded to Low following a Phase 1 PIA. The areas underlain by dolerite have been allocated a Low palaeontological sensitivity as a result of their igneous nature.

Recommendations:

- The EAP as well as the ECO for this project must be made aware of the fact that the Adelaide Subgroup is extremely rich in fossil remains. Several types of fossils have been recorded from this subgroup in the Karoo Basin of South Africa.
- It is recommended that a Phase 1 PIA be undertaken by a qualified palaeontologist to assess and record the extent of erosion and outcrop of fossiliferous units, notably strata of the Adelaide Subgroup, which have been allocated a Medium palaeontological sensitivity rating within the study area.

General

Further to these recommendations the general Heritage Management Guidelines in Section 6.1 need to be incorporated into the EMP for the project.

The overall impact of the development on heritage resources is seen as acceptably low and impacts can be mitigated to acceptable levels.

6 HERITAGE MANAGEMENT GUIDELINES

6.1 General Management Guidelines

1. The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-

(a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;

(b) the construction of a bridge or similar structure exceeding 50m in length;

(c) any development or other activity which will change the character of a site-

  (i) exceeding 5 000 m^2 in extent; or

  (ii) involving three or more existing erven or subdivisions thereof; or

  (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or

  (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;

(d) the re-zoning of a site exceeding 10 000 m^2 in extent; or

(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish

it with details regarding the location, nature and extent of the proposed development.

In the event that an area previously not included in an archaeological or cultural resources survey is to be disturbed, the SAHRA needs to be contacted. An enquiry must be lodged with them into the necessity for a Heritage Impact Assessment.

2. In the event that a further heritage assessment is required it is advisable to utilise a qualified heritage practitioner, preferably registered with the Cultural Resources Management Section (CRM) of the Association of Southern African Professional Archaeologists (ASAPA).

   This survey and evaluation must include:

   (a) The identification and mapping of all heritage resources in the area affected;

   (b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7 of the National Heritage Resources Act;

   (c) An assessment of the impact of the development on such heritage resources;

   (d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;

   (e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

   (f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and

   (g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.

3. It is advisable that an information section on cultural resources be included in the SHEQ training given to contractors involved in surface earthmoving activities. These sections must include basic information on:

   a. Heritage;

   b. Graves;

   c. Archaeological finds; and

   d. Historical Structures.

This module must be tailor made to include all possible finds that could be expected in that area of construction.

4. In the event that a possible find is discovered during construction, all activities must be halted in the area of the discovery and a qualified archaeologist contacted.
5. The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures.
6. If mitigation is necessary, an application for a rescue permit must be lodged with SAHRA.
7. After mitigation, an application must be lodged with SAHRA for a destruction permit. This application must be supported by the mitigation report generated during the rescue excavation. Only after the permit is issued may such a site be destroyed.
8. If during the initial survey sites of cultural significance are discovered, it will be necessary to develop a management plan for the preservation, documentation or destruction of such a site. Such a program must include an archaeological/palaeontological monitoring programme, timeframe and agreed upon schedule of actions between the company and the archaeologist.
9. In the event that human remains are uncovered, or previously unknown graves are discovered, a qualified archaeologist needs to be contacted and an evaluation of the finds made.
10. If the remains are to be exhumed and relocated, the relocation procedures as accepted by SAHRA need to be followed. This includes an extensive social consultation process.

The purpose of an archaeological/palaeontological monitoring programme[1] is:

- To allow, within the resources available, the preservation by recording of archaeological/palaeontological deposits, the presence and nature of which could not be established (or established with sufficient accuracy) in advance of development or other potentially disruptive works

[1] The definition of an archaeological/palaeontological monitoring programme is a formal program of observation and investigation conducted during any operation carried out for non-archaeological reasons. This will be within a specified area or site on land, in the inter-tidal zone or underwater, where there is a possibility that archaeological deposits may be disturbed or destroyed. The programme will result in the preparation of a report and ordered archive.

- To provide an opportunity, if needed, for the watching archaeologist to signal to all interested parties, before the destruction of the material in question, that an archaeological/palaeontological find has been made for which the resources allocated to the watching brief itself are not sufficient to support treatment to a satisfactory and proper standard.
- A monitoring programme is not intended to reduce the requirement for excavation or preservation of known or inferred deposits, and it is intended to guide, not replace, any requirement for contingent excavation or preservation of possible deposits.
- The objective of the monitoring programme is to establish and make available information about the archaeological resource existing on a site.

PGS can be contacted on the way forward in this regard.

Table 13: Roles and responsibilities of archaeological and heritage management

ROLE	RESPONSIBILITY	IMPLEMENTATION
A responsible specialist needs to be allocated and should attend all relevant meetings, especially when changes in design are discussed, and liaise with SAHRA.	The client	Archaeologist and a competent archaeology support team
If chance finds and/or graves or burial grounds are identified during construction or operational phases, a specialist must be contacted in due course for evaluation.	The client	Archaeologist and a competent archaeology support team
Comply with defined national and local cultural heritage regulations on management plans for identified sites.	The client	Environmental Consultancy and the Archaeologist
Consult the managers, local communities and other key stakeholders on mitigation of archaeological sites.	The client	Environmental Consultancy and the Archaeologist
Implement additional programs, as appropriate, to promote the safeguarding of our cultural heritage. (i.e. integrate the archaeological components into the employee induction course).	The client	Environmental Consultancy and the Archaeologist,
If required, conservation or relocation of burial grounds and/or graves according to the	The client	Archaeologist, and/or competent authority for

applicable regulations and legislation.		relocation services
Ensure that recommendations made in the Heritage Report are adhered to.	The client	The client
Provision of services and activities related to the management and monitoring of significant archaeological sites.	The client	Environmental Consultancy and the Archaeologist
After the specialist/archaeologist has been appointed, comprehensive feedback reports should be submitted to relevant authorities during each phase of development.	Client and Archaeologist	Archaeologist

6.2 All phases of the project

6.2.1 Archaeology

Based on the findings of the HIA, all stakeholders and key personnel should undergo an archaeological induction course during this phase. Induction courses generally form part of the employees' overall training and the archaeological component can easily be integrated into these training sessions. Two courses should be organised – one aimed more at managers and supervisors, highlighting the value of this exercise and the appropriate communication channels that should be followed after chance finds, and the second targeting the actual workers and getting them to recognize artefacts, features and significant sites. This needs to be supervised by a qualified archaeologist. This course should be reinforced by posters reminding operators of the possibility of finding archaeological/palaeontological sites.

The project will encompass a range of activities during the construction phase, including ground clearance, establishment of construction camps area and small scale infrastructure development associated with the project/operations.

It is possible that cultural material will be exposed during operations and may be recoverable, but this is the high-cost front of the operation, and so any delays should be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, but construction trenches do offer a window into the past and it thus may be possible to rescue some of the data and materials. It is also possible that substantial alterations will be implemented during this phase of the project and these must be catered

for. Temporary infrastructure is often changed or added to during the subsequent history of the project. In general these are low impact developments as they are superficial, resulting in little alteration of the land surface, but still need to be catered for.

During the construction/operational phase, it is important to recognize any significant material being unearthed, and to make the correct judgment on which actions should be taken. A responsible archaeologist/palaeontologist must be appointed for this commission. This person does not have to be a permanent employee, but needs to attend relevant meetings, for example when changes in design are discussed, and notify SAHRA of these changes. The archaeologist would inspect the site and any development on a recurrent basis, with more frequent visits to the actual workface and operational areas.

In addition, feedback reports can be submitted by the archaeologist to the client and SAHRA to ensure effective monitoring. This archaeological monitoring and feedback strategy should be incorporated into the Environmental Management Plan (EMP) of the project. Should an archaeological/palaeontological site or cultural material be discovered during construction (or operation), such as burials or grave sites, the project needs to be able to call on a qualified expert to make a decision on what is required and if it is necessary to carry out emergency recovery. SAHRA would need to be informed and may give advice on procedure. The developers therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the material and data are recovered. The project thus needs to have an archaeologist/palaeontologist available to do such work. This provision can be made in an archaeological/palaeontological monitoring programme.

6.2.2 **Graves**

In the case where a grave is identified during construction the following measures must be taken:

- Upon the accidental discovery of graves, a buffer of at least 20 meters should be implemented.
- If graves are accidentally discovered during construction, activities must cease in the area and a qualified archaeologist be contacted to evaluate the find. To remove the remains a rescue permit must be applied for with SAHRA and the local South African Police Services must be notified of the find.

- Where it is then recommended that the graves be relocated, a full grave relocation process that includes comprehensive social consultation must be followed.

The grave relocation process must include:

i. A detailed social consultation process, that will trace the next-of-kin and obtain their consent for the relocation of the graves, that will be at least 60 days in length;
ii. Site notices indicating the intent of the relocation;
iii. Newspaper notices indicating the intent of the relocation;
iv. A permit from the local authority;
v. A permit from the Provincial Department of Health;
vi. A permit from the South African Heritage Resources Agency, if the graves are older than 60 years or unidentified and thus presumed older than 60 years;
vii. An exhumation process that keeps the dignity of the remains intact;
viii. The whole process must be done by a reputable company that is well versed in relocations;
ix. The exhumation process must be conducted in such a manner as to safeguard the legal rights of the families as well as that of the developing company.

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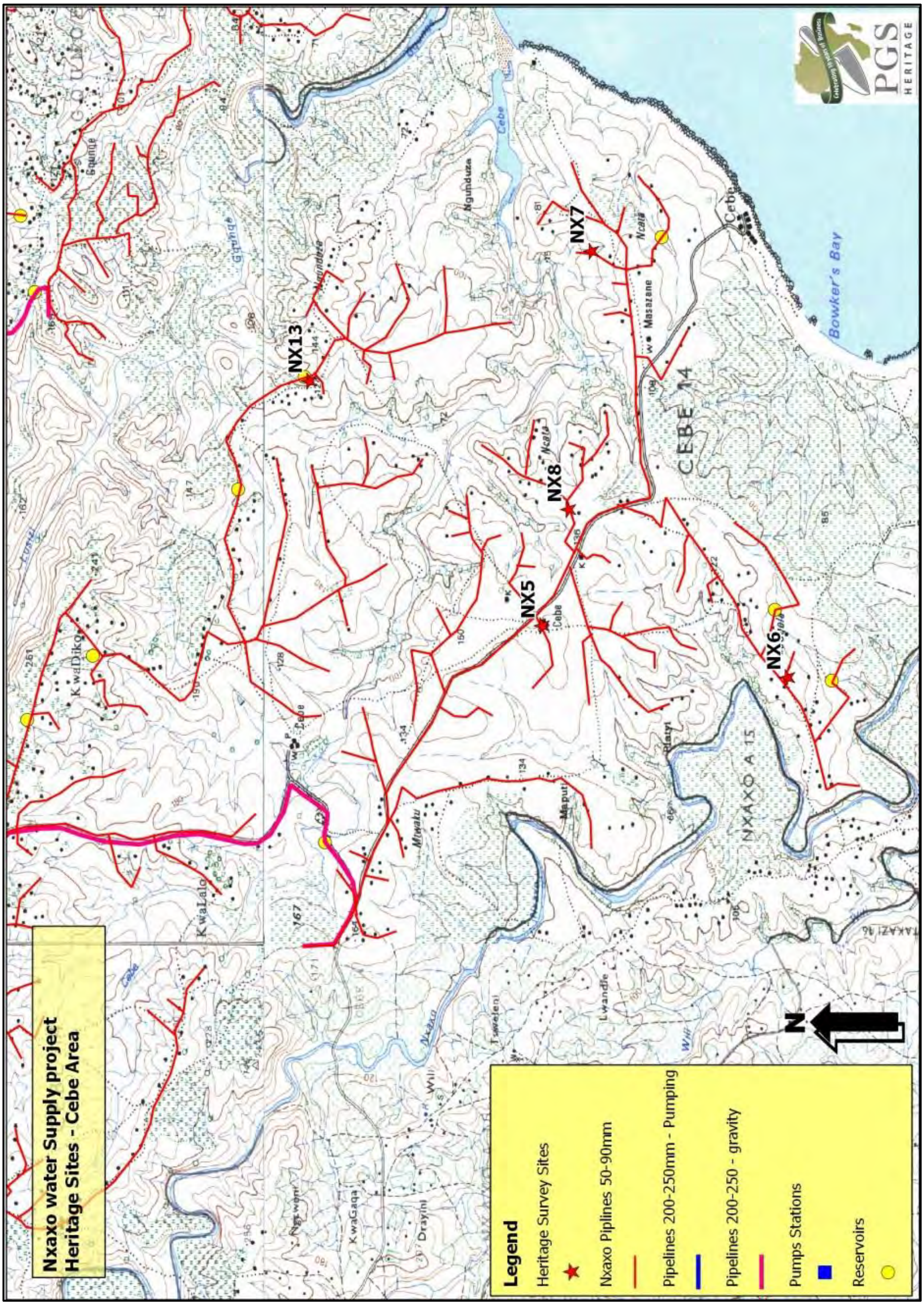
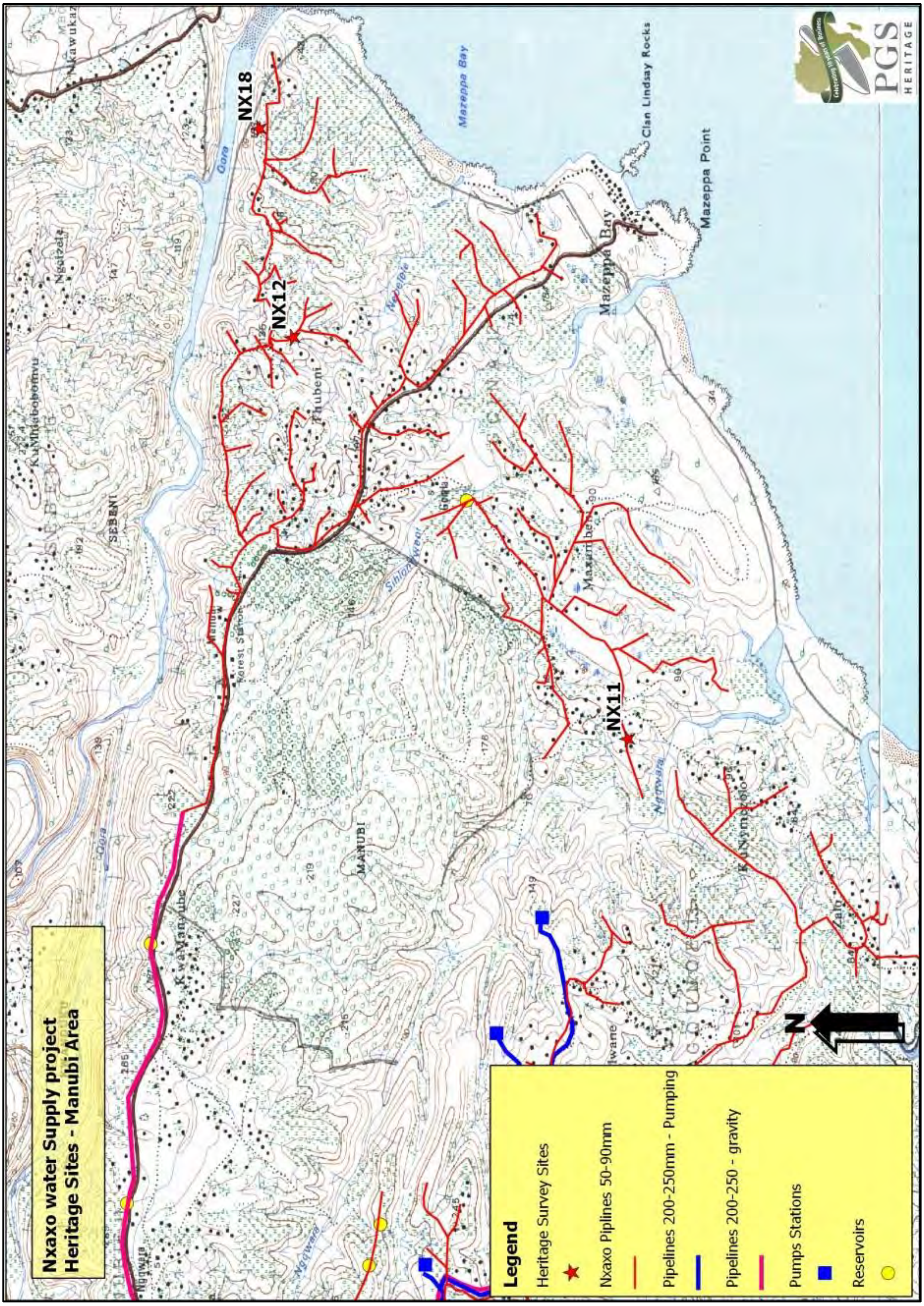
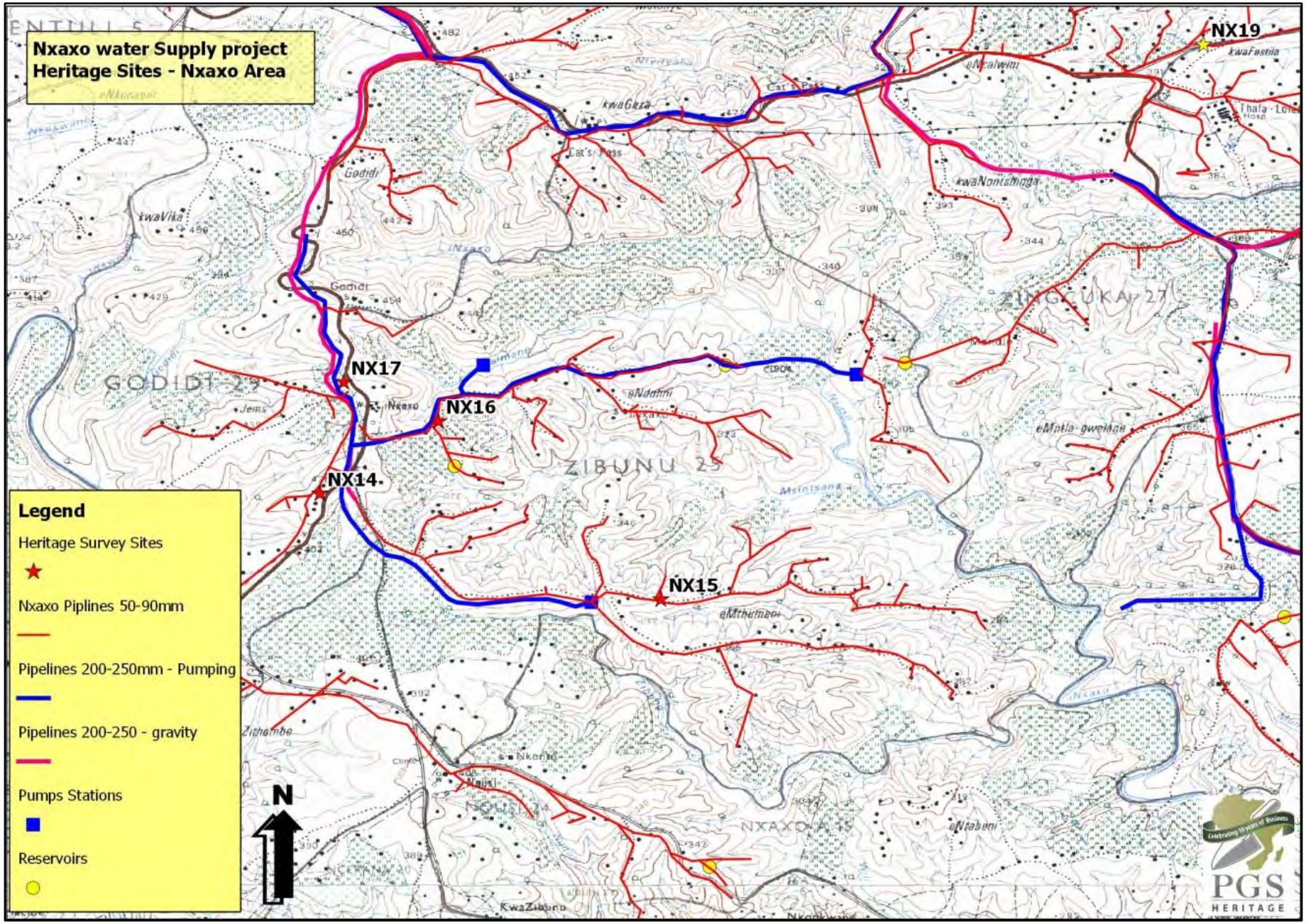
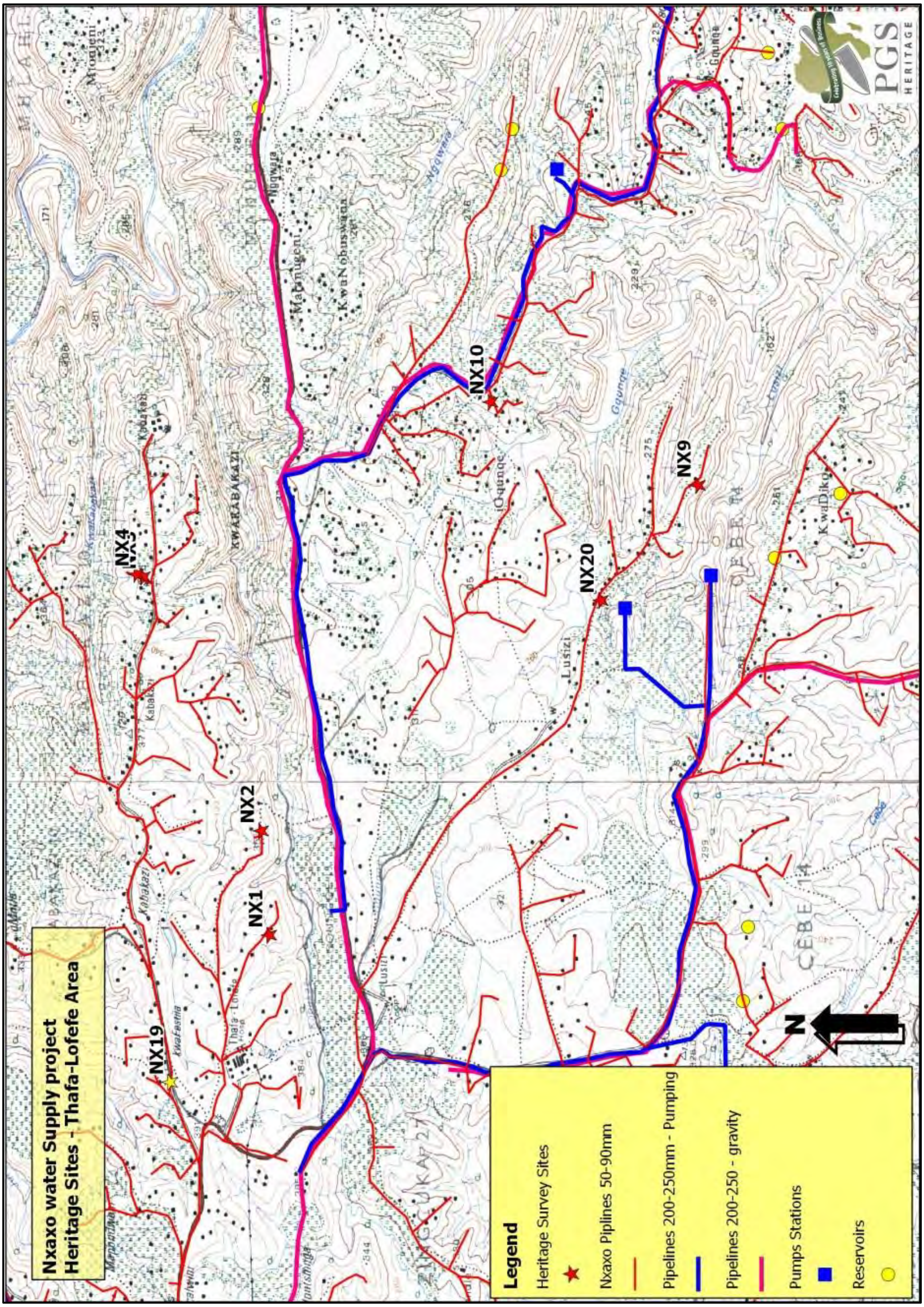
Appendix A

HERITAGE SITE DISTRIBUTION MAPS


Nxaxo water Supply project
Heritage Sites - Cebe Area
Legend
Heritage Survey Sites
Nxaxo Piplines 50-90mm
Pipelines 200-250mm - Pumping
Pipelines 200-250 - gravity
Pumps Stations
Reservoirs
NX13
NX8
NX7
NX5
NX6
CEBE 14
NXAXO A 15
Bowker's Bay
PGS HERITAGE


Nxaxo water Supply project
Heritage Sites - Manubi Area
Legend
Heritage Survey Sites
Nxaxo Piplines 50-90mm
Pipelines 200-250mm - Pumping
Pipelines 200-250 - gravity
Pumps Stations
Reservoirs
NX18
NX12
NX11
Mazeppa Bay
Mazeppa Point
Clan Lindsay Rocks
MANUBI
SEBENI
N
PGS
HERITAGE


Nxaxo water Supply project
Heritage Sites - Nxaxo Area
NX19
NX17
NX16
NX14
NX15
GODIDI 29
ZIBUNU 29
NXAXO
Legend
Heritage Survey Sites
Nxaxo Piplines 50-90mm
Pipelines 200-250mm - Pumping
Pipelines 200-250 - gravity
Pumps Stations
Reservoirs
N
PGS
HERITAGE



Nxaxo water Supply project
Heritage Sites - Thafa-Lofefe Area
Legend
Heritage Survey Sites
Nxaxo Piplines 50-90mm
Pipelines 200-250mm - Pumping
Pipelines 200-250 - gravity
Pumps Stations
Reservoirs
NX1
NX2
NX3
NX4
NX9
NX10
NX19
NX20
N
PGS HERITAGE

Appendix B

PHOTOGRAPHS OF HERITAGE SITES


NX 1. 003


NX 1. 004

NX 2. 001

NX 2. 002


NX 2. 003


NX 2. 004


NX 3. 001


NX 4. 002


NX 4. 003


NX 4. 005


NX 5. 002


NX 6. 001


NX 6. 002


NX 7. 002


NX 8. 001


NX 8. 002


NX 8. 003


NX 8. 004

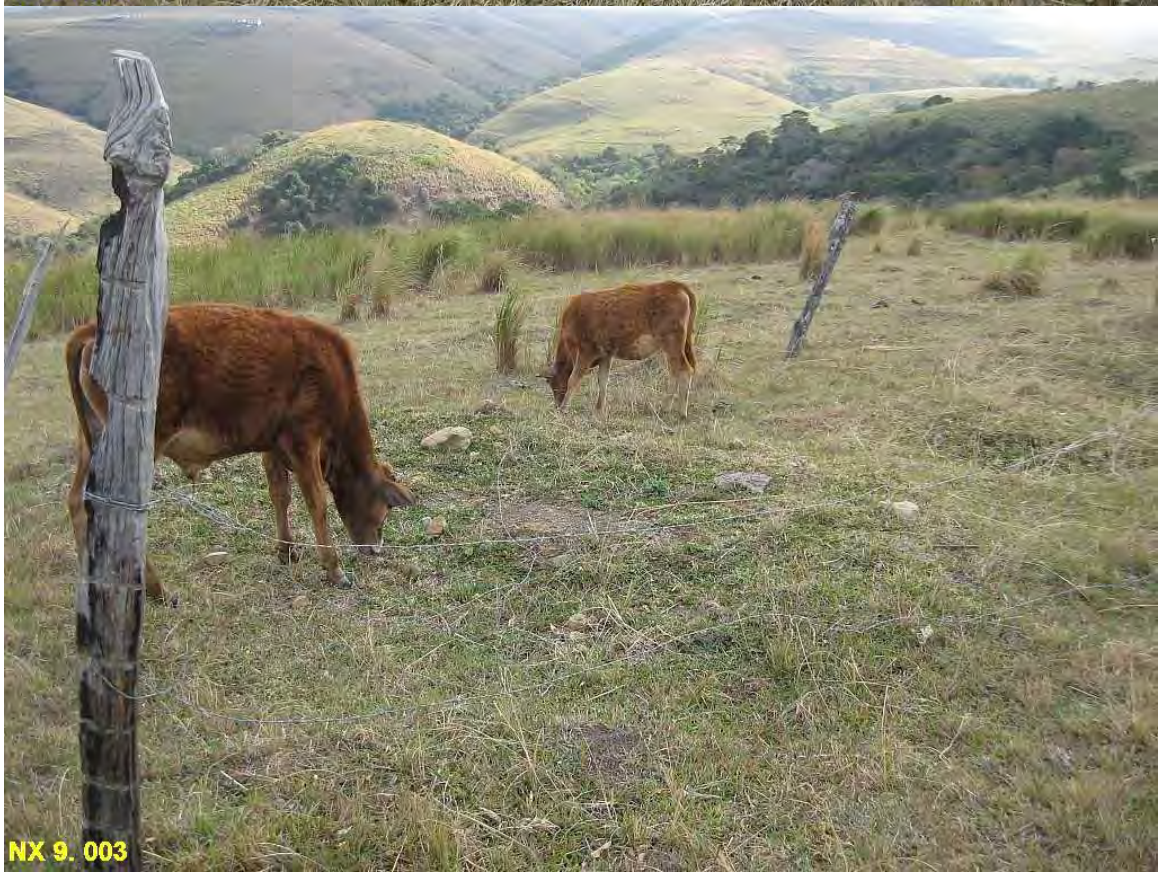

NX 8. 005


NX 8. 006


NX 8. 007


NX 9. 001


NX 9. 002


NX 9. 003


NX 9. 004


NX 10. 002


NX 10. 003


NX 11. 001


NX 11. 002


NX 12. 001


In Loving Memory of
FUZILE
JONONO
REST IN PEACE GATYENI
NX 12. 003


In Loving Memory Of
OUR DEAREST FATHER & GRANDFATHER
QIMNGQOSHE JONONO
BORN: 16-05-1934
DIED: 22-10-2001
REMEMBERED BY YOUR FAMILY
REST IN PEACE NDONDELA
NX 12. 005


In
Loving
Memory of
MY DEAREST
HUSBAND & FATHER
FUZILE
BORN: 27-09-1970
DIED: 14-11-2009
SADLY MISSED BY
YOUR FAMILY
EVEREST
JONONO
REST IN PEACE GATYENI
NX 12_006


NX 13_001


RHODA NONDILI TYWAKADI
BORN 12 06 1932
DIED 22 10 1998
NX 13. 002


RHODA NONDILI TYWAKADI
BORN 12 06 1932
DIED 22 10 1998
NX 13. 004


NX Site 4. 004


NX1. 001


NX1. 002


NX3. 002


NX4. 001


NX5. 001


NX7_001


NX10_001


NX12. 002


In Loving Memory
Of
OUR DEAREST FATHER & GRANDFATHER
QIMNGQOSHE
JONONO
REST IN PEACE NDONDELA
NX12. 004


NX13_003


NX14


NX15


NX16


NX17


NX18


NX19


NX20

LEGISLATIVE REQUIREMENTS – TERMINOLOGY AND ASSESSMENT CRITERIA

3.1 General principles

In areas where there has not yet been a systematic survey to identify conservation worthy places, a permit is required to alter or demolish any structure older than 60 years. This will apply until a survey has been done and identified heritage resources are formally protected.

Archaeological and palaeontological sites, materials, and meteorites are the source of our understanding of the evolution of the earth, life on earth and the history of people. In the NHRA, permits are required to damage, destroy, alter, or disturb them. People who already possess material are required to register it. The management of heritage resources is integrated with environmental resources and this means that before development takes place heritage resources are assessed and, if necessary, rescued.

In addition to the formal protection of culturally significant graves, all graves, which are older than 60 years and are not in a formal cemetery (such as ancestral graves in rural areas), are protected. The legislation protects the interests of communities that have an interest in the graves: they should be consulted before any disturbance takes place. The graves of victims of conflict and those associated with the liberation struggle are to be identified, cared for, protected and memorials erected in their honour.

Anyone who intends to undertake a development must notify the heritage resource authority and if there is reason to believe that heritage resources will be affected, an impact assessment report must be compiled at the construction company's cost. Thus, the construction company will be able to proceed without uncertainty about whether work will have to be stopped if an archaeological or heritage resource is discovered.

According to the National Heritage Act (Act 25 of 1999 section 32) it is stated that:

An object or collection of objects, or a type of object or a list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object, including –

- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects, meteorites and rare geological specimens;
- visual art objects;
- military objects;
- numismatic objects;
- objects of cultural and historical significance;
- objects to which oral traditions are attached and which are associated with living heritage;
- objects of scientific or technological interest;
- books, records, documents, photographic positives and negatives, graphic material, film or video or sound recordings, excluding those that are public records as defined in section 1 (xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996), or in a provincial law pertaining to records or archives; and
- any other prescribed category.

Under the National Heritage Resources Act (Act No. 25 of 1999), provisions are made that deal with, and offer protection to, all historic and pre-historic cultural remains, including graves and human remains.

3.2 Graves and cemeteries

Graves younger than 60 years fall under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance no. 7 of 1925) as well as the Human Tissues Act (Act 65 of 1983) and are under the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the Office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning, or in some cases the MEC for Housing and Welfare. Authorisation for exhumation and reinterment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the

grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. In order to handle and transport human remains, the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

Graves older than 60 years, but younger than 100 years, fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act) as well as the Human Tissues Act (Act 65 of 1983) and are under the jurisdiction of the South African Heritage Resource Agency (SAHRA). The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years, over and above SAHRA authorisation.

If the grave is not situated inside a formal cemetery but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws set by the cemetery authority must be adhered to.

Appendix D

PALAEONTOLOGICAL DESKTOP ASSESSMENT

PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE NXAXO WATER SUPPLY PROJECT, MNQUNA LOCAL MINICIPALITY, AMATHOLE DISTRICT MUNICIPALITY, EASTERN CAPE.

For:

DATE: 17 September 2013

By

GIDEON GROENEWALD

EXECUTIVE SUMMARY

Gideon Groenewald was appointed by PSG Heritage to undertake a desktop survey, assessing the potential palaeontological impact of the proposed Nxaxo Water Supply Project, Mnquna Local Municipality, Amathole District Municipality, Eastern Cape.

This report forms part of the Basic Environmental Impact Assessment and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the development.

The project involves the development and construction of a bulk and reticulated water supply infrastructure for rural communities in the area between the Nxaxo and Qora Rivers. It includes the development of pipelines, pump stations and reservoirs.

The study area of the Nxaxo Water Supply Project is mainly underlain by Permian aged rocks of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. Three sections are underlain by prominent Jurassic aged dolerite sills and numerous dolerite dykes cut the study area. A small section in the south east of the study area is underlain by Quaternary sand, dune sand and dune rock.

Due to the high fossiliferous potential of the Adelaide Subgroup strata, areas underlain by these units have been allocated a Medium palaeontological sensitivity. This may be upgraded to High following a Phase 1 PIA. The area underlain by Quaternary sand, dune sand and dune rock has also been allocated a Medium palaeontological sensitivity which may be either upgraded to High or downgraded to Low following a Phase 1 PIA. The areas underlain by dolerite have been allocated a Low palaeontological sensitivity as a result of their igneous nature.

Recommendations:

1. The EAP as well as the ECO for this project must be made aware of the fact that the Adelaide Subgroup is extremely rich in fossil remains. Several types of fossils have been recorded from this subgroup in the Karoo Basin of South Africa.
2. It is recommended that a Phase 1 PIA be undertaken by a qualified palaeontologist to assess and record the extent of erosion and outcrop of fossiliferous units, notably strata of the Adelaide Subgroup, which have been allocated a Medium palaeontological sensitivity rating within the study area.

3. **TABLE OF CONTENT**

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1 INTRODUCTION

1.1 Background

Gideon Groenewald was appointed by PSG Heritage to undertake a desktop survey, assessing the potential palaeontological impact of the proposed Nxaxo Water Supply Project, Mnquna Local Municipality, Amathole District Municipality, Eastern Cape.

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Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

1.2 Aims and Methodology

Following the *"SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports"* the aims of the palaeontological impact assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

In preparing a palaeontological desktop study the potential fossiliferous rock units (groups, formations etc.) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is inventoried from the published scientific literature and previous palaeontological impact studies in the same region.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1.1 below.

Table 14 - Palaeontological Sensitivity Analysis Outcome Classification

Sensitivity	Description
Low Sensitivity	Areas where a negligible impact on the fossil heritage is likely. This category is reserved largely for areas underlain by igneous rocks. However, development in fossil bearing strata with shallow excavations or with deep soils or weathered bedrock can also form part of this category.
Moderate Sensitivity	Areas where fossil bearing rock units are present but fossil finds are localised or within thin or scattered sub-units. Pending the nature and scale of the proposed development the chances of finding fossils are moderate.A field-based assessment by a professional palaeontologist is usually warranted.
High Sensitivity	Areas where fossil bearing rock units are present with a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops and the chances of finding fossils during a field-based assessment by a professional palaeontologist are very high. Palaeontological mitigation measures need to be incorporated into the Environmental Management Plan

1.3 Scope and Limitations of the Desktop Study

The study will include: i) an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units; ii) a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports; iii) data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and iv) where feasible, location and examination of any fossil collections from the study area (e.g. museums).

The key assumption for this scoping study is that the existing geological maps and datasets used to assess site sensitivity are correct and reliable. However, the geological maps used were not intended for fine scale planning work and are largely based on aerial photographs alone, without ground-truthing. There is also an inadequate database for fossil heritage for much of the RSA, due to the small number of professional palaeontologists carrying out fieldwork in RSA. Most development study areas have never been surveyed by a palaeontologist.

These factors may have a major influence on the assessment of the fossil heritage significance of a given development and without supporting field assessments may lead to either:

- an underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
- an overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium etc.).

2 DESCRIPTION OF THE PROPOSED DEVELOPMENT

The project involves the development and construction of a bulk and reticulated water supply infrastructure for rural communities in the area between the Nxaxo and Qora Rivers (Figure 2.1) and includes the development of pipeline, pump stations and reservoirs.

In Figure 2.1 below, the red lines represent reticulation pipelines 50-90mm diameter, the cerise lines represent bulk gravity pipelines 200-250mm diameter and the blue lines are bulk pumping pipelines, also 200-250mm diameter. Pump stations are shown as blue squares and resevoirs as yellow circles. Green markers show where the pipeline crosses water courses. Reticulation systems appearing to link to nothing, are linking to existing water pipelines. The light blue ovals are potential groundwater well fields, although there is no surface action.

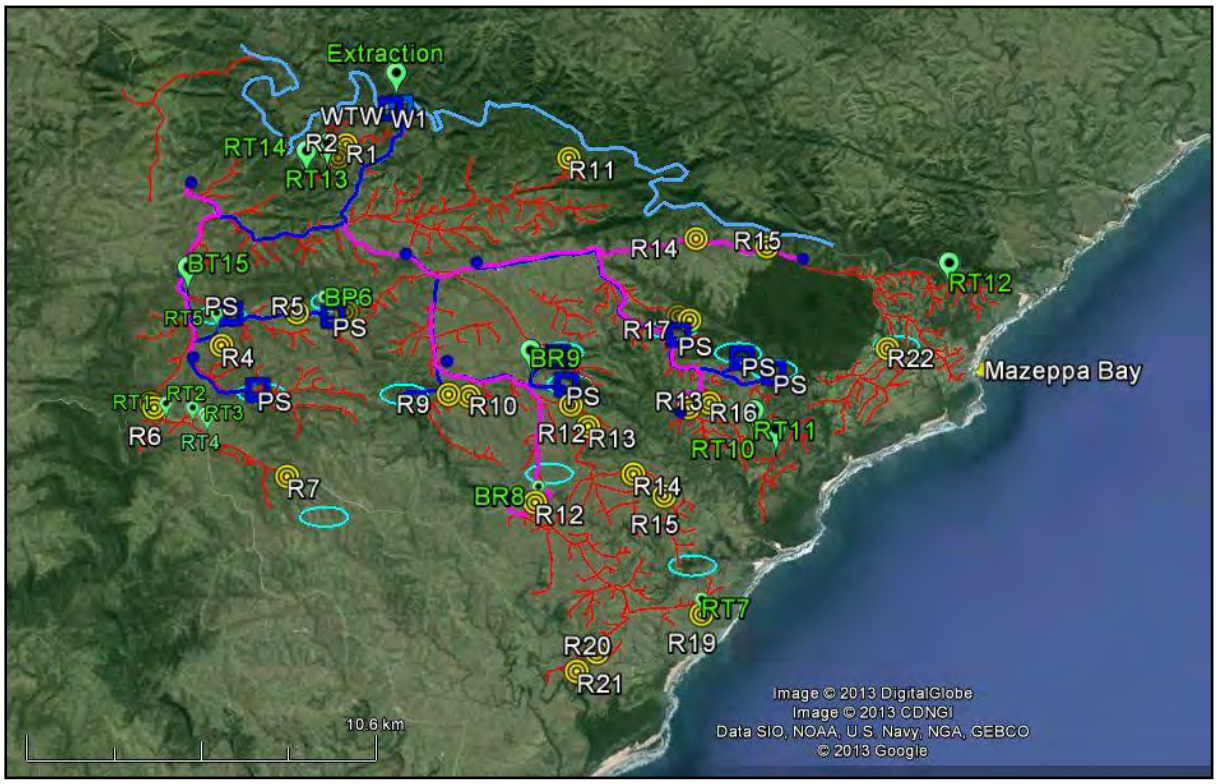

*Figure **Error! No text of specified style in document.**.14 Location and layout of the Nxaxo Water Supply Project*

3 GEOLOGY

The study area is underlain by Permian aged sedimentary rocks of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup with three sections underlain by prominent dolerite sills and numerous dolerite dykes (Figure 3.1). There is a very small section in the South East of the study area that is underlain by Quaternary sand, dune sand and dune rock.

3.1 Adelaide Subgroup (Pa)

The study area is mainly underlain by Permian aged rocks of the Lower to Middle Adelaide Subgroup which are comprised of the Koonap and Middleton Formations in this region, although these are not differentiated on the map. The lower Koonap Formation consists of interbedded greenish-grey and grey mudstones and light grey fine-grained sandstones. The Koonap Formation is interpreted as a transitional brackish lacustrine to fluvial deposit. The Middleton Formation is mainly characterised by a greater relative abundance of red mudstone compared with the underlying Koonap Formation

and overlying Balfour Formation units (Johnson et al, 2006). The Middleton Formation is characterised by cyclic deposits of lenticular sandstone bodies grading into greenish grey mudstone as well as lenses of red mudstone which were deposited in sub-aerial fluvial environments. The Middleton Formation represents a period during which a semi-arid climate supported a lush flora and fauna that thrived along meandering belts and semi-permanent lakes.

3.2 Dolerite (Jd)

The sedimentary sequence is cut by prominent Jurassic aged dolerite dykes and sills which formed during the cooling of magma that intruded the Karoo Supergroup sedimentary sequences.

3.3 Sand, dune sand and dune rock

A small section in the South East of the study area is underlain by Quaternary aged sand and dune deposits which might be correlated with the Algoa Group sediments (Johnson et al, 2006). These correlations are limited in scale with the best possible correlation of the beach rock in the study area with the Nanaga Formation aeolinites, south of Port St. Johns.

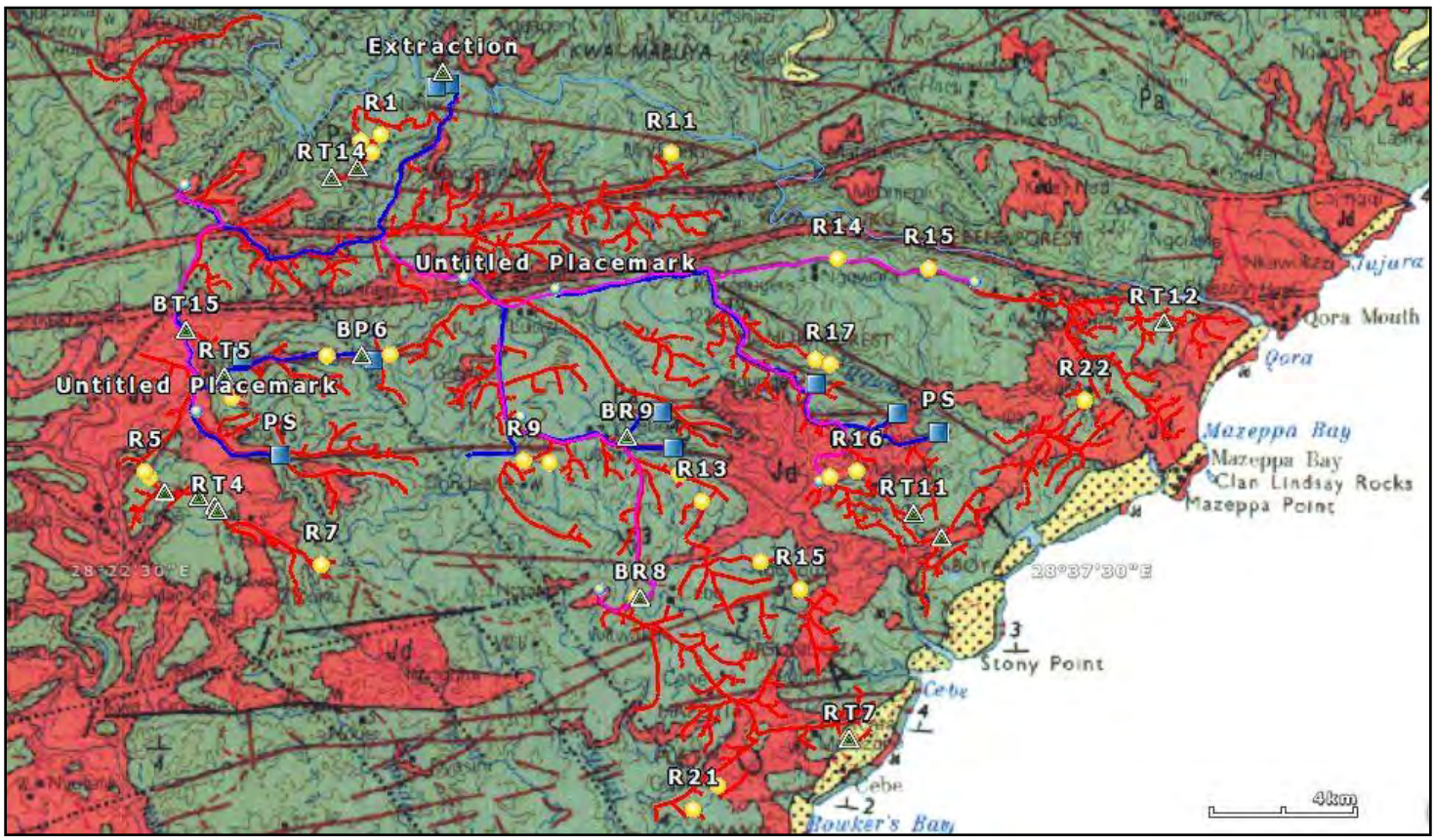

*Figure **Error! No text of specified style in document.**.15 Geology of the Nxaxo Water Supply Scheme*

Adelaide Subgroup have been allocated a Medium Palaeontological Sensitivity, although this may be increased to High Sensitivity following a Phase 1 PIA of the study area, especially where the reservoirs and pump stations are proposed.

Although no record of fossils from the Quaternary deposits in the study area was found, there is a possibility that fossils might be present in this unit and areas underlain by Quaternary sand, dune sand and dune rock have been allocated a Medium palaeontological sensitivity, which will be either upgraded to High sensitivity or downgraded to Low sensitivity following a Phase 1 PIA study.

Due to the igneous nature of dolerite, no fossils will be found and areas underlain by dolerite have been allocated a Low palaeontological sensitivity.

Table 15 - Palaeontological sensitivity of the Geological units present within the study area

Geological Unit	Rock Type and Age	Fossil Heritage	Vertebrate Biozone	Palaeontological Sensitivity
Sand	Sand, dune sand and dune rock QUATERNARY	None	None	Medium sensitivity
Jurassic dolerite	Dolerite JURASSIC	None	None	Low sensitivity
Middleton Formation	Red and Grey Mudstone & Sandstone PERMIAN	Vertebrate fossils of the *Therapsids* group e.g. *Gorgonopsian* and *Dicynodonts*. Plant fossils e.g. *Glossopteris* trees and leaves.	*Pristerognathus, Tropidostoma* and *Cistecephalus* assemblage zone	Medium sensitivity
Koonap Formation	Grey Mudstone, Sandstone and Shale PERMIAN	*Vertebtate fossils of Eodicynodon* and *Tapinocephalus.* Plant fossils also recorded	*Eodicynodon* and *Tapinocephalus* assemblage zone	Medium sensitivity

The palaeontological sensitivity of the study area is shown in Figure 5.1.

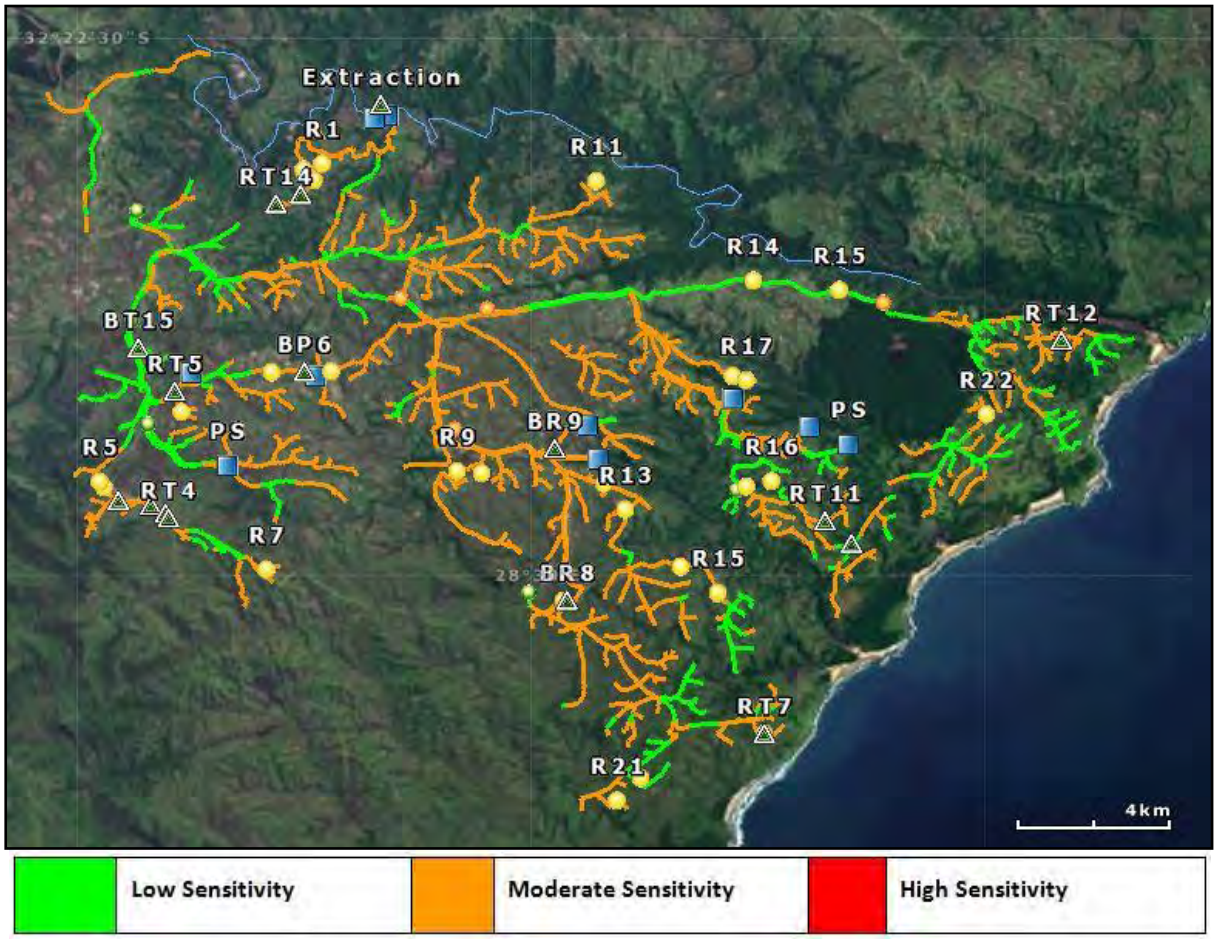

*Figure **Error! No text of specified style in document.**.16 Palaeontological sensitivity of the Nxaxo Water Supply Scheme*

6 CONCLUSION AND RECOMMENDATIONS

The study area of the Nxaxo Water Supply Project is mainly underlain by Permian aged rocks of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. Three sections are underlain by prominent Jurassic aged dolerite sills and numerous dolerite dykes cut the study area. A small section in the south east of the study area is underlain by Quaternary sand, dune sand and dune rock.

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