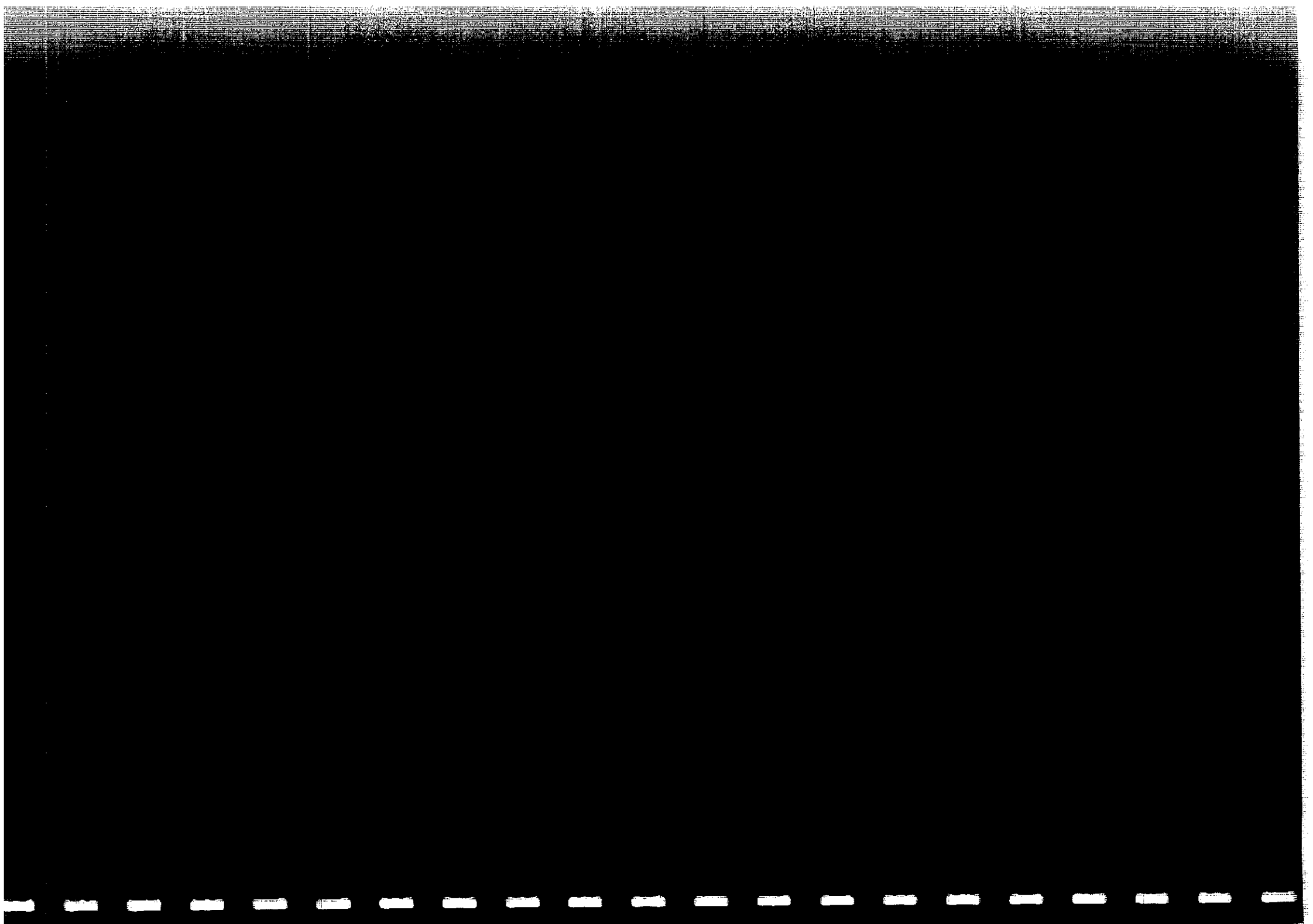

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IRON ORE
KUMBA IRON ORE LTD
Sishen Iron Ore Company

Sishen Iron Ore Company (Pty) Ltd

APPENDIX 3

AFFECTED PARTIES REGISTER

NC 30/5/1/1/4/1116 PR

Appendix 3

Affected Parties Register

PROJECT TEAM			Contact Number	E-mail	Postal address
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GOVERNMENT DEPARTMENTS			**Contact Number**	**E-mail**	**Postal address**
Koen	Julius	Department of Environmental Affairs and Nature Conservation	053 8077430	julius.koen@gmail.com	
LOCAL AUTHORITY			**Contact Number**	**E-mail**	**Postal address**
Gamagara Local Municipality			0836360006		P.O. Box 1001, Kathu, 8446
J	Keyser		0733951969		P.O. Box 146, Kathu, 8446
OTHER NGOs, CBOs, CONSERVANCIES, RESIDENTS ASSOCIATIONS ETC.			**Contact Number**	**E-mail**	**Postal address**
No active NGO's or Conservancies were found for this area, residents are presented at Dingleton Community Forum					
LANDOWNERS		**Farm Name**	**Contact Number**	**E-mail**	**Postal address**
Mr.	Markram	Moria Boerdery BK	053 739 2553		P.O. Box 1600, Kathu, 8446

OTHER AFFECTED PARTIES					
		XXX Drilling Company			

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IRON ORE
KUMBA IRON ORE LTD
Sishen Iron Ore Company

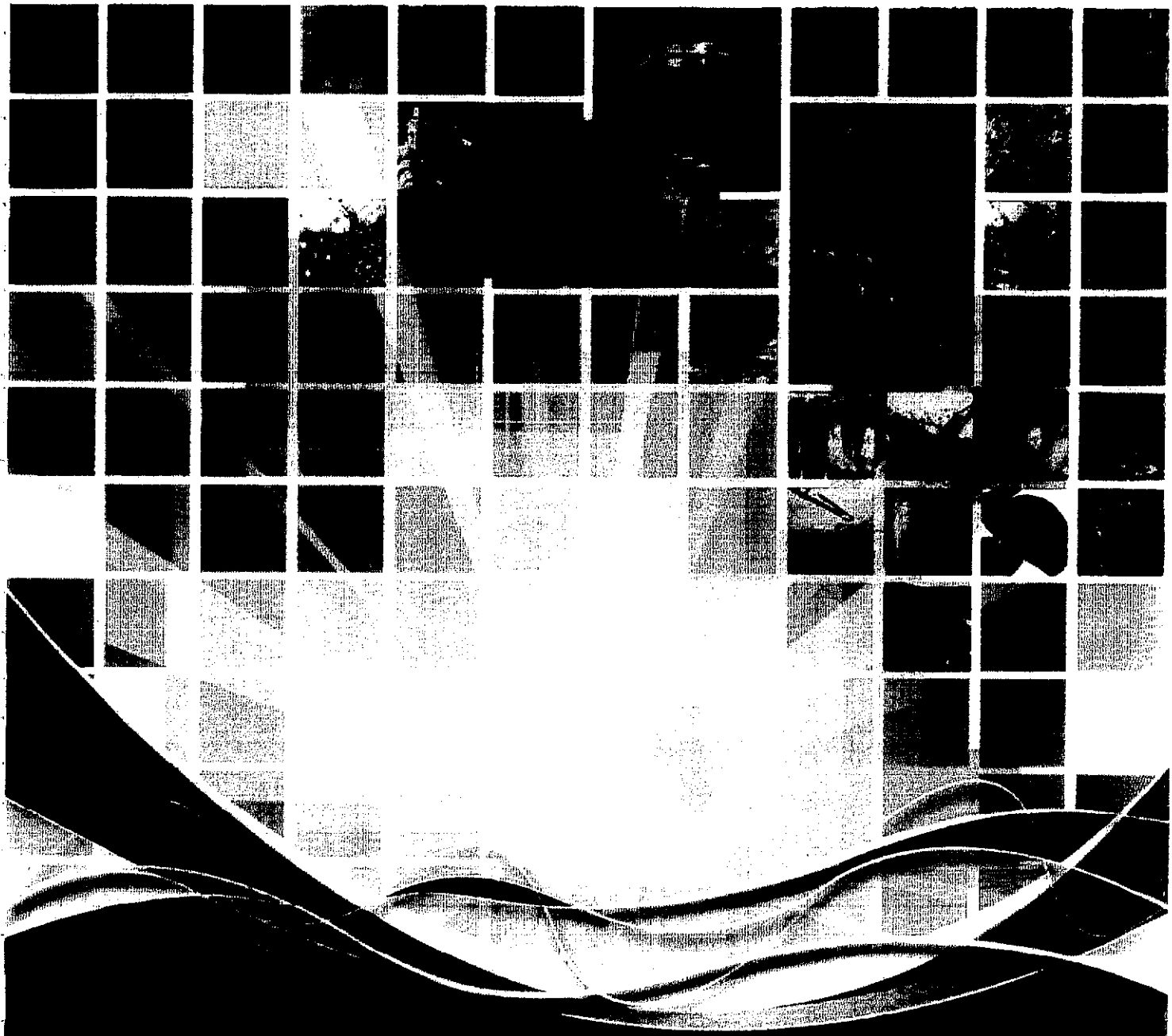
Sishen Iron Ore Company (Pty) Ltd

APPENDIX 4

HERITAGE ASSESSMENT RELEVANT TO THIS PROJECT

SISHEN MINE EXPANSION

NC 30/5/1/1/4/1116 PR



SISHEN WESTERN WASTE DUMPS: SISHEN IRON ORE MINE, KGALAGADI DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

Phase 1 Archaeological Impact Assesment Report

September 2012

Document version 3.0
Compiled by N. Kruger

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Purpose with Passion

ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF DEMARCATED SURFACE AREAS ON THE FARMS GAMAGARA 541, ONVERWACHT 540 (FRITZ 540 PORTION 1) AND NOOITGEDACHT 469 (WOON 469), SISHEN IRON ORE MINE, KGALAGADI DISTRICT MUNICIPALITY, NORTHERN CAPE PROVINCE

September 2012

Conducted on behalf of:

Sishen Iron Ore Company
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AGES (Pty) promotes the conservation of sensitive archaeological and heritage resources and therefore uncompromisingly adheres to relevant Heritage Legislation (National Heritage Resources Act no. 25 of 1999, Human Tissue Act 65 of 1983 as amended, Removal of Graves and Dead Bodies Ordinance no. 7 of 1925, Excavations Ordinance no. 12 of 1980). In order to ensure best practices and ethics in the examination, conservation and mitigation of archaeological and heritage resources, AGES (Pty) follows the Minimum Standards: Archaeological and Palaeontological Components of Impact Assessment as set out by the South African Heritage Resources Agency (SAHRA) and the CRM section of the Association for South African Professional Archaeologists (ASAPA).

NOTATIONS AND TERMS

Absolute dating:
Absolute dating provides specific dates or range of dates expressed in years.

Archaeology:
The study of the human past through its material remains.

Archaeological record:
The archaeological record minimally includes all the material remains documented by archaeologists. More comprehensive definitions also include the record of culture history and everything written about the past by archaeologists.

Artefact:
Entities whose characteristics result or partially result from human activity. The shape and other characteristics of the artifact are not altered by removal of the surroundings in which they are discovered. In the southern African context examples of artefacts include potsherds, iron objects, stone tools, beads and hut remains.

Assemblage:
A group of artefacts recurring together at a particular time and place, and representing the sum of human activities.

^{14}C or radiocarbon dating:
The ^{14}C method determines the absolute age of organic material by studying the radioactivity of carbon. It is reliable for objects not older 70 000 years by means of isotopic enrichment. The method becomes increasingly inaccurate for samples younger than ±250 years.

Ceramic Facies:
In terms of the cultural representation of ceramics, a facies is denoted by a specific branch of a larger ceramic tradition. A number of ceramic facies thus constitute a ceramic tradition.

Ceramic Tradition:
In terms of the cultural representation of ceramics, a series of ceramic units constitutes as ceramic tradition.

Context:
An artefact's context usually consists of its immediate *matrix*, its *provenience* and its *association* with other artefacts. When found in *primary context*, the original artefact or structure was undisturbed by natural or human factors until excavation and if in *secondary context*, disturbance or displacement by later ecological action or human activities occurred.

Culture:
A contested term, "culture" could minimally be defined as the learned and shared things that people have, do and think.

Cultural Heritage Resource:
The broad generic term *Cultural Heritage Resources* refers to any physical and spiritual property associated with past and present human use or occupation of the environment, cultural activities and history. The term includes sites, structures, places, natural features and material of palaeontological, archaeological, historical, aesthetic, scientific, architectural, religious, symbolic or traditional importance to specific individuals or groups, traditional systems of cultural practice, belief or social interaction.

Cultural landscape:
A cultural landscape refers to a distinctive geographic area with cultural significance.

Cultural Resource Management (CRM):
A system of measures for safeguarding the archaeological heritage of a given area, generally applied within the framework of legislation designed to safeguard the past.

Ecofact:
Non artifactual material remains that has cultural relevance which provides information about past human activities. Examples would include remains or evidence of domesticated animals or plant species.

Excavation:
The principal method of data acquisition in archaeology, involving the systematic uncovering of archaeological remains through the removal of the deposits of soil and the other material covering and accompanying it.

Feature:
Non-portable artifacts, in other words artifacts that cannot be removed from their surroundings without destroying or altering their original form. Hearths, roads, and storage pits are examples of archaeological features

GIS:
Geographic Information Systems are computer software that allows layering of various types of data to produce complex maps; useful for predicting site location and for representing the analysis of collected data within sites and across regions.

Historical archaeology:
Primarily that aspect of archaeology which is complementary to history based on the study of written sources. In the South African context it concerns the recovery and interpretation of relics left in the ground in the course of Europe's discovery of South Africa, as well as the movements of the indigenous groups during, and after the "Great Scattering" of Bantu-speaking groups – known as the *mfecane* or *difaqane*.

Iron Age:
Also known as "Farmer Period", the "Iron Age" is an archaeological term used to define a period associated with domesticated livestock and grains, metal working and ceramic manufacture.

Lithic:
Stone tools or waste from stone tool manufacturing found in on archaeological sites.

Matrix:
The material in which an artefact is situated (sediments such as sand, ashy soil, mud, water, etcetera). The matrix may be of natural origin or human-made.

Megalith:
A large stone, often found in association with others and forming an alignment or monument, such as large stone statues.

Midden:
Refuse that accumulates in a concentrated heap.

Microlith:
A small stone tool, typically knapped of flint or chert, usually about three centimetres long or less.

Monolith:
A geological feature such as a large rock, consisting of a single massive stone or rock, or a single piece of rock placed as, or within, a monument or site.

Oral Histories:
The historical narratives, stories and traditions passed from generation to generation by word of mouth.

Pre-Phase 1 CRM Assessment:
An initial pre-assessment (scoping) phase, where the specialist establishes the scope of the project and terms of reference for the developer.

Phase 1 CRM Assessment:
An Impact Assessment which identifies archaeological and heritage sites, assesses their significance and comments on the impact of a given development on the sites. Recommendations for site mitigation or conservation are also made during this phase.

Phase 2 CRM Study:
In-depth studies which could include major archaeological excavations, detailed site surveys and mapping / plans of sites, including

historical / architectural structures and features. Alternatively, the sampling of sites by collecting material, small test pit excavations or auger sampling is required. Mitigation / Rescue involves planning the protection of significant sites or sampling through excavation or collection (in terms of a permit) at sites that may be lost as a result of a given development.

Phase 3 CRM Measure:

A Heritage Site Management Plan (for heritage conservation), is required in rare cases where the site is so important that development will not be allowed and sometimes developers are encouraged to enhance the value of the sites retained on their properties with appropriate interpretive material or displays.

Prehistoric archaeology:

That aspect of archaeology which concerns itself with the development of humans and their culture before the invention of writing. In South Africa, prehistoric archaeology comprises the study of the Early Stone Age, the Middle Stone Age and the greater part of the Later Stone Age and the Iron Age.

Probabilistic Sampling:

A sampling strategy that is not biased by any person's judgment or opinion. Also known as statistical sampling, it includes systematic, random and stratified sampling strategies.

Provenience

Provenience is the three-dimensional (horizontal and vertical) position in which artefacts are found. Fundamental to ascertaining the provenience of an artefact is *association*, the co-occurrence of an artefact with other archaeological remains; and *superposition*, the principle whereby artefacts in lower levels of a matrix were deposited before the artefacts found in the layers above them, and are therefore older.

Random Sampling:

A probabilistic sampling strategy whereby randomly selected sample blocks in an area are surveyed. These are fixed by drawing coordinates of the sample blocks from a table of random numbers.

Relative dating:

The process whereby the relative antiquity of sites and objects are determined by putting them in sequential order but not assigning specific dates.

Remote Sensing:

The small or large-scale acquisition of information of an object or phenomenon, by the use of either recording or real-time sensing device(s) that is not in physical or intimate contact with the object (such as by way of aircraft, spacecraft or satellite). Here, ground-based geophysical methods such as Ground Penetrating Radar and Magnetometry are often used for archaeological imaging.

Rock Art Research:

Rock art can be "decoded" in order to inform about cultural attributes of prehistoric societies, such as dress-code, hunting and food gathering, social behaviour, religious practice, gender issues and political issues.

Sensitive:

Often refers to graves and burial sites although not necessarily a heritage place, as well as ideologically significant sites such as ritual / religious places. *Sensitive* may also refer to an entire landscape / area known for its significant heritage remains.

Site (Archaeological):

A distinct spatial clustering of artefacts, features, structures, and organic and environmental remains, as the residue of human activity. These include surface sites, caves and rock shelters, larger open-air sites, sealed sites (deposits) and river deposits. Common functions of archaeological sites include living or habitation sites, kill sites, ceremonial sites, burial sites, trading, quarry, and art sites,

Slag:

The material residue of smelting processes from metalworking.

Stone Age:

An archaeological term used to define a period of stone tool use and manufacture.

Stratigraphy:
This principle examines and describes the observable layers of sediments and the arrangement of strata in deposits

Stratified Sampling:
A probabilistic sampling strategy whereby a study area is divided into appropriate zones – often based on the probable location of archaeological areas, after which each zone is sampled at random.

Systematic Sampling:
A probabilistic sampling strategy whereby a grid of sample blocks is set up over the survey area and each of these blocks is equally spaced and searched.

Tradition:
Artefact types, assemblages of tools, architectural styles, economic practices or art styles that last longer than a phase and even a horizon are describe by the term *tradition*. A common example of this is the early Iron Age tradition of Southern Africa that originated ± 200 AD and came to an end at about 900 AD.

Tuyère:
A ceramic blow-tube used in the process of iron smelting / reduction.

LIST OF ABBREVIATIONS

Abbreviation	Description
ASAPA	Association for South African Professional Archaeologists
AIA	Archaeological Impact Assessment
BP	Before Present
BCE	Before Common Era
EIA	Early Iron Age (also Early Farmer Period)
EIA	Environnemental Impact Assessment
EFP	Early Farmer Period (also Early Iron Age)
ESA	Earlier Stone Age
GIS	Geographic Information Systems
HIA	Heritage Impact Assessment
K2/Map	K2/Mapungubwe Period
LFP	Later Farmer Period (also Later Iron Age)
LIA	Later Iron Age (also Later Farmer Period)
LSA	Later Stone Age
MIA	Middle Iron Age (also Early later Farmer Period)
MRA	Mining Rights Application
MSA	Middle Stone Age
NHRA	National Heritage Resources Act No.25 of 1999, Section 35
SAHRA	South African Heritage Resources Association
SIOC	Sishen Iron Ore Company
YCE	Years before Common Era (Present)

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1 EXECUTIVE SUMMARY

This report details the results of an Archaeological Impact Assessment (AIA) study of surface portions of the farms Gamagara 541, Onverwacht 540 (Fritz 540 Portion 1) and Nooitgedacht 469 (Woon 469) subject to an Environmental Impact Assessment (EIA) for the Sishen Iron Ore Company in the Northern Cape Province. The study was requested for the further development of additional waste rock dumps for the Sishen Mine. The report includes background information on the area's archaeology, its representation in southern Africa, and the history of the larger area under investigation, survey methodology and results as well as heritage legislation and conservation policies. A copy of the report will be supplied to the South African Heritage Resources Agency (SAHRA) and recommendations contained in this document will be reviewed in order to consider the conservation priority of sites located in the area.

A number of archaeological and historical studies have been conducted in the Sishen area. These studies all infer a rich and diverse archaeological landscape. Similarly, 4 areas of archaeological potential were located during the pedestrian and automobile survey of the area totalling approximately 2700ha. These areas are generally located within close proximity of sources of water such as dams and pans.

Stone Age Remains:

A few Middle Stone Age (MSA) artefacts, generally made from fine grained specularite and jaspilite, were recorded at three locations around small water pans in the area. These lithics include only rough core and flake artefacts with smoothed surfaces, and no formal stone tools were observed. However, larger amounts of Earlier and Middle Stone Age artefacts including handaxes, cores and flakes were noted in one area near a manmade dam and borehole. Previous research by the McGregor Museum in Kimberly, attributed related occurrences in the area to the Earlier Stone Age, specifically the Fauresmith – Acheulean timespan at about 600 000 years ago, and the Middle Stone Age.

Recommendations

The MSA surface scatters documented around water pans in the study area are of limited scientific value due to the mixing of artefacts as well as the low density of the occurrences. In addition, such MSA scatters are not unique to the area and they occur widely across in the landscape, especially around water sources such as the Gamagara River and Kathu Pan. No further action is therefore recommended for the occurrences but care should be taken when disturbing any water sources or pans as Stone Age sites generally occur in the proximately these resources in the area. However, the Earlier and Middle Stone Age scatters documented at the manmade dam in the area is of scientific value and it is recommended that a limited Phase 2 Specialist Study be considered for these occurrences. Such a study should minimally include the systematic documentation of surface material by a qualified Stone Age specialist.

This report details the methodology, limitations and recommendations relevant to these heritage areas, as well as areas of proposed development. It should be noted that mitigation measures are valid for the duration of the development process, and mitigation measures might have to be implemented on additional features of heritage importance not detected during this Phase 1 assessment (e.g. uncovered during the construction process).

2 BACKGROUND

2.1 Scope and Motivation

AGES was appointed by the Sishen Iron Ore Company for an Archaeological Impact Assessment (AIA) Study of demarcated surface portions of the farms Gamagara 541, Onverwacht 540 (Fritz 540 Portion 1) and Nooitgedacht 469 (Woon 469) subject to an EIA for the Sishen Iron Ore Mine Western Waste Dumps project in the Kgalagadi District Municipality of the Northern Cape Province. The SIOC are planning an expansion of waste dump facilities for the mine (see Figures 2-1). The rationale of the AIA study was to determine the presence of heritage resources such as archaeological and historical sites and features, graves and places of religious and cultural significance; to consider the impact of the proposed project on such heritage resources, and to submit appropriate recommendations with regard to the cultural resources management measures that may be required at affected sites / features.

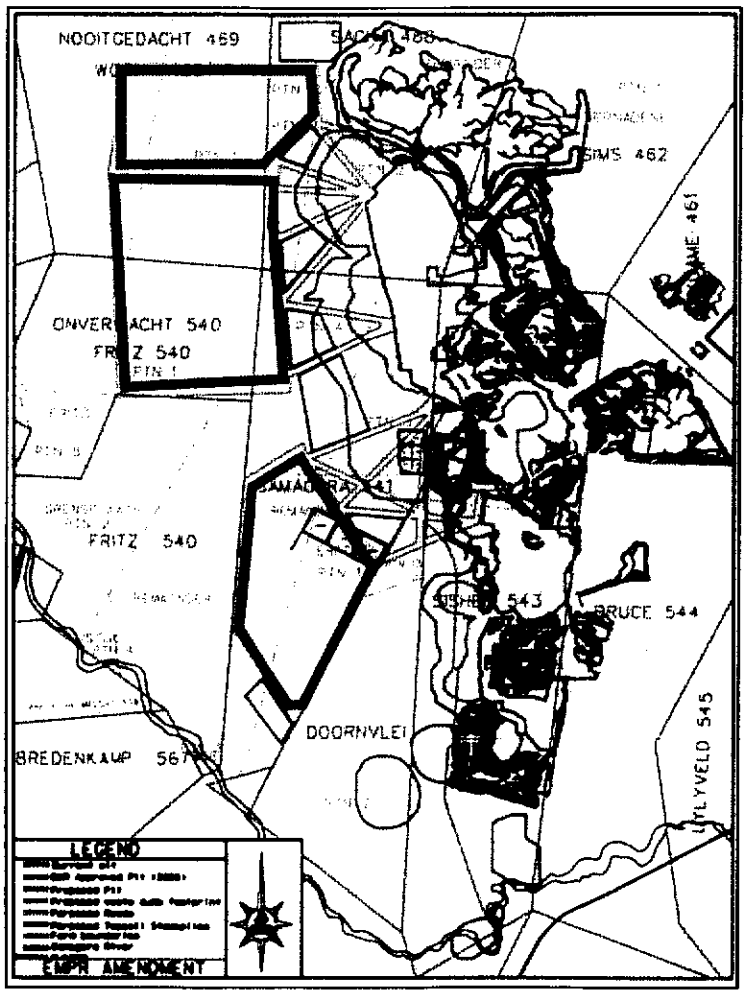

Figure 2-1: Map indicating the general location of the project area subject to the Sishen Western Waste Dumps project (Courtesy of SIOC).

2.2 Project Direction

AGES's expertise ensures that all projects be conducted to the highest international ethical and professional standards. As archaeological specialist for AGES, Mr Neels Kruger acted as field director for the project; responsible for the assimilation of all information, the compilation of the final AIA report and recommendations in

terms of heritage resources on the demarcated project areas. Mr Kruger is an accredited archaeologist and Culture Resources Management (CRM) practitioner with the Association of South African Professional Archaeologists (ASAPA), a member of the Society for Africanist Archaeologists (SAFA) and the Pan African Archaeological Association (PAA) as well as a Master's Degree candidate in archaeology at the University of Pretoria.

2.3 Terms of Reference

Environmental Impact Assessments (EIA's) should, in all cases, include the assessment of Heritage Resources. The heritage component of the EIA is provided for in the **National Environmental Management Act, (Act 107 of 1998)** and endorsed by section 38 of the **National Heritage Resources Act (NHRA - Act 25 of 1999)**. In addition, the NHRA protects all structures and features older than 60 years (see Section 34), archaeological sites and material (see Section 35) and graves as well as burial sites (see Section 36). The objective of this legislation is to enable and to facilitate developers to employ measures to limit the potentially negative effects that the development could have on heritage resources.

Based hereon, this project functioned according to the following **terms of reference:**

- *Provide a detailed description of all archaeological artefacts, structures (including graves) and settlements, if any.*
- *Estimate the level of significance/importance of the archaeological remains within the area.*
- *Assess any possible impact on the archaeological and historical remains within the area emanating from the proposed development activities.*
- *Propose possible mitigation measures provided that such action is necessitated by the development.*
- *Liaise and consult with the South African Heritage Resources Agency (SAHRA).*

2.4 CRM: Legislation, Conservation and Heritage Management

The broad generic term *Cultural Heritage Resources* refers to any physical and spiritual property associated with past and present human use or occupation of the environment, cultural activities and history. The term includes sites, structures, places, natural features and material of palaeontological, archaeological, historical, aesthetic, scientific, architectural, religious, symbolic or traditional importance to specific individuals or groups, traditional systems of cultural practice, belief or social interaction.

2.4.1 Legislation regarding archaeology and heritage sites

The South African Heritage Resources Agency (SAHRA) and their provincial offices aim to conserve and control the management, research, alteration and destruction of cultural resources of South Africa. It is therefore vitally important to adhere to heritage resource legislation at all times.

- *National Heritage Resources Act No 25 of 1999, section 35*

According to the National Heritage Resources Act of 1999 a historical site is "any identifiable building or part thereof, marker, milestone, gravestone, landmark or tell older than 60 years." This clause is commonly known as the "60-years clause". Buildings are amongst the most enduring features of human occupation, and this definition therefore includes all buildings older than 60 years, modern architecture as well as ruins, fortifications and Iron Age settlements. "Tell" refers to the evidence of human existence which is no longer above ground level, such as building foundations and buried remains of settlements (including artefacts).

The Act identifies heritage objects as:

- 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
- any other prescribed category

With regards to activities and work on archaeological and heritage sites this Act states that:

"No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit by the relevant provincial heritage resources authority." (34. [1] 1999:58)

and

"No person may, without a permit issued by the responsible heritage resources authority-

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites. (35. [4] 1999:58)."

And:

"No person may, without a permit issued by SAHRA or a provincial heritage resources agency-

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority;

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) and excavation equipment, or any equipment which assists in the detection or recovery of metals (36. (3) 1999:60)."

- *Human Tissue Act of 1983 and Ordinance on the Removal of Graves and Dead Bodies of 1925*

Graves 60 years or older are heritage resources and fall under the jurisdiction of both the National Heritage Resources Act and the Human Tissues Act of 1983. However, graves younger than 60 years are specifically protected by the Human Tissues Act (Act 65 of 1983) and the Ordinance on the Removal of Graves and Dead Bodies (Ordinance 7 of 1925) as well as any local and regional provisions, laws and by-laws. Such burial places also fall under the jurisdiction of the National Department of Health and the Provincial Health Departments. Approval for the exhumation and re-burial must be obtained from the relevant Provincial MEC as well as the relevant Local Authorities.

2.4.2 Background to HIA and AIA Studies

South Africa's unique and non-renewable archaeological and palaeontological heritage sites are 'Generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority. Heritage sites are frequently threatened by development projects and both the environmental and heritage legislation require impact assessments (HIAs & AIAs) that identify all heritage resources in areas to be developed. Particularly, these assessments are required to make recommendations for protection or mitigation of the impact of the sites. HIA's and AIAs should be done by qualified professionals with adequate knowledge to (a) identify all heritage resources including archaeological and palaeontological sites that might occur in areas of developed and (b) make recommendations for protection or mitigation of the impact on the sites.

The National Heritage Resources Act (Act No. 25 of 1999, section 38) provides guidelines for Cultural Resources Management and prospective developments:

***"38.** (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as:*

(a) the construction of a road, wall, powerline, 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 50 m 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."

And:

"The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)(a): Provided that the following must be included:

(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;

(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 (38. [3] 1999:64)."

Consequently, section 35 of the Act requires Heritage Impact Assessments (HIAs) or Archaeological Impact Assessments (AIAs) to be done for such developments in order for all heritage resources, that is, all places or objects of aesthetics, architectural, historic, scientific, social, spiritual, linguistic or technological value or significance to be protected. Thus any assessment should make provision for the protection of all these heritage components, including archaeology, shipwrecks, battlefields, graves, and structures older than 60 years, living heritage, historical settlements, landscapes, geological sites, palaeontological sites and objects.

3 REGIONAL CONTEXT

3.1 Area Location

The study area for the Sishen Western Waste Dumps project is located on the western outskirts of the Sishen Iron Ore Mine on the farms Gamagara 541, Onverwacht 540 (Fritz 540 Portion 1) and Nooitgedacht 469 (Woon 469) in the Kgalagadi District of the Northern Cape Province. The town of Kathu occurs east of the study area. The Sishen Iron Ore Mine Complex is situated more or less 5km south-west of the town of Kathu and approximately 180km north-east of the Northen Cape town of Upington.

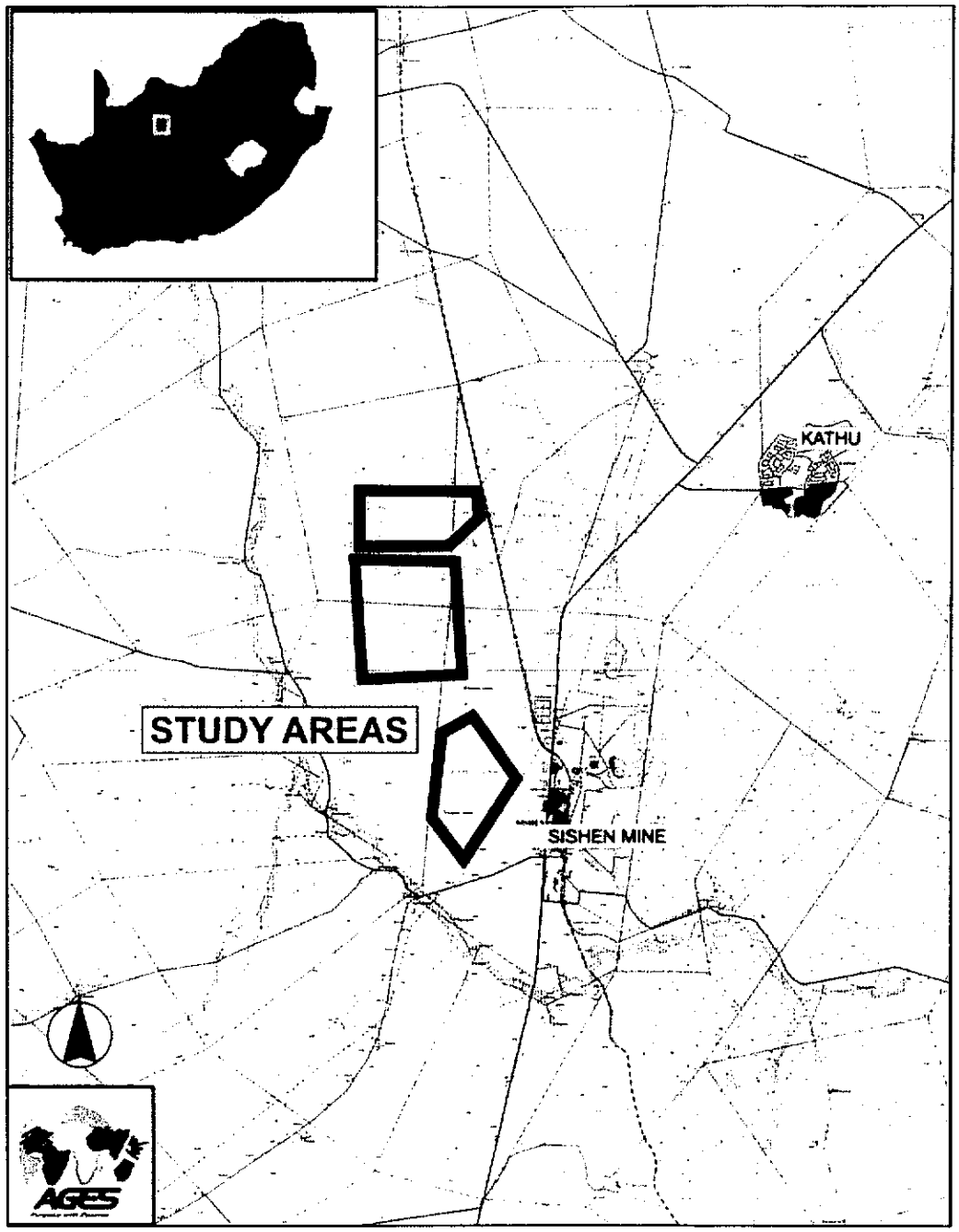

Figure 3-1: 1:50 00 Map representation of the Sishen Western Waste Dumps project location (2722DD).

3.2 Area Description: Receiving Environment

The Northern Cape area around Kathu and the Sishen Iron Ore Mine receives around 200-400 mm of rain in the summer months. The local vegetation is classified as Karroid Bushveld where a transition occurs between trees in a mixed grassveld, typical to the Bushveld complex, to a Karoo landscape with more open grasslands and succulents (Acocks 1988). The geology of the region is underlain by rocks older than 1000 million years and the overburden consists mainly of geologically recent Kalahari sand, which in turn is un-fossiliferous. Some quartzites also occur on area on the landscape. Previous studies in the area indicated that the area is underlain more specifically by Proterozoic-aged rocks belonging to the Asbestos Hills Subgroup of the Transvaal Supergroup (Beaumont 2009). The Gamagara River, a major non-perennial waterway transects the landscape south and west of the Sishen Iron Ore Mine.

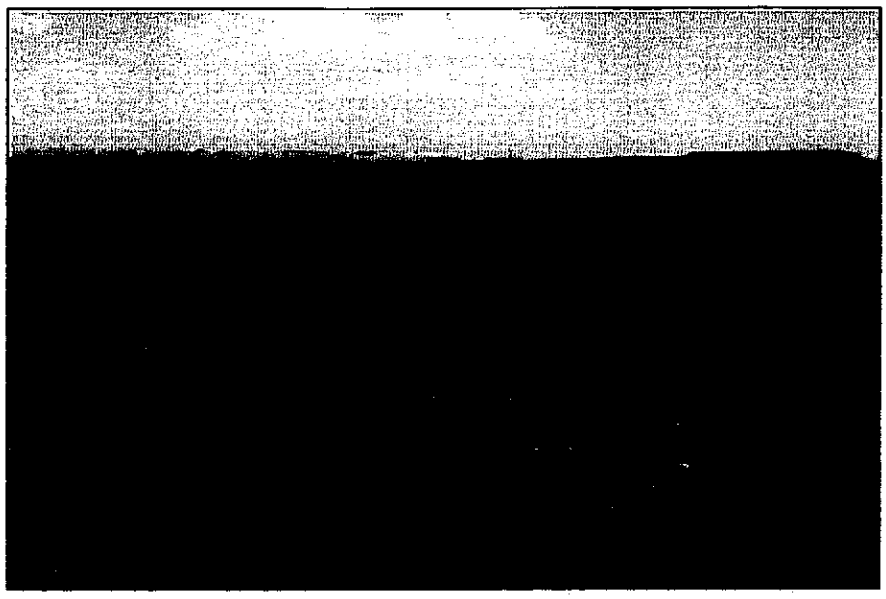

Figure 3-2: General surroundings of the northern portion of the study area looking east.

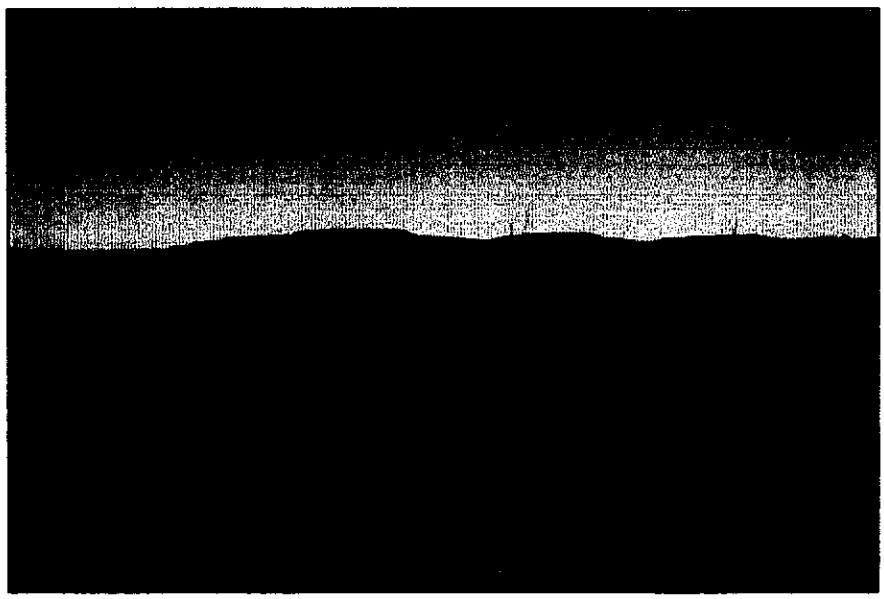

Figure 3-3: General surroundings of the central portion of the study area looking north-east.

3.3 Site Description

The project area subject to the Sishen Western Waste Dumps EIA comprises three larger zones to the west of the Sishen Iron Ore Mine where waste rock dumps are planned (see Figure 3-4). Surface areas in certain parts of this area have been altered as a result of past mining activities, agriculture and natural agents such as erosion. However, extensive surface disturbances across the larger landscape do not occur (see Section 4.2.2).

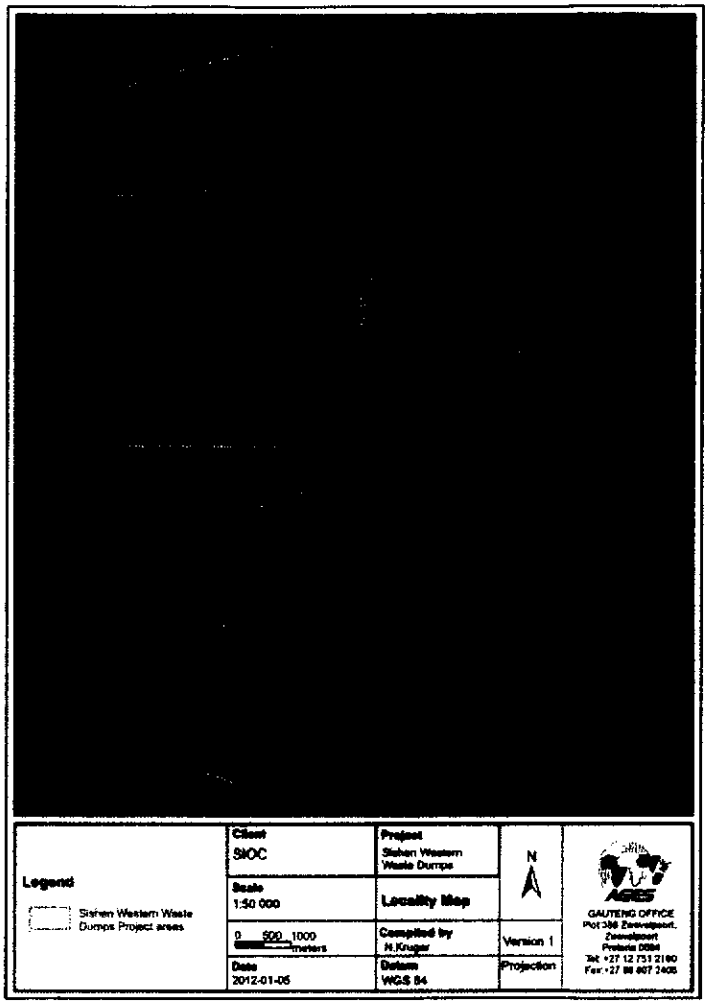

Figure 3-4: Regional setting of the Sishen Iron Ore Mine, indicating the Sishen Western Waste Dumps project areas and general situation of the base case for the waste dumps.

A number of alternatives for the waste rock dumps have been considered based on various specialist opinions and environmental impacts (see Figure 3-5 to Figure 3-7). The physical variations in options considered for waste dumps have no implication for the AIA as all alternatives fall within the boundaries of the Sishen Western Waste Dumps project and the AIA survey area.

The alternatives for the Sishen Western Waste Dumps Project include:

- A base case, which generally follows the design of the footprints of the study area (Figure 3-4).
- "Alternative 2" which is a "narrower/higher" alternative, comprised of higher G80 benches up to 160 m with a narrower footprint than the base case (Figure 3-5).

- A third "wider/lower" alternative ("Alternative 3"), consisting of similar higher G80 benches up to 160m, but with a wider footprint (Figure 3-6).
- A final and preferred alternative ("Alternative 12"), similar to "Alternative 2" but adapted to incorporate further ecological and other sensitive receptors (Figure 3-7).

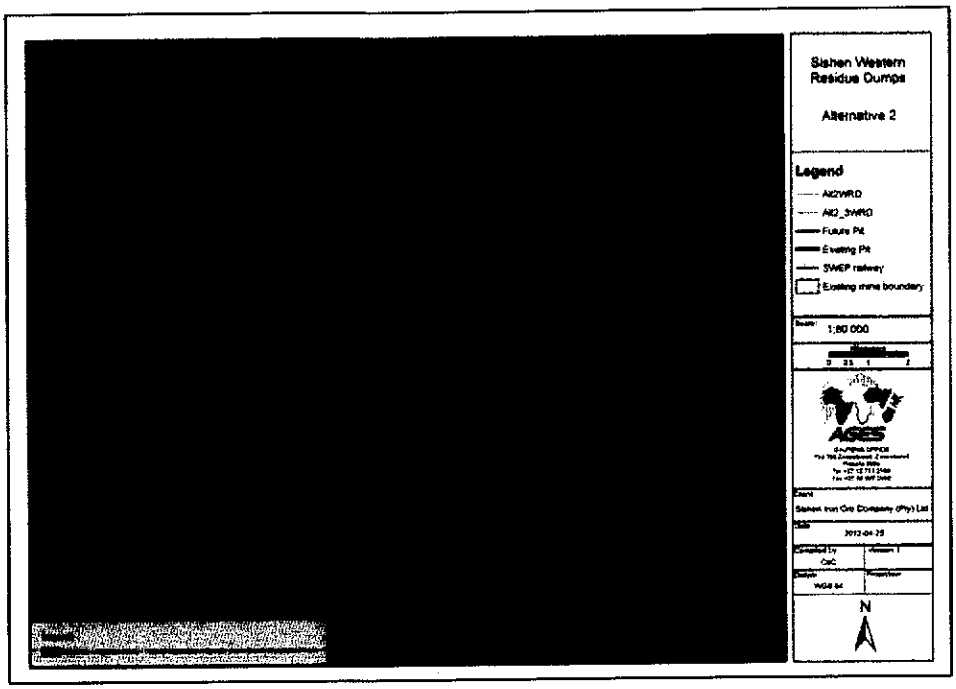

Figure 3-5: Map indicating the Sishen Western Waste Dumps project areas and general situation of "Alternative 2" for the waste dumps.

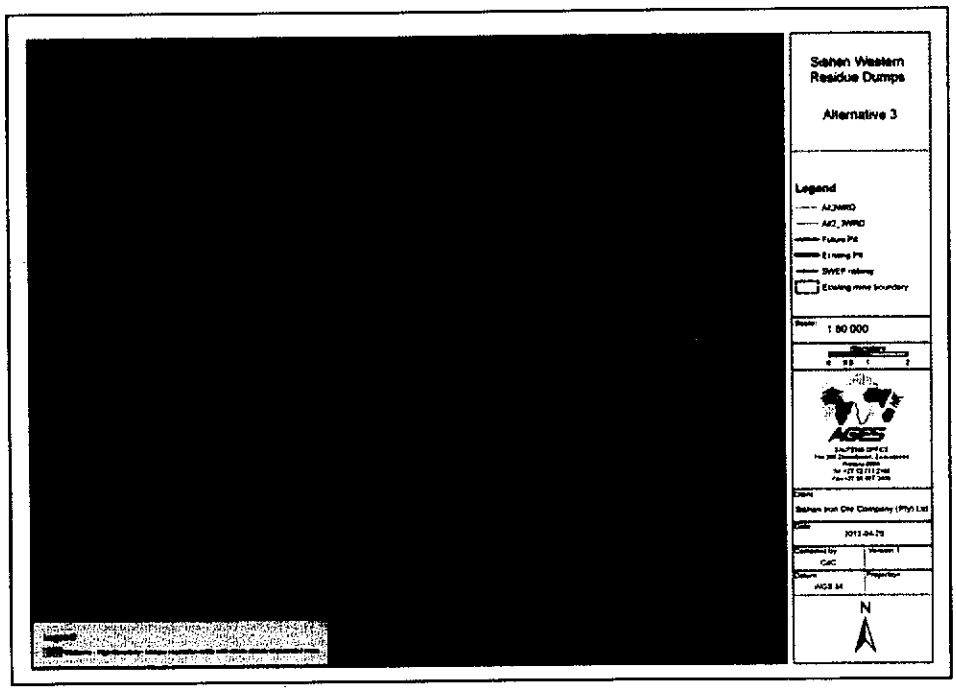

Figure 3-6: Map indicating the Sishen Western Waste Dumps project areas and general situation of "Alternative 3" for the waste dumps.

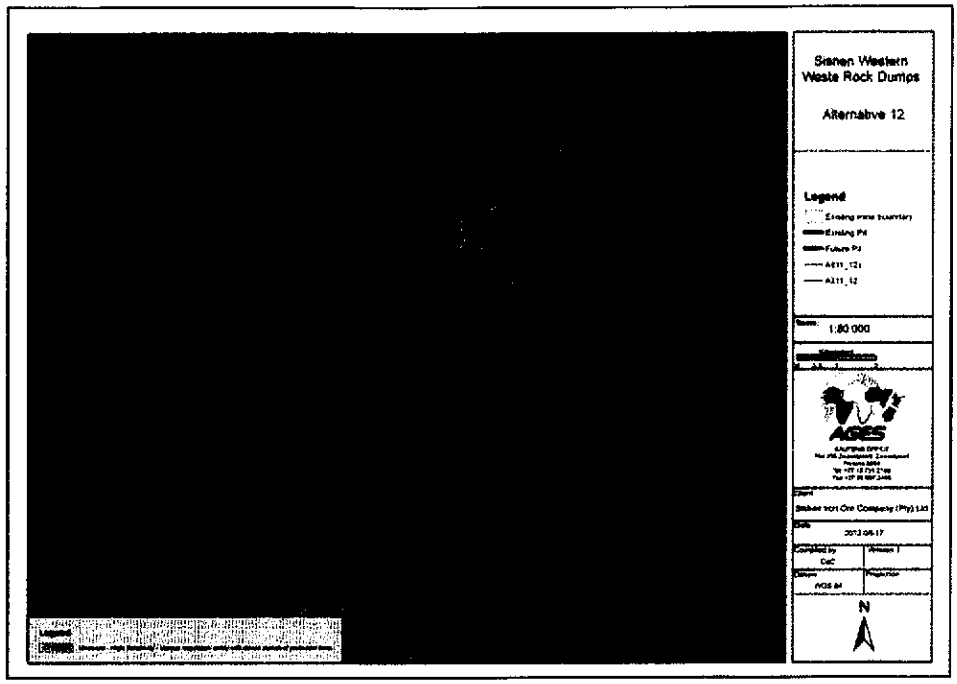

Figure 3-7: Map indicating the Sishen Western Waste Dumps project areas and general situation of "Alternative 12" the preferred alternative for the waste dumps.

"Alternative 12" has been identified as the most viable option for the waste dumps and this alternative will, in all probability be implemented as the preferred option for the development.

4 METHOD OF ENQUIRY

4.1 Sources of Information

4.1.1 Desktop Study

A desktop study was prepared in order to contextualize the proposed project within a larger historical milieu. The study focused on relevant previous studies, archaeological and archival sources, aerial photographs, historical maps and local histories, all pertaining to the Kathu area and the larger landscape of this section of the Northern Cape Province.

4.1.2 Aerial Representations and Survey

Aerial photography is often employed to locate and study archaeological sites, particularly where larger scale area surveys are performed. This method was applied to aid the pedestrian and vehicular survey of the 2700ha project area, where contour lines of elevations, depressions, variation in vegetation, soil marks and landmarks were examined. Specific attention was given to shadow sites (shadows of walls or earthworks which are visible early or late in the day), crop mark sites (crop mark sites are visible because disturbances beneath crops cause variations in their height, vigour and type) and soil marks (e.g. differently coloured or textured soil (soil marks) might indicate ploughed-out burial mounds). Attention was also given to moisture differences, as prolonged dampening of soil as a result of precipitation frequently occurs over walls or embankments. By superimposing high frequency aerial photographs with images generated with Google Earth, potential sensitive areas were

subsequently identified. These areas served as referenced points from where further transect surveys were carried out.

Figure 4-1: Aerial representation indicating areas identified as possible archaeological sites / disturbances prior to site survey.

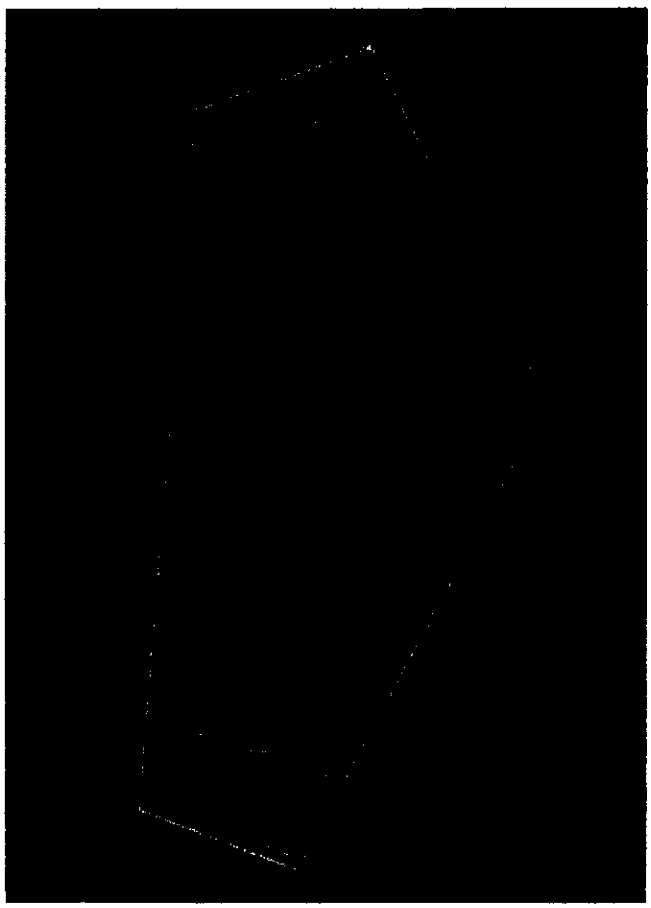

Figure 4-2: Aerial representation indicating areas identified as possible archaeological sites / disturbances prior to site survey.

4.1.3 Field Survey

Archaeological survey implies the systematic procedure of the identification of archaeological sites. An archaeological survey of the Sishen Western Waste Dumps project area was done by means of a systematic pedestrian and vehicular survey in accordance with standard archaeological practise by which heritage resources are observed and documented. In order to sample surface areas systematically and to ensure a high probability of site recording, a transect grid system at a frequency of between 50m and 100m was digitally superimposed on maps of the infrastructure development areas. This system was then applied as guide for the pedestrian survey. Moving along the transect grid with a Garmin E-trex Legend GPS, objects and structures of archaeological / heritage value were recorded and photographed with a Canon 450D Digital camera. The pedestrian and vehicular survey also focused around potentially sensitive areas identified during the aerial survey (see Figure 4-1) as well as areas of higher site catchment probability – for example around water sources such as pans, drainage lines and soils suitable for prehistoric agriculture. Real time aerial orientation, by means of a mobile Google Earth application was also employed to investigate possible disturbed areas during the survey (see Figure 4-2). As most archaeological material occur in single or multiple stratified layers beneath the soil surface, special attention was given to disturbances, both man-made such as roads and clearings, as well as those made by natural agents such as burrowing animals and erosion.

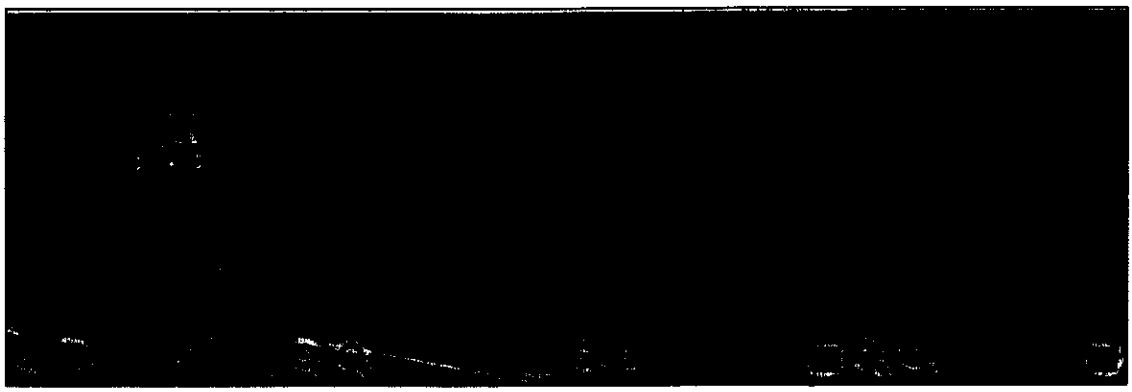

Figure 4-3: Captured screen contents of real time mobile aerial orientation representations employed during the field survey, current location indicated by blue marker.

4.2 Limitations

4.2.1 Access

Access control is applied to all the farms relevant to this assessment but no restrictions were encountered during site visits as the author of this report was accompanied by an official from Kumba. Here, farm service roads provided access to all portions of these farms, and all areas relevant to the study were easily reachable.

4.2.2 Visibility

The surrounding vegetation in the Sishen area is mostly comprised out of mixed grasslands and scattered trees with the occurrence of semi-arid succulents in places. The general visibility at the time of the initial AIA survey (November 2011) ranged between moderate to high visibility in areas to the north and south, and moderate to low visibility in places in central to the study area (see Figures 4-1 to 4-4). In single cases during the survey sub-surface inspection was possible. Where applied, this revealed no archaeological deposits.

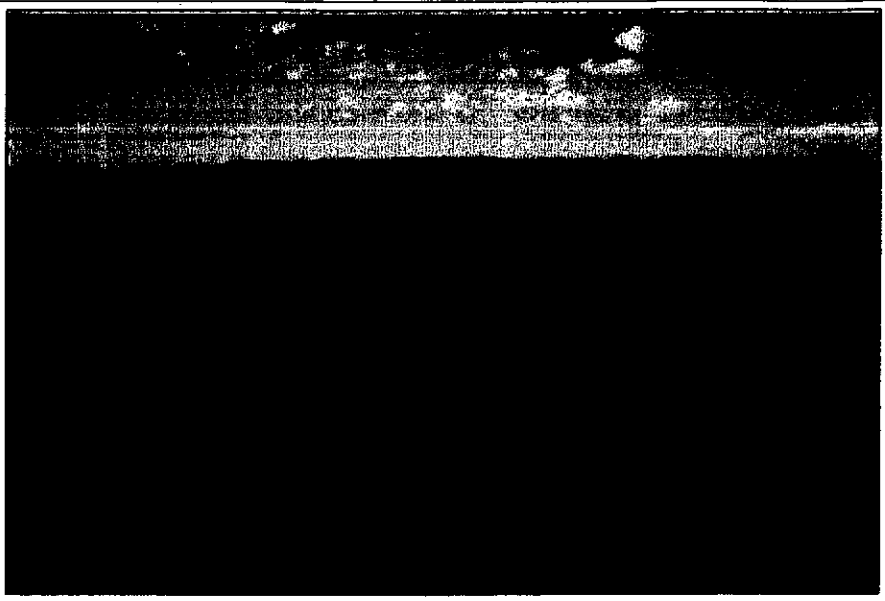

Figure 4-4: View of Springbok Pan in the northern portion of the study area, looking north.

Figure 4-5: General surroundings of the northern portion of the study area looking north-east.

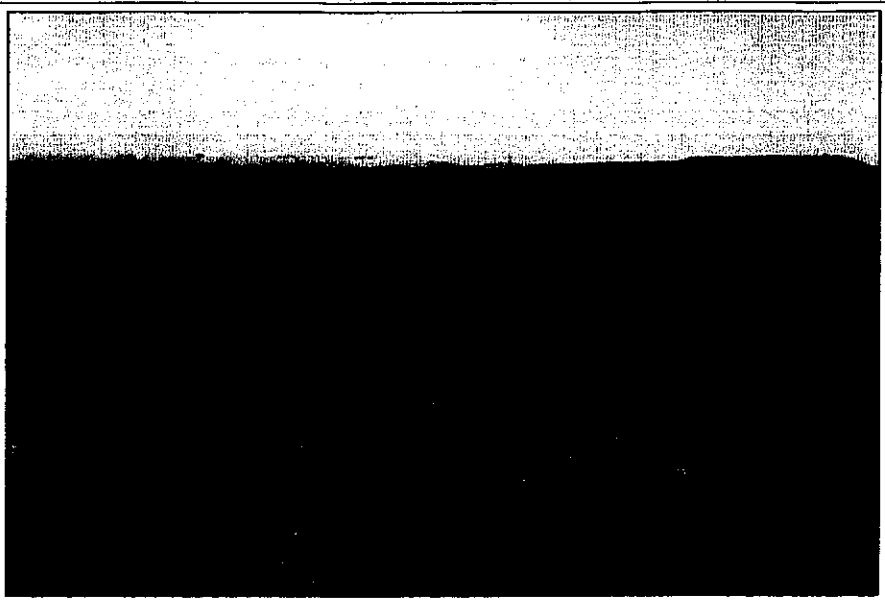

Figure 4-6: General surroundings of the central portion of the study area looking east.

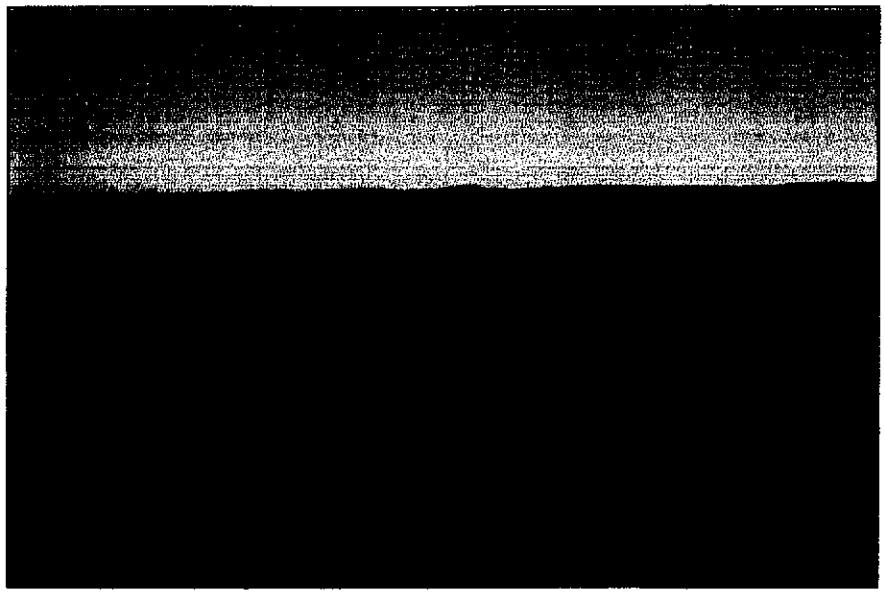

Figure 4-7: General surroundings of the central portion of the study area looking east.

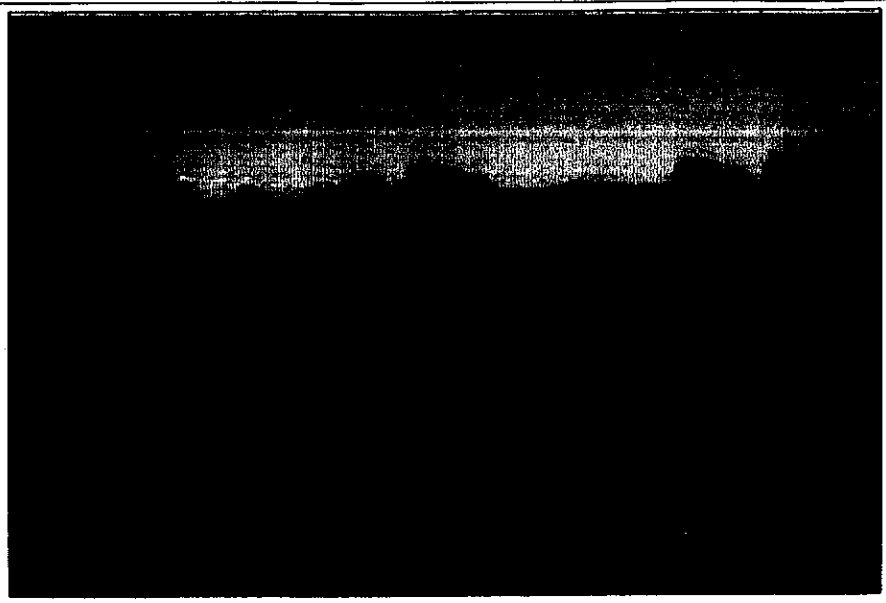

Figure 4-8: General surroundings of the southern portion of the study area looking east.

Figure 4-9: Surface disturbance in the southern portion of the study area adjacent to the old mine slimes dams, looking north-east.

4.2.3 Constraints

Generally, time restrictions in terms of the site survey proved to be a constraint due to the vast surface extent of the larger project area. Also, in accordance with Sishen site policy, the author of this report was accompanied by an official from Kumba during visits to all farms which somewhat restricted survey time and free movement on site. Therefore, pedestrian site surveys focused around areas tentatively identified as sensitive (i.e. along drainage lines and pans and those noted during the aerial survey). Vehicular surveys were applied at all other areas. Maintaining due cognisance of the integrity and accuracy of the archaeological survey, it should be stated

that the heritage resources identified during the study do not necessarily represent *all* the heritage resources present on the property. The subterranean nature of some archaeological sites, dense vegetation cover and visibility constraints sometimes distort heritage representations and any additional heritage resources located during consequent development phases must be reported to the Heritage Resources Authority or an archaeological specialist.

5 RESULTS: ARCHAEOLOGICAL SURVEY

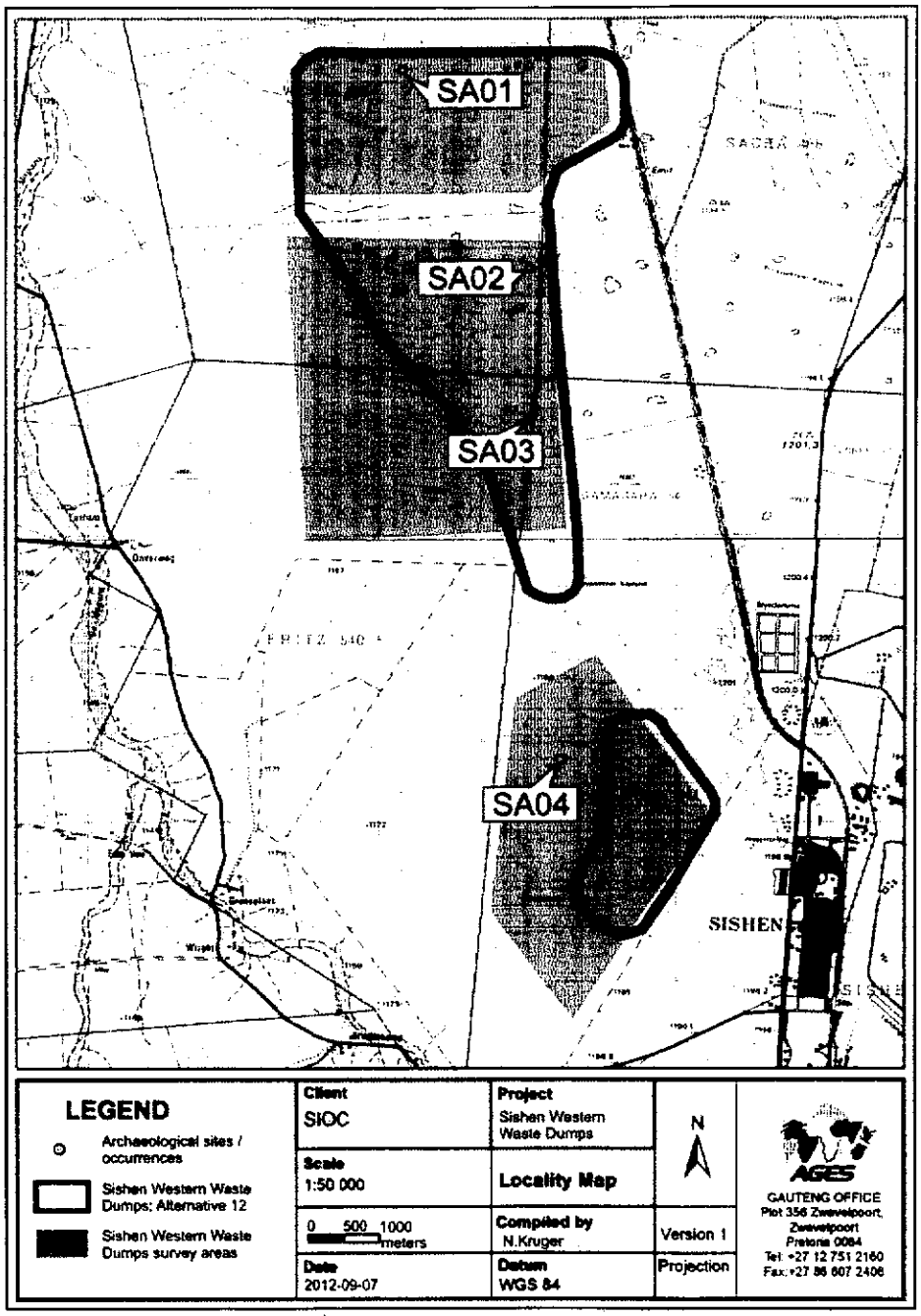

Figure 5-1: Map indicating the location of sites of interest discussed in the text in relation to the survey area and the waste dumps preferred alternative ("Alternative 12").

5.1 The Stone Age

During the survey, low density Stone Age Scatters were identified in three areas in the study area. Another site with larger amounts of Earlier and Middle Stone Age material was documented at a man-made dam and borehole on the farm Fritz 540 (see Figure 5-1 and Section 7.3):

Site SA01 (S27°41'51" E22°56'20.6"): Single MSA lithics on the farm Woon 469.

Site SA03 (S27°44'16.1" E22°57'13.2"): Single MSA lithics on the farm Woon 469.

Site SA04 (S27°46'30.6" E22°57'24.3"): Single MSA lithics on the farm Gamagara 541

Single MSA lithics were documented at three sites near water pans in the area. The location of these scatters corresponds with a general Stone Age site distribution pattern in the area where archaeological sites in the landscape occur near water sources such as rivers and pans. Amongst the lithics observed, were lightly smoothed jasper artefacts, cores with some peripheral preparation and scattered debris. However, no formal tools or distinctive tool-types were observed. The occurrence is probably of limited scientific value due to the low density of the material and the frequent occurrence of such MSA assemblages in the general landscape.

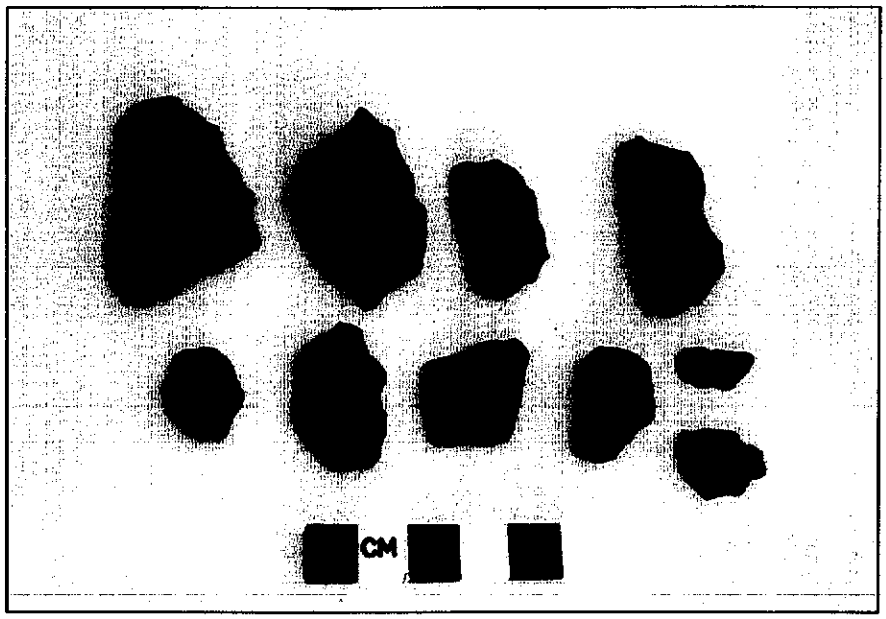

Figure 5-2: Flaked MSA lithics from sites SA01, SA03 and SA04.

Site SA02 (S27°43'13.7" E22°57'12.7"): ESA & MSA lithic scatter on the farm Fritz 540

ESA and MSA lithic scatters were documented next to a man-made dam and borehole on the farm Frits in medium densities. The density of the scatter was arbitrarily estimated by placing a one-meter drawing frame, sub-divided into quadrants, on a randomly-selected area displaying higher amounts of surface lithics. By plotting the counts of all lithic elements present in the 1x1 metre square relative density per m^2 was established and rated on a scale of low (<10), medium (10-20) and high (>20). This method has been adapted as expedient and non-invasive sampling technique that is particularly useful in value assessment of lithic occurrences during Phase 1 AIA's (see Van Der Ryst 2012). Amongst the lithics observed, were ESA hand axes and cleavers, lightly smoothed jasper artefacts, MSA cores with some peripheral preparation and scattered debris. Previous research

by the McGregor Museum in Kimberly, attributed related occurrences in the area to the Earlier Stone Age, specifically the Fauresmith – Acheulean timespan at about 600 000 years ago, and the Middle Stone Age (e.g. Beaumont & Morris 1990). The occurrence has scientific potential due to the presence of formal stone tools, and the occurrence of less widespread ESA material at this site.

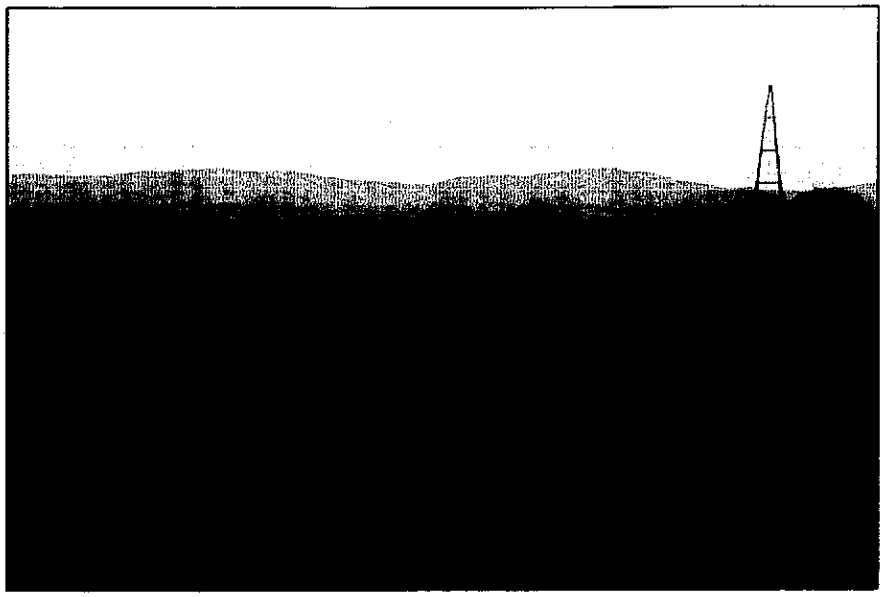

Figure 5-3: Site SA02 is situated at a man-made catchment dam and borehole.

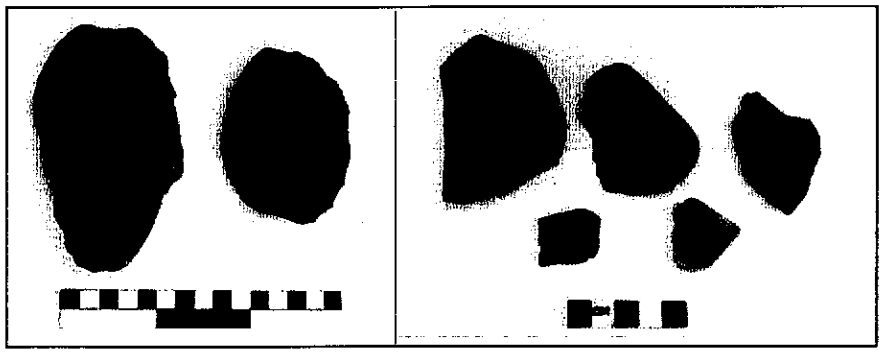

Figure 5-4 ESA hand axe and cleaver (left) and MSA flaked lithics (right) from site SA02.

5.2 The Iron Age (Farmer Period)

No Iron Age (Farmer Period) occurrences were observed in the survey area.

5.3 Historical / Colonial Period and recent times

No Historical / Colonial Period occurrences were observed in the survey area.

5.4 Graves

No graves / burial places were observed in the survey area.

5.5 Other: Palaeontology

No palaeontologocal occurrences were documented in the survey area. Geological scoping studies in the area concludes that the basement rocks in the area are extensively overlain by superficial sediments such as alluvial sands and calcretes of Quaternary age. These superficial sediments are generally only sparsely fossiliferous to unfossiliferous. It is therefore improbable that palaeontological features will be impacted by mining activities.

6 ARCHAE0-HISTORICAL CONTEXT

6.1 The archaeology of Southern Africa

Archaeology in southern Africa is typically divided into two main fields of study, the **Stone Age** and the **Iron Age** or **Farmer Period**. The following table gives a concise outline of the chronological sequence of periods in Southern African history:

Period	Epoch	Associated cultural groups	Typical Material Expressions
Early Stone Age 2.5m – 250 000 YCE	Pleistocene	Early Hominins: *Australopithecines* *Homo habilis* *Homo erectus*	Typically large stone tools such as hand axes, choppers and cleavers.
Middle Stone Age 250 000 – 25 000 YCE	Pleistocene	First *Homo sapiens* species	Typically smaller stone tools such as scrapers, blades and points.
Late Stone Age 20 000 BC – present	Pleistocene / Holocene	*Homo sapiens sapiens* including San people	Typically small to minute stone tools such as arrow heads, points and bladelets.
Early Iron Age / Early Farmer Period 300 – 900 AD	Holocene	First Bantu-speaking groups	Typically distinct ceramics, bead ware, iron objects, grinding stones.
Middle Iron Age (Mapungubwe / K2) / early Later Farmer Period 900 – 1350 AD	Holocene	Bantu-speaking groups, ancestors of present-day groups	Typically distinct ceramics, bead ware and iron / gold / copper objects, trade goods and grinding stones.
Late Iron Age / Later Farmer Period 1400 AD -1850 AD	Holocene	Various Bantu-speaking groups including Venda, Thonga, Sotho-Tswana and Zulu	Distinct ceramics, grinding stones, iron objects, trade objects, remains of iron smelting activities including iron smelting furnace, iron slag and residue as well as iron ore.
Historical / Colonial Period ±1850 AD – present	Holocene	Various Bantu-speaking groups as well as European farmers, settlers and explorers	Remains of historical structures e.g. homestead, missionary schools etc. as well as, glass, porcelain, metal and ceramics.

6.1.1 The Stone Ages

- **The Earlier Stone Age (ESA)**

Earlier Stone Age deposits typically occur on the flood-plains of perennial rivers and may date to between 2 million and 250 000 years ago. These ESA open sites sometimes contain stone tool scatters and manufacturing debris ranging from pebble tool choppers to core tools such as handaxes and cleavers. These stone tools were made by the earliest hominins. These groups seldom actively hunted and relied heavily on the opportunistic scavenging of meat from carnivore fill sites.

- **The Middle Stone Age (MSA)**

The majority of Middle Stone Age (MSA) sites occur on flood plains and sometimes in caves and rock shelters. Sites usually consist of large concentrations of knapped stone flakes such as scrapers, points and blades and

associated manufacturing debris. Tools may have been hafted but organic materials, such as those used in hafting, seldom remain preserved in the archaeological record. Limited drive-hunting activities are also associated with the MSA.

- **The Later Stone Age (LSA)**

Sites dating to the Later Stone Age (LSA) are better preserved in rock shelters, although open sites with scatters of mainly stone tools can occur. Well-protected deposits in shelters allow for stable conditions that result in the preservation of organic materials such as wood, bone, hearths, ostrich eggshell beads and even bedding material. By using San (Bushman) ethnographic data a better understanding of this period is possible. South African rock art is also associated with the LSA.

6.1.2 The Iron Age (Farmer Period)

- **Early Iron Age (Early Farming Communities)**

The Early Iron Age (also Early Farmer Period) marks the movement of Bantu speaking farming communities into South Africa at around 200 A.D. These groups were agro-pastoralists that settled in the vicinity of water in order to provide subsistence for their cattle and crops. Artefact evidence from Early Farmer Period sites is mostly found in the form of ceramic assemblages and the origins and archaeological identities of this period are largely based upon ceramic typologies and sequences, where diagnostic pottery assemblages can be used to infer group identities and to trace movements across the landscape. Early Farmer Period ceramic traditions are classified by some scholars into different "streams" or trends in pot types and decoration that, over time emerged in southern Africa. These "streams" are identified as the Kwale Branch (east), the Nkope Branch (central) and the Kalundu Branch (west). More specifically, in the northern regions of South Africa at least three settlement phases have been distinguished for prehistoric Bantu-speaking agropastoralists. The first phase of the Early Iron Age, known as Happy Rest (named after the site where the ceramics were first identified), is representative of the Western Stream of migrations, and dates to AD 400 - AD 600. The second phase of Diamant is dated to AD 600 - AD 900 and was first recognized at the eponymous site of Diamant in the western Waterberg. The third phase, characterised by herringbone-decorated pottery of the Eiland tradition, is regarded as the final expression of the Early Iron Age (EIA) and occurs over large parts of the North West Province, Northern Province, Gauteng and Mpumalanga. This phase has been dated to about AD 900 - AD 1200. Early Farmer Period ceramics typically display features such as large and prominent inverted rims, large neck areas and fine elaborate decorations. The Early Iron Age continued up to the end of the first millennium AD.

- **Middle Iron Age / K2 Mapungubwe Period (early Later Farming Communities)**

The onset of the middle Iron Age dates back to ±900 AD, a period more commonly known as the Mapungubwe / K2 phase. These names refer to the well known archaeological sites that are today the pinnacle of South Africa's Iron Age heritage. The inhabitants of K2 and Mapungubwe, situated on the banks of the Limpopo, were agriculturalists and pastoralists and were engaged in extensive trade activities with local and foreign traders. Although the identity of this Bantu-speaking group remains a point of contestation, the Mapungubwe people were the first state-organized society southern Africa has known. A considerable amount of golden objects, ivory, beads (glass and gold), trade goods and clay figurines as well as large amounts of potsherds were found at these sites and also appear in sites dating back to this phase of the Iron Age. Ceramics of this tradition take the form of beakers with upright sides and decorations around the base (K2) and shallow-shouldered bowls with decorations as well as globular pots with long necks. (Mapungubwe). The site of Mapungubwe was deserted at around 1250 AD and this also marks the relative conclusion of this phase of the Iron Age.

- **Later Iron Age (Later Farming Communities)**

The late Iron Age of southern Africa marks the grouping of Bantu speaking groups into different cultural units. It

also signals one of the most influential events of the second millennium AD in southern Africa, the difaqane. The difaqane (also known as "the scattering") brought about a dramatic and sudden ending to centuries of stable society in southern Africa. Reasons for this change was essentially the first penetration of the southern African interior by Portuguese traders, military conquests by various Bantu speaking groups primarily the ambitious Zulu King Shaka and the beginning of industrial developments in South Africa. Different cultural groups were scattered over large areas of the interior. These groups conveyed with them their customs that in the archaeological record manifest in ceramics, beads and other artefacts. This means that distinct pottery typologies can be found in the different late Iron Age groups of South Africa.

6.1.3 Historical and Colonial Times and Recent History:

The Historical period in southern Africa encompass the course of Europe's discovery of South Africa and the spreading of European settlements along the East Coast and subsequently into the interior. In addition, the formation stages of this period are marked by the large scale movements of various Bantu-speaking groups in the interior of South Africa, which profoundly influenced the course of European settlement. Finally, the final retreat of the San and Khoekhoen groups into their present-day living areas also occurred in the Historical period in southern Africa.

6.2 Sishen Iron Mine Surroundings: Specific Themes

The history of the Northern Cape Province is reflected in a rich archaeological landscape, mostly dominated by Stone Age occurrences. Numerous sites, documenting Earlier, Middle and Later Stone Age habitation occur across the province, mostly in open air locales or in sediments alongside rivers or pans. In addition, a wealth of Later Stone Age rock art sites, most of which are in the form of rock engravings are to be found in the larger landscape. These sites occur on hilltops, slopes, rock outcrops and occasionally in river beds. Sites dating to the Iron Age occur in the north eastern part of the Province but environmental factors delegated that the spread of Iron Age farming westwards from the 17th century was constrained mainly to the area east of the Langeberg Mountains. However, evidence of an Iron Age presence as far as the Upington area in the eighteenth century occurs in this area. Moving into recent times, the archaeological record reflects the development of a rich colonial frontier, characterised by, amongst others, a complex industrial archaeological landscape such as mining developments at Kimberley, which herald the modern era in South African history.

6.2.1 Palaeontology and Early History

As previously noted, the Kathu area is underlain by rocks older than 1000 million years, which makes them too old to contain hard-bodied fossils (Beaumont 2009). This overburden consists mainly of un-fossiliferous Kalahari sand, which is relatively recent in geological age. An indurated calcareous layer frequently occurs at the interface of the sandy overburden and the rock beneath. This layer may contain fossil remains in more suitable localities, although none have been reported from such contexts in this area.

6.2.2 The Early and Middle stone Ages in the Northern Cape

The landscape around the town of Kathu is rich in archaeological material dating to Earlier and Middle Stone Ages. Sites such as Wonderwerk Cave, Kathu Pan and Kathu Townlands have yielded significant Stone Age assemblages that all inform on our general understanding of the technological sequences of the Stone Age in the Northern Cape (e.g. see Beaumont 2008; Morris 2006; Morris 2007; Dreyer 2007). In addition, a large amount of Middle and Later Stone Age sites have been documented across the landscape on calcrete lined pans and road cuttings

6.2.3 Significant Stone Age Sites in the Kathu area

Archaeological sites in the vicinity of the Sishen Iron Ore Mine Complex are not randomly scattered within the landscape and they occur either near water or close to local source of two highly-prized raw materials, specularite and jaspilite. Besides the Gamagara River where numerous low density artefact scatters occur, another regional water source occurs below superficial sands on the bedrock plains around Kathu, where water was contained at times that gradually filled up with stratified sediments often containing massive calcretes of Tertiary age. Large tracts are far more widespread, where archaeological traces are almost non-existent with very occasional specimens of the Later Stone Age on the sand surface and thin scatters of specimens from the Early Stone Age on calcrete below.

Rock engravings previously occurred on the farms Bruce and Sishen, but as these were located in land that was to be mined, personnel of the McGregor Museum removed them prior to mining developments.

At least two archaeological sites of note occur in the general landscape around the town of Kathu.

- Kathu Pan

This site, situated near the town of Kathu, is a shallow water pan about 30ha in extent. The site was extensively studied from 1974 to 1990 by Humpreys and Beaumont, amongst others. Kathu Pan is an extremely significant site as it represents the major industries of the Stone Age, more specifically two phases of the Earlier Stone Age, two phases of the Middle Stone Age, and more or less the entire Later Stone Age (Beaumont 1990). The site yielded large amounts of hand axes and faunal remains, including the concentrated remains of large mammal remains. The abundance of Stone Age material at Kathu Pan can probably be attributed to the presence of a permanent water source at the pan.

Figure 6-1: Early Stone Age (Acheul) handaxe from the Kathu Pan site (http://www.museumsnc.co.za).

- Kathu Townlands

This Provincial Heritage Site, covering an estimated area of 250 000 m² is located away from the Kathu pan on the outskirts of the town of Kathu. The site, excavated in 1982 and 1990, primary displays a large Earlier Stone

Age horizon in deposits up to a metre below surface. This deposit dates to the Acheul phase of the Earlier Stone Age. It is estimated that in total, the site holds more than 2 billion artefacts. This abundance of lithic debris could be ascribed to the protracted use of the high-grade banded ironstone outcrop in the area, as a raw material source (Beaumont 1990).

- Other sites around the Sishen area

Studies by the McGregor Museum in Kimberley have recorded Earlier and Later Stone Age sites on e.g. the farm Lylyveld 545 along the Gamagara River and Earlier Stone Age plus Iron Age material from around specularite pits on the hillside (Beaumont 2009 & 1990). These studies also mention pecked engravings on off – white Gamagara Shale located on the farms Sishen 543 and Bruce 544. In addition, another Acheul quarry of similar extent to the Kathu Towlands Site occurs on the crest of Kathu Hill close to the town of Kathu.

7 STATEMENT OF SIGNIFICANCE

7.1 Heritage resources management and conservation

Archaeological sites, as previously defined in the National Heritage Resources Act (Act 25 of 1999) are places in the landscape where people have lived in the past – generally more than 60 years ago – and have left traces of their presence behind. In South Africa, archaeological sites include hominid fossil sites, places where people of the Earlier, Middle and Later Stone Age lived in open sites, river gravels, rock shelters and caves, Iron Age sites, graves, and a variety of historical sites and structures in rural areas, towns and cities. Palaeontological sites are those with fossil remains of plants and animals where people were not involved in the accumulation of the deposits. The basic principle of cultural heritage conservation is that archaeological and other heritage sites are valuable, scarce and *non-renewable.* Many such sites are unfortunately lost on a daily basis through development for housing, roads and infrastructure and once archaeological sites are damaged, they cannot be re-created as site integrity and authenticity is permanently lost. Archaeological sites have the potential to contribute to our understanding of the history of the region and of our country and continent. By preserving links with our past, we may not be able to revive lost cultural traditions, but it enables us to appreciate the role they have played in the history of our country.

7.2 Categories of significance

Rating the significance of archaeological sites, and consequently grading the potential impact on the resources is linked to the significance of the site itself. The significance of an archaeological site is based on the amount of deposit, the integrity of the context, the kind of deposit and the potential to help answer present research questions. Historical structures are defined by Section 34 of the National Heritage Resources Act, 1999, while other historical and cultural significant sites, places and features, are generally determined by community preferences. The guidelines as provided by the NHRA (Act No. 25 of 1999) in Section 3, with special reference to subsection 3 are used when determining the cultural significance or other special value of archaeological or historical sites. In addition, ICOMOS (the Australian Committee of the International Council on Monuments and Sites) highlights four cultural attributes, which are valuable to any given culture:

- *Aesthetic value:*

Aesthetic value includes aspects of sensory perception for which criteria can and should be stated. Such criteria include consideration of the form, scale, colour, texture and material of the fabric, the general atmosphere associated with the place and its uses and also the aesthetic values commonly assessed in the analysis of landscapes and townscape.

- *Historic value:*

Historic value encompasses the history of aesthetics, science and society and therefore to a large extent

underlies all of the attributes discussed here. Usually a place has historical value because of some kind of influence by an event, person, phase or activity.

- *Scientific value:*

The scientific or research value of a place will depend upon the importance of the data involved, on its rarity, quality and on the degree to which the place may contribute further substantial information.

- *Social value:*

Social value includes the qualities for which a place has become a focus of spiritual, political, national or other cultural sentiment to a certain group.

It is important for heritage specialist input in the EIA process to take into account the heritage management structure set up by the NHR Act. It makes provision for a 3-tier system of management including the South Africa Heritage Resources Agency (SAHRA) at a national level, Provincial Heritage Resources Authorities (PHRAs) at a provincial and the local authority. The Act makes provision for two types or forms of protection of heritage resources; i.e. formally protected and generally protected sites:

Formally protected sites:

- Grade 1 or national heritage sites, which are managed by SAHRA
- Grade 2 or provincial heritage sites, which are managed by the provincial HRA.
- Grade 3 of local heritage sites.

Generally protected sites:

- Human burials older than 60 years.
- Archaeological and palaeontological sites.
- Shipwrecks and associated remains older than 70 years.
- Structures older than 60 years.

With reference to the evaluation of sites, the certainty of prediction is definite, unless stated otherwise and if the significance of the site is rated high, the significance of the impact will also result in a high rating. The same rule applies if the significance rating of the site is low. The significance of archaeological sites is generally ranked into the following categories.

Significance	Rating Action
No significance: sites that do not require mitigation.	None
Low significance: sites, which may require mitigation.	2a. Recording and documentation (Phase 1) of site; no further action required 2b. Controlled sampling (shovel test pits, augering), mapping and documentation (Phase 2 investigation); permit required for sampling and destruction
Medium significance: sites, which require mitigation.	3. Excavation of representative sample, C14 dating, mapping and documentation (Phase 2 investigation); permit required for sampling and destruction [including 2a & 2b]
High significance: sites, where disturbance should be avoided.	4a. Nomination for listing on Heritage Register (National, Provincial or Local) (Phase 2 & 3 investigation); site management plan; permit required if utilised for education or tourism
High significance: Graves and burial places	4b. Locate demonstrable descendants through social consulting; obtain permits from applicable legislation, ordinances and regional by-laws; exhumation and reinterment [including 2a, 2b & 3]

Furthermore, the significance of archaeological 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),
- Social value,
- Uniqueness, and
- Potential to answer current and future research questions.

A fundamental aspect in assessing the significance and protection status of a heritage resource is often whether or not the sustainable social and economic benefits of a proposed development outweigh the conservation issues at stake. When, for whatever reason the protection of a heritage site is not deemed necessary or practical, its research potential must be assessed and mitigated in order to gain data / information, which would otherwise be lost.

7.3 Potential Impacts and Significance Ratings[1]

The following section provides a background to the identification and assessment of possible impacts and alternatives, as well as a range of risk situations and scenarios commonly associated with heritage resources management. The section ultimately provides a guideline (Section 7.3.1, Section 7.3.2 & Section 7.3.3) for the rating of impacts and recommendation of management actions for sites of heritage potential in the Wayland Iron Ore Mine Project area, as supplied in section 7.3.4.

7.3.1 General assessment of impacts on resources

Generally, the value and significance of archaeological and other heritage sites might be impacted on by any activity that would result immediately or in the future in the destruction, damage, excavation, alteration, removal or collection from its original position, any archaeological material or object (as indicated in the National Heritage Resources Act (No 25 of 1999)). Thus, the destructive impacts that are possible in terms of heritage resources would tend to be direct, once-off events occurring during the initial construction period. However, in the long run, the proximity of operations in any given area could result in secondary indirect impacts. The EIA process therefore specifies impact assessment criteria which can be utilised from the perspective of a heritage specialist study which elucidates the overall extent of impacts.

Significance of the heritage resource
This is a statement of the nature and degree of significance of the heritage resource being affected by the activity. From a heritage management perspective it is useful to distinguish between whether the significance is embedded in the physical fabric or in associations with events or persons or in the experience of a place; i.e. its visual and non-visual qualities. This statement is a primary informant to the nature and degree of significance of an impact and thus needs to be thoroughly considered. Consideration needs to be given to the significance of a heritage resource at different scales (i.e. sitespecific, local, regional, national or international) and the relationship between the heritage resource, its setting and its associations.

Nature of the impact
This is an assessment of the nature of the impact of the activity on a heritage resource, with some indication of its positive and/or negative effect/s. It is strongly informed by the statement of resource significance. In other words, the nature of the impact may be historical, aesthetic, social, scientific, linguistic or architectural, intrinsic, associational or contextual (visual or non-visual). In many cases, the nature of the impact will include more than one value.

Extent
Here it should be indicated whether the impact will be experienced:
- On a site scale, i.e. extend only as far as the activity;

[1] Based on: Winter, S. & Baumann, N. 2005. *Guideline for involving heritage specialists in EIA processes: Edition 1.*

- Within the immediate context of a heritage resource;
- On a local scale, e.g. town or suburb
- On a metropolitan or regional scale; or
- On a national/international scale.

Duration

Here it should be indicated whether the lifespan of the impact will be:

- Short term, (needs to be defined in context)
- Medium term, (needs to be defined in context)
- Long term where the impact will persist indefinitely, possibly beyond the operational life of the activity, either because of natural processes or by human intervention; or
- Permanent where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Of relevance to the duration of an impact are the following considerations:

- Reversibility of the impact; and
- Renewability of the heritage resource.

Intensity

Here it should be established whether the impact should be indicated as:

- Low, where the impact affects the resource in such a way that its heritage value is not affected;
- Medium, where the affected resource is altered but its heritage value continues to exist albeit in a modified way; and
- High, where heritage value is altered to the extent that it will temporarily or permanently be damaged or destroyed.

Probability

This should describe the likelihood of the impact actually occurring indicated as:

- Improbable, where the possibility of the impact to materialize is very low either because of design or historic experience;
- Probable, where there is a distinct possibility that the impact will occur;
- Highly probable, where it is most likely that the impact will occur; or
- Definite, where the impact will definitely occur regardless of any mitigation measures

Confidence

This should relate to the level of confidence that the specialist has in establishing the nature and degree of impacts. It relates to the level and reliability of information, the nature and degree of consultation with I&AP's and the dynamic of the broader socio-political context.

- High, where the information is comprehensive and accurate, where there has been a high degree of consultation and the socio-political context is relatively stable.
- Medium, where the information is sufficient but is based mainly on secondary sources, where there has been a limited targeted consultation and socio-political context is fluid.
- Low, where the information is poor, a high degree of contestation is evident and there is a state of socio-political flux.

Impact Significance

The significance of impacts can be determined through a synthesis of the aspects produced in terms of the nature and degree of heritage significance and the nature, duration, intensity, extent, probability and confidence of impacts and can be described as:

- Low; where it would have a negligible effect on heritage and on the decision
- Medium, where it would have a moderate effect on heritage and should influence the decision.
- High, where it would have, or there would be a high risk of, a big effect on heritage. Impacts of high significance should have a major influence on the decision;
- Very high, where it would have, or there would be high risk of, an irreversible and possibly irreplaceable negative impact on heritage. Impacts of very high significance should be a central factor in decision-making.

7.3.2 Direct impact rating

Direct or primary effects on heritage resources occur at the same time and in the same space as the activity, e.g. loss of historical fabric through demolition work. **Indirect effects or secondary effects** on heritage resources occur later in time or at a different place from the causal activity, or as a result of a complex pathway, e.g. restriction of access to a heritage resource resulting in the gradual erosion of its significance, which is dependent on ritual patterns of access. The following table provides an outline as to the relationship between the significance of a heritage context, the intensity of development and the significance of heritage impacts to be expected.

	TYPE OF DEVELOPMENT			
HERITAGE CONTEXT	**CATEGORY A**	**CATEGORY B**	**CATEGORY C**	**CATEGORY D**
CONTEXT 1 High heritage Value	Moderate heritage impact expected			
CONTEXT 2 Medium to high heritage value	Minimal heritage impact expected	Moderate heritage impact expected		
CONTEXT 3 Medium to low heritage value	Little or no heritage impact expected	Minimal heritage impact expected	Moderate heritage impact expected	
CONTEXT 4 Low to no heritage value	Little or no heritage impact expected	Little or no heritage impact expected	Minimal heritage value expected	

NOTE: A DEFAULT "LITTLE OR NO HERITAGE IMPACT EXPECTED" VALUE APPLIES WHERE A HERITAGE RESOURCE OCCURS OUTSIDE THE IMPACT ZONE OF THE DEVELOPMENT.

HERITAGE CONTEXTS	CATEGORIES OF DEVELOPMENT
Context 1: Of high intrinsic, associational and contextual heritage value within a national, provincial and local context, i.e. formally declared or potential Grade 1, 2 or 3A heritage resources **Context 2:** Of moderate to high intrinsic, associational and contextual value within a local context, i.e. potential Grade 3B heritage resources. **Context 3:** Of medium to low intrinsic, associational or contextual heritage value within a national, provincial and local context, i.e. potential Grade 3C heritage resources **Context 4:** Of little or no intrinsic, associational or contextual heritage value due to disturbed, degraded conditions or extent of irreversible damage.	**Category A: Minimal intensity development** - No rezoning involved; within existing use rights. - No subdivision involved. - Upgrading of existing infrastructure within existing envelopes - Minor internal changes to existing structures - New building footprints limited to less than 1000m2. **Category B: Low-key intensity development** - Spot rezoning with no change to overall zoning of a site. - Linear development less than 100m - Building footprints between 1000m2-2000m2 - Minor changes to external envelop of existing structures (less than 25%) - Minor changes in relation to bulk and height of immediately adjacent structures (less than 25%). **Category C: Moderate intensity development** - Rezoning of a site between 5000m2-10 000m2. - Linear development between 100m and 300m. - Building footprints between 2000m2 and 5000m2 - Substantial changes to external envelop of existing structures (more than 50%) - Substantial increase in bulk and height in relation to immediately adjacent buildings (more than 50%) **Category D: High intensity development** - Rezoning of a site in excess of 10 000m2 - Linear development in excess of 300m. - Any development changing the character of a site exceeding 5000m2 or involving the subdivision of a site into three or more erven. - Substantial increase in bulk and height in relation to immediately adjacent buildings (more than 100%)

7.3.3 Management actions

Recommendations on relevant heritage resources management actions are vital to the conservation of heritage resources. Recommended management actions may include the following:

No further action / Monitoring

Where no heritage resources have been documented, heritage resources occur well outside the impact zone of any development or the primary context of the surroundings at a development footprint has been largely destroyed or altered, no further immediate action is required. Site monitoring during development, by an ECO or the heritage specialist are often added to this recommendation in order to ensure that no undetected heritage\ remains are destroyed.

Avoidance

This is appropriate where any type of development occurs within a formally protected or significant or sensitive heritage context and is likely to have a high negative impact. Mitigation is not acceptable or not possible.

Mitigation

This is appropriate where development occurs in a context of heritage significance and where the impact is such that it can be mitigated to a degree of medium to low significance, e.g. the high to medium impact of a development on an archaeological site could be mitigated through sampling/excavation of the remains. Not all negative impacts can be mitigated.

Compensation

Compensation is generally not an appropriate heritage management action. The main function of management actions should be to conserve the resource for the benefit of future generations. Once lost it cannot be renewed. The circumstances around the potential public or heritage benefits would need to be exceptional to warrant this type of action, especially in the case of where the impact was high.

Rehabilitation

Rehabilitation is considered in heritage management terms as a intervention typically involving the adding of a new heritage layer to enable a new sustainable use. It is not appropriate when the process necessitates the removal of previous historical layers, i.e. restoration of a building or place to the previous state/period. It is an appropriate heritage management action in the following cases:

- The heritage resource is degraded or in the process of degradation and would benefit from rehabilitation.
- Where rehabilitation implies appropriate conservation interventions, i.e. adaptive reuse, repair and maintenance, consolidation and minimal loss of historical fabric.
- Where the rehabilitation process will not result in a negative impact on the intrinsic value of the resource.

Enhancement

Enhancement is appropriate where the overall heritage significance and its public appreciation value are improved. It does not imply creation of a condition that might never have occurred during the evolution of a place, e.g. the tendency to sanitize the past. This management action might result from the removal of previous layers where these layers are culturally of low significance and detract from the significance of the resource. It would be appropriate in a range of heritage contexts and applicable to a range of resources. In the case of formally protected or significant resources, appropriate enhancement action should be encouraged. Care should, however, be taken to ensure that the process does not have a negative impact on the character and context of the resource. It would thus have to be carefully monitored.

7.3.4 Site significance and impact rating

Refer to Section 7.3.1, Section 7.3.2 & Section 7.3.3 for background on the rating of impacts and recommendation of management actions for sites of heritage potential. Impact thresholds and management measures for the sites are further discussed in section 7.3.5.

- **Earlier and Middle Stone Age Site (Site SA02)**

1. SITE DESCRIPTION : Earlier and Middle Stone Age lithic scatter.

1.1 General Site Description

Earlier and Middle Stone Age Site.

1.2 Site features / artefacts / Other

Site Location					
Province / Dsitrict	Northern Cape Province		Map Number	2722DD	
Farm Name	Fritz 540		Co-ordinates	S27°43'13.7"	S27°43'13.7"
Site Type					
Surface sites	X		Caves and rock shelters		
Larger open-air sites	X		Sealed sites (deposits		
River deposits			Other		
Site Function					
Living / habitation			Kill		
Ceremonial			Burial		
Trading / Barter			Art		
Quarry / Mining / Smelting			Other	X –scatter	
Site Placement					
Valley floor		Hill top		Vlei/swamp		River Mouth	

Dam		River Bank		Slope		Plains	X
Other / Comments							
Vegetation							
Riverine forest		Bushveld		Savannah		Mountain forest	
Thornveld	X	Grassland	X	Cultivated		Other	
Age Classification							
Stone Age	X	Early Iron Age		Middle Iron Age		Later Iron Age	
Historical		Other					
Material Culture							
Midden		House Remains		Stone Walling		Stone Structures	
Granary		Grinding Stone (L)		Grinding Stone (U)		Granary Stand	
Metal		Ceramics (Pottery)		Ceramics (Porcelain)		Stone (non-lithic)	
Metal slag		Tuyere		Fauna		Bead (Glass)	
Bead (OES / Shell)		Glass		Lithics	X	Smelting Residues	
Other: **X - terracing**				Other:			

1.3 Site Condition

The site integrity has compromised due to the mixing of surface deposits and displacement of artefacts.

2. SITE EVALUATION

2.1 HERITAGE VALUE (NHRA, Section 2 [3])	High	Medium	Low
It has importance to the community or pattern of South Africa's history or pre-colonial history.		X	
It possesses unique, uncommon, rare or endangered aspects of South Africa's natural or cultural heritage.		X	
It has potential to yield information that will contribute to an understanding of South Africa's natural and cultural heritage.		X	
It is of importance in demonstrating the principle characteristics of a particular class of South Africa's natural or cultural places or objects.		X	
It has importance in exhibiting particular aesthetic characteristics valued by a particular community or cultural group.			X
It has importance in demonstrating a high degree of creative or technical achievement at a particular period.		X	
It has marked or special association with a particular community or cultural group for social, cultural or spiritual reasons (sense of place).			X
It has strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.			X
It has significance through contributing towards the promotion of a local sociocultural identity and can be developed as a tourist destination.			X
It has significance relating to the history of slavery in South Africa.			X
It has importance to the wider understanding of temporal changes within cultural landscapes, settlement patterns and human occupation.		X	

FIELD REGISTER RATING	
National/Grade 1 [should be registered, retained]	
Provincial/Grade 2 [should be registered, retained]	
Local/Grade 3A [should be registered, mitigation not advised]	
Local/Grade 3B [High significance; mitigation, partly retained]	
Generally Protected A [High/Medium significance, mitigation]	
Generally protected B [Medium significance, to be recorded]	X
Generally Protected C [Low significance, no further action]	

C. SPHERE OF SIGNIFICANCE	High	Medium	Low

International			
National			
Provincial			
Local		X	
Specific community			

E. GENERAL STATEMENT OF SITE SIGNIFICANCE

Low	
Medium	X
High	

F. RATING OF POTENTIAL IMPACT OF DEVELOPMENT

NATURE OF IMPACT: HISTORICAL & SCIENTIFIC

APPROXIMATE DISTANCE FROM DEVELOPMENT: 0 - 30METERS

		Without Management*	**With Management***
General assessment of impacts on resource (Refer to Section 7.3.1)	Extent	**Local**	**Local**
	Duration	**Sort Term: Medium**	**Sort Term: Low**
	Intensity	**Medium**	**Low**
	Probability	**Probable**	**Improbable**
	Confidence	**High**	**High**
	Impact Significance	**Medium**	**Low**

Direct impact on resource	None (the potential development does not adversely or positively affect the heritage resource)	
	Peripheral / Indirect (the heritage resource or its setting is located in proximity to the footprint of the potential development)	
	Destruction / Direct (the heritage resource or site is physically located within the footprint of the potential development)	X

Direct impact rating (Refer to Section 7.3.2) Note that a default "Little or no heritage impact expected" value applies where a heritage resource occurs outside the impact matrix of the development.	**High heritage impact**

G. RECOMMENDED MANAGEMENT* (REFER TO SECTION 7.3.3)

Mitigation

If further impact is envisaged:

- **Documentation of sites.**
- **Further desktop study to more accurately ascertain context of sites.**
- **Limited Phase 2 site sampling.**
- **Relevant Permitting from Heritage Resources Authority.**

H. APPLICABLE LEGISLATION AND LEGAL REQUIREMENTS

- **National Heritage Resources Act (Act no. 25 of 1999)**

7.4 Evaluation of Results

Previous studies conducted in the larger Sishen area, coupled with finds noted in this report suggest a rich and diverse archaeological landscape (e.g. Kathu Pan and Stone Age occurrences along the Gamagara River) and cognisance should be taken of archaeological material that might be present in surface and sub-surface deposits along drainage lines and at water pans.

The following significance rating applies to Stone Age material located in the Sishen Western Waste Dumps project area:

- Stone Age material dating to the **Middle Stone Age** occurs at three locations the study area. One of these sites is situated outside the design alternative for the waste rock dumps. The lithic scatters occur in low densities in single horizons within calcrete formations. They are not unique as an abundance of related Stone Age sites occur in the surrounding landscape and on the banks of Gamagara River. These occurrences are therefore of low significance. The impact on the sites by the proposed activity will be

local, and of permanent duration where in essence, the impact will result the possible confusing of the archaeological context and potential loss of archaeological structures and material. However, the threshold of the impact is not regarded as high considering the low significance of the sites.

- Larger amounts of **Earlier and Middle Stone Age** artefacts including handaxes, cores and flakes are present near a man-made dam in the area. The site and its cultural context might be of notable research value and these occurrences are therefore of medium significance. The impact on the site by the proposed activity will be local, and of permanent duration where in essence, the impact will result the possible confusing of the archaeological context and potential loss of archaeological structures and material. The site will be also sterilized of any future heritage research opportunities. However, the threshold of the impact can be limited by the implementation of mitigation measures for the site.

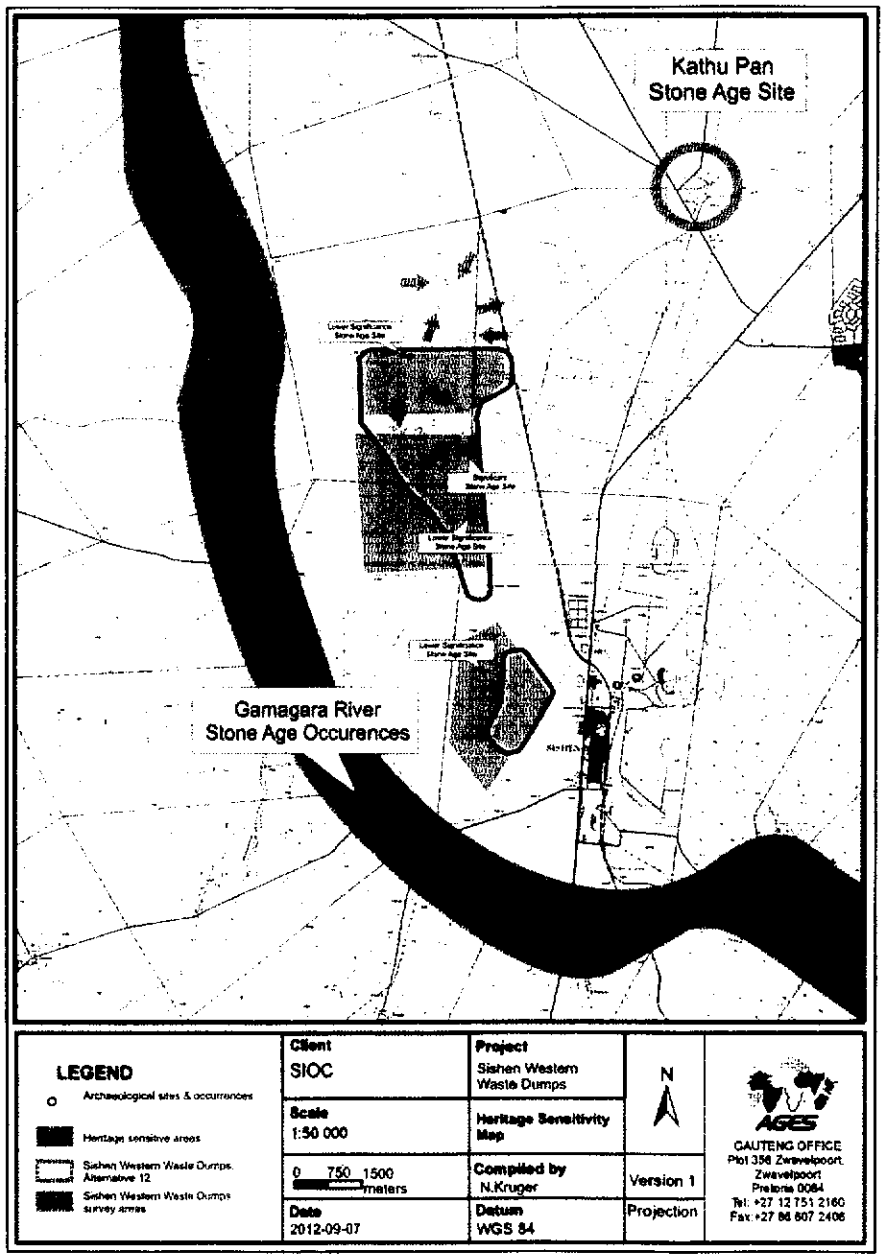

Figure 7-1: Heritage sensitivity map of the Sishen Western Waste Dumps Project Area and surroundings. The arrows indicate the positions on natural pans and associated possible Stone Age occurrences.

8 RECOMMENDATIONS

Low densities of MSA material occur around pans and other water sources in the study area. Such MSA scatters are not unique to the area and they occur widely across in the landscape. Higher MSA occurrences, as well as the presence of ESA hand axes and cleavers are more significant and have scientific potential. Therefore, the author of this report proposes the following recommendations, based on findings contained in this Phase 1 AIA Report:

- Cognisance should be taken of the larger natural and archaeological horizon and the representation and position of the Sishen / Kathu area in the landscape's heritage. As such, care should be taken when disturbing any water sources or pans as Stone Age sites generally occur in the proximately these resources in the area
- The Middle Stone Age surface scatters observed at three sites around pans in the area is probably of limited scientific value and no significant impact on these resources is foreseen. Therefore no further actions are recommended.
- The ESA and higher density MSA scatters on the farm Fritz are of scientific value and a limited Phase 2 Specialist Study is recommended. Such a study should include the systematic documentation of surface material by a qualified Stone Age specialist in order to record the lithic occurrence prior to the possible alteration of the site.
- A careful watching brief monitoring process is recommended for any future developments at the site. Should any subsurface paleontological / archaeological material be exposed during construction activities, all activities should be suspended and the archaeological specialist should be notified immediately
- It should be noted that mitigation measures are valid for the duration of the development process, and mitigation measures might have to be implemented on additional features of heritage importance not detected during this Phase 1 assessment (e.g. uncovered during the construction process).

9 GENERAL COMMENTS AND CONDITIONS

This Phase 1 AIA report serves to confirm the extent and significance of archaeological material in study areas in the Sishen Western Waste Dumps project area. Apart from heritage remains in the study area , the Kathu and larger Sishen Area encompasses a rich and diverse archaeological landscape and cognisance should be taken of archaeological material that might be present in surface and sub-surface deposits.

Such material might include:

- Formal Earlier Stone Age stone tools such as handaxes, choppers and cleavers.
- Formal Middle Stone Age stone tools such as points, blades and scrapers.
- Formal Later Stone Age stone tools such a microlithic blades, points and scrapers.
- Lithic residues and debris such as stone cores and flakes.
- Decorated and undecorated potsherds.
- Iron objects.
- Beads made from ostrich eggshell and glass.
- Ash middens and cattle dung deposits and accumulations.
- Animal bones and faunal remains.
- Human remains/graves.
- Stone walling or any sub-surface structures.

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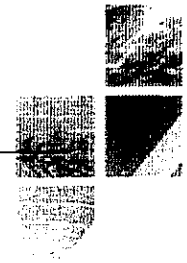

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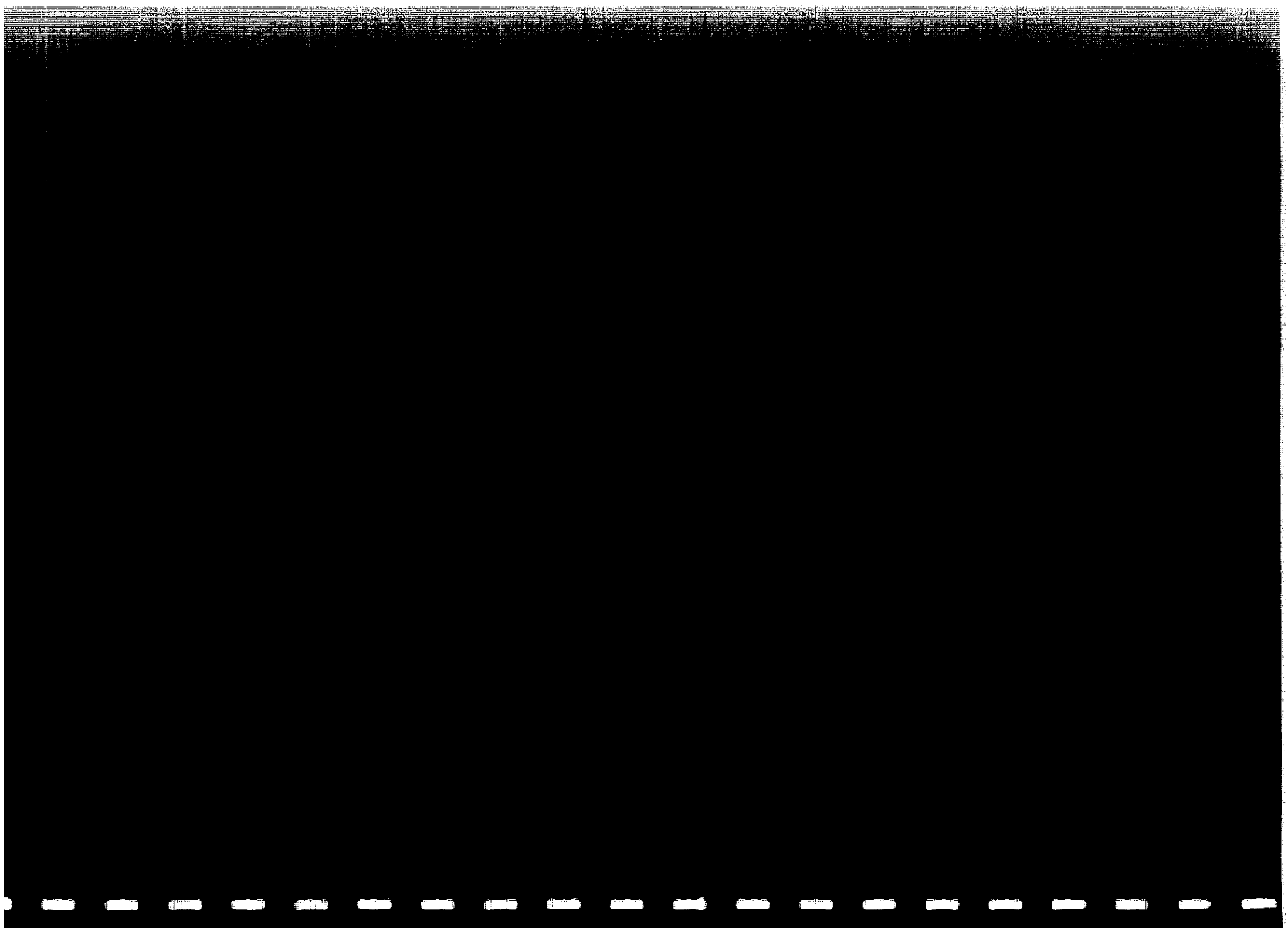


AngloAmerican

IRON ORE
KUMBA IRON ORE LTD
Sishen Iron Ore Company

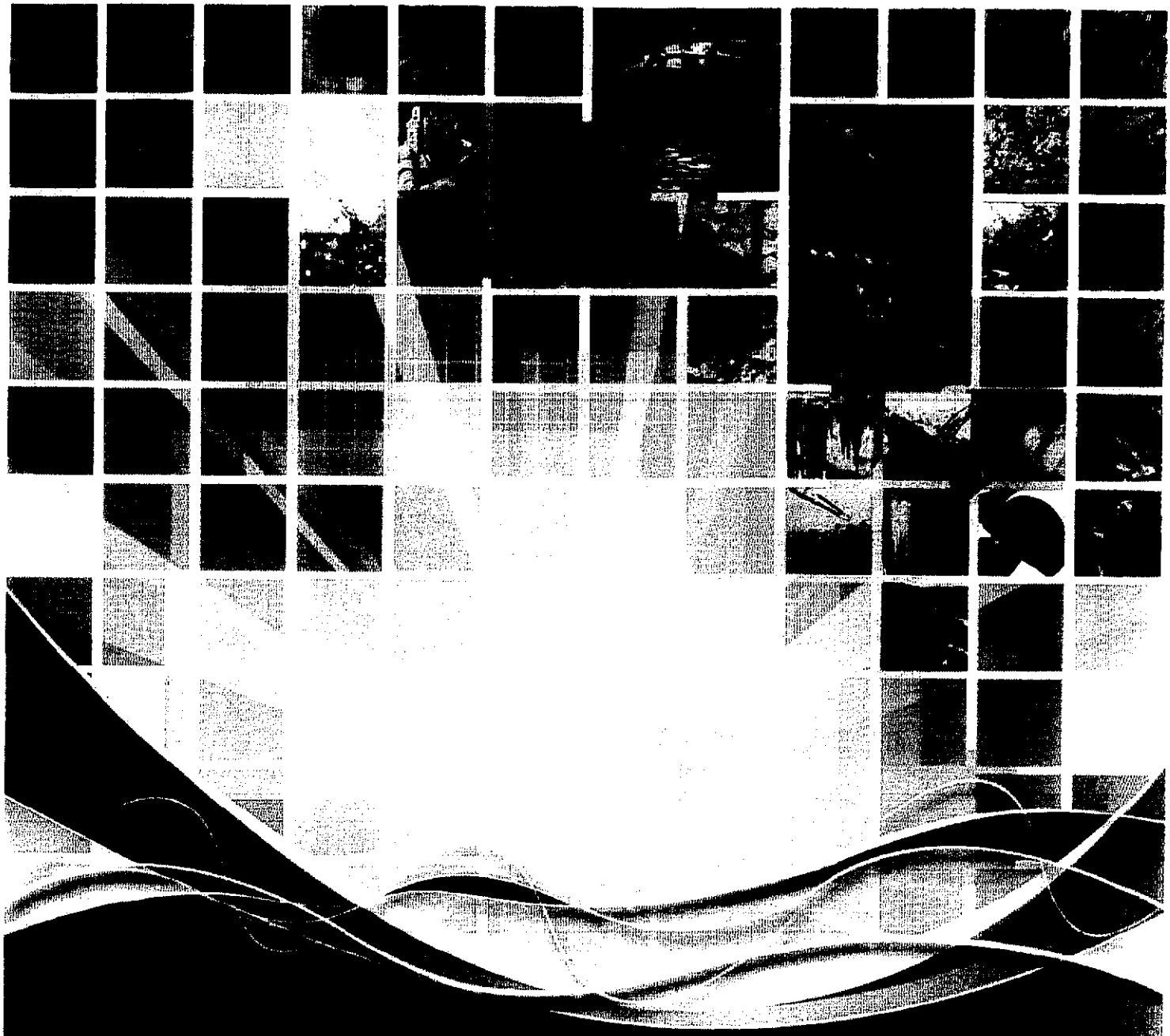
Sishen Iron Ore Company (Pty) Ltd

APPENDIX 5

ECOLOGICAL ASSESSMENT RELEVANT TO THIS PROJECT

SISHEN MINE EXPANSION

NC 30/5/1/1/4/1116 PR



FINAL ECOLOGICAL REPORT

AN ENVIRONMENTAL REPORT ON THE ECOLOGY (FLORA AND FAUNA) FOR THE PROPOSED DEVELOPMENT OF THE SISHEN WESTERN WASTE DUMPS AND ASSOCIATED INFRASTRUCTURE, NORTHERN CAPE PROVINCE

JULY 2012

Prepared for: SISHEN IRON ORE COMPANY (SIOC)
Document version 2.0 – FINAL
Compiled by Dr.B.J.Henning

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JULY 2012

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1 ASSIGNMENT

AGES Limpopo was commissioned by AGES Gauteng to conduct an ecological study on behalf of Sishen Iron Ore Company (SIOC). Sishen Iron Ore Mine (SIOM) has updated its medium to long term mining schedule and this requires the establishment of new waste rock dumps on the western side of the area covered by the mining right as granted to the SIOC for its operations at Sishen. The existing waste rock dump facilities do not have the capacity to cater in the long run for the mine's planned operational activities and therefore a need was identified to develop new waste rock dumps and the associated infrastructure on the farms Gamagara 541, Onverwacht 540 / Fritz 540 Portion 1 and Nooitgedacht 469 / Woon 469. Four alternative options for the Waste Rock Dumps (WRD's) were investigated.

This report will consist of an assessment of the fauna, flora and ecological sensitivity for the proposed development of the Sishen Western Waste Dumps (SWWD) and the associated infrastructure on the abovementioned farm portions in the Northern Cape Province.

The assignment is interpreted as follows: Compile an ecological study on the flora (vegetation units), fauna and general ecology of the site according to guidelines and criteria set by the Northern Cape Department of Environmental Affairs and Nature Conservation (DENC). The study will include site surveys, detailed investigation, impact assessment and risk analyses. **In order to compile this, the following had to be done:**

1.1 Information sources

The following information sources were obtained:

1. All relevant maps through GIS mapping, and information (previous studies and environmental databases) on the natural environment of the area concerned.
2. Requirements regarding the fauna and flora survey as requested by the Northern Cape DENC.
3. Red data species list from the South African National Biodiversity Institute (SANBI).

1.2 Regulations governing this report

This report has been prepared in terms of Regulation 32 of the National Environmental Management Act (No. 107 of 1998) Regulations GN 33306 GNR 543 for environmental impact assessment. Regulation 33 states that a specialist report must contain:

1. An application or the EAP managing an application may appoint a person to carry out a specialist study or specialized process.
2. The person referred to in sub-regulation 1 must comply with the requirements of regulation 17 (General requirements for EAPs or a person compiling a specialist report or undertaking a specialized process).
3. A specialist report or a report on a specialized process prepared in terms of these regulations must contain:
    a. Details of
        i. The person who prepared the report; and Letter of Appointment
        ii. The expertise of that person to carry out the specialist study or specialized process.
    b. A declaration that the person is independent in a form as may be specified by the competent authority;
    c. An indication of the scope of, and purpose for which, the report was prepared;
    d. A description of the methodology adopted in preparing the report or carrying out the specialized process;
    e. A description of any assumptions made and any uncertainties or gaps in knowledge;
    f. A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
    g. Recommendations in respect of any mitigation measures that should be considered by the applicant and competent authority;
    h. A description of any consultation process that was undertaken during the course of carrying out the study;
    i. A summary and copies of any comments that were received during any consultation process;
    j. Any other information requested by the competent authority.

1.3 Terms of reference

The project is done according to the following:

1.3.1 Objectives

1. The primary aim of this project is to investigate options for enhancing and / or maintaining biodiversity to mitigate the impact of the proposed SWWD development and related infrastructure with the overall objective of preventing further loss of biodiversity. The end product would be a tool for promoting and lobbying for the recognition of the importance of species habitat and habitat conservation. Options available to maintain the current level of floral diversity include:
    a. Protection of native vegetation restored elsewhere in return for unavoidable clearing;
    b. Minimisation of habitat fragmentation;
    c. Minimisation of any threats to the native flora and fauna and their habitats during the construction and operational phases of the developments and;
    d. Rehabilitation to establish plant communities / landscaping that will provide future habitat values.
2. To produce a clear and agreed species and habitat priorities for conservation actions. This includes the following:
    i. Determine the potential ecological impacts and actions the developments will have on the biodiversity on a species and habitat level;
    ii. Conduct a risk analyses of the impacts identified to determine the significance of the impacts on the fauna and flora of the study area;
    iii. Protection and enhancement of vegetation / habitats of high conservation value;
    iv. The retention of a substantial amount of native vegetation / habitat of adequate size and configuration to promote the conservation of the existing flora communities;

v. The retention and / or creation of vegetation links, wildlife corridors and vegetation buffers wherever possible, subject to the appropriate bush fire risk management; and

vi. The protection of water quality in the locality so as not to threaten native aquatic flora that rely on the watercourse for survival.

3. Provide recommendations on the ecological mitigation measures to be implemented by SIOC and the way forward.

1.3.2 Scope

1. Detailed flora survey – in each vegetation type/plant community on site:
    a. After studying the aerial photograph identify specific areas to be surveyed and confirm location by making use of a Geographical Positioning System (GPS).
    b. Conduct a site visit and list the plant species (trees, shrubs, grasses, succulents and other herbaceous species of special interest) present for plant community and ecosystem delimitation.
    c. Identify potential red data plant species, possible encroacher species, medicinal plants of value and exotic plant species.
    d. Indicate suitable plant species that can be used for the landscaping around the proposed developments.

2. Plant community delimitation and description
    a. Process data (vegetation and habitat classification) to determine vegetation types on an ecological basis.
    b. Describe the habitat and vegetation.

3. Fauna scoping
    a. List the potential fauna (mammal species, red data birds, reptiles, amphibians, invertebrates) present linked to the specific potential habitats that occur as identified in the vegetation survey.
    b. Analyse the data and identify potential red data fauna species, as well as other endemic or protected species of importance.

c. Indicate species mitigation measures and management measures to be implemented to prevent any negative impacts on the fauna of the area.

4. General

a. Identify and describe ecologically sensitive areas. Create a sensitivity map to indicate specific sensitive areas based on various environmental parameters such as natural vegetation in a good condition, rockiness, slopes, floodlines etc.

b. Identify problem areas in need of special treatment or management, e.g. bush encroachment, erosion, degraded areas, reclamation areas.

c. Make recommendations, impact ratings and risk assessments for each specific impact.

2 INTRODUCTION

South Africa has one of the world's greatest diversity of plant and animal species contained within one country, and is home to many species found nowhere else in the world. Terrestrial resources are rapidly disappearing however, due to conversion of natural habitat to farmland, forestry, human settlement, and industrial development. Some species are under threat from over-collection for medicinal, ornamental, and horticultural purposes.

Today it is widely recognised that it is of utmost importance to conserve natural resources in order to maintain ecological processes and life support systems for plants, animals and humans. Recent policies, international conventions, and community-based initiatives being carried out are aimed at improved conservation and more sustainable use of natural resources in future. To ensure that sustainable development takes place, it is therefore important that the environment is considered before local authorities approve any development.

Biodiversity and mines need to co-exist and find common ground. Biodiversity issues are very real and present a real crisis due to increased consumption and populations. It has also become evident that the biosphere cannot tolerate the current mode of economic growth. Massive change in behaviour is required in all sectors to achieve sustainable development. Mainstreaming biodiversity involves integrating the values and goals of biodiversity conservation into the economy (Cowling, 2005). The aim of mines today is to be good stewards of the environment and strive to leave the communities in which they work better than they found them (Godsell, 2005). Mines have huge conservation potential, as they own large amounts of land and only utilize a small portion for mining operations. It is therefore at the local level that mining and conservation can get integrated (Godsell, 2005). It is important to build into the mining decision framework the understanding that not all biodiversity can be restored, and this should influence mining decision-making. An ecosystem approach should be followed for planning and conservation and it should include a holistic biodiversity and livelihoods assessment (Coombes, 2005).

All components of any of the ecosystems (physical environment, vegetation, animals) of a site are interrelated and interdependent. A holistic approach is therefore imperative to effectively include any proposed development, utilisation and where

necessary conservation of the given natural resources in an integrated development plan, which will address all the needs of the modern human population (Bredenkamp & Brown 2001). Ideally the area should be developed so that the quality of the resources does not decrease, as this would inevitably lead to ecosystem degradation and lower productivity. It is therefore necessary to make a thorough inventory of the plant communities at the site of the proposed development, their biota and their associated habitats (=ecosystems), in order to evaluate its potential for development, or conservation. This inventory should then serve as a scientific and ecological basis for the planning exercises.

3 STUDY AREA

3.1 Location and description of activity

The project area is located in the Northern Cape Province, ~230 km northeast of the town of Upington and 280 km northwest of the town of Kimberley and 7.5 km from the town of Kathu. The proposed development site of the new SWWD is located to the western side of the area covered by the mining right as granted to the SIOC for its operations at Sishen. Four options for the waste dumps and the associated infrastructure will be investigated on the farms Gamagara 541, Onverwacht 540 / Fritz 540 Portion 1 and Nooitgedacht 469 / Woon 469. Infrastructural elements will include the following:

- New waste rock dumps
- Topsoil stockpiles
- Haul roads

The three options for the WRDs are as follows:

- Alternative 1 (Base Case): Three Waste Rock Dumps (WRDs) are being planned and according to their locations will be referred to as the Northern, Central and Southern WRDs in this report (Figure 1).
- Alternative 2 (narrower / higher): This alternative is proposed to comprise of higher G80 benches up to 160 m (8 benches), with the footprint as indicated

in the attached figure 1 (a narrower footprint than the base case), with a maximum height of 200 m applied throughout (Figure 1)

- Alternative 3 (wider / lower): The third alternative is proposed to comprise of higher G80 benches up to 160 m and the footprint as indicated in figure 1 (a wider footprint), with a maximum height of 180 m (but varies from 120m to 180m)
- Alternative 11 is a modified design of the western dumps displaying a similar footprint shape to the design of Alternative 2. However, the footprint of both the dumps is further restricted on the western side to maximize the conservation area for the Camel Thorn trees. This alternative consists of two dumps with the northern dump approximately 180m above ground level (9 benches) and the southern dump approximately 160m high (8 benches). In addition to the two dumps, there will be higher benches on the existing G80 waste rock dump up to 160 m (8 benches) with the addition of backfill design for the mined out GR35 pit.

The aerial image of the study area and the four options is indicated in figure 2.

Figure 1.Proposed layout map of the proposed SWWD alternatives

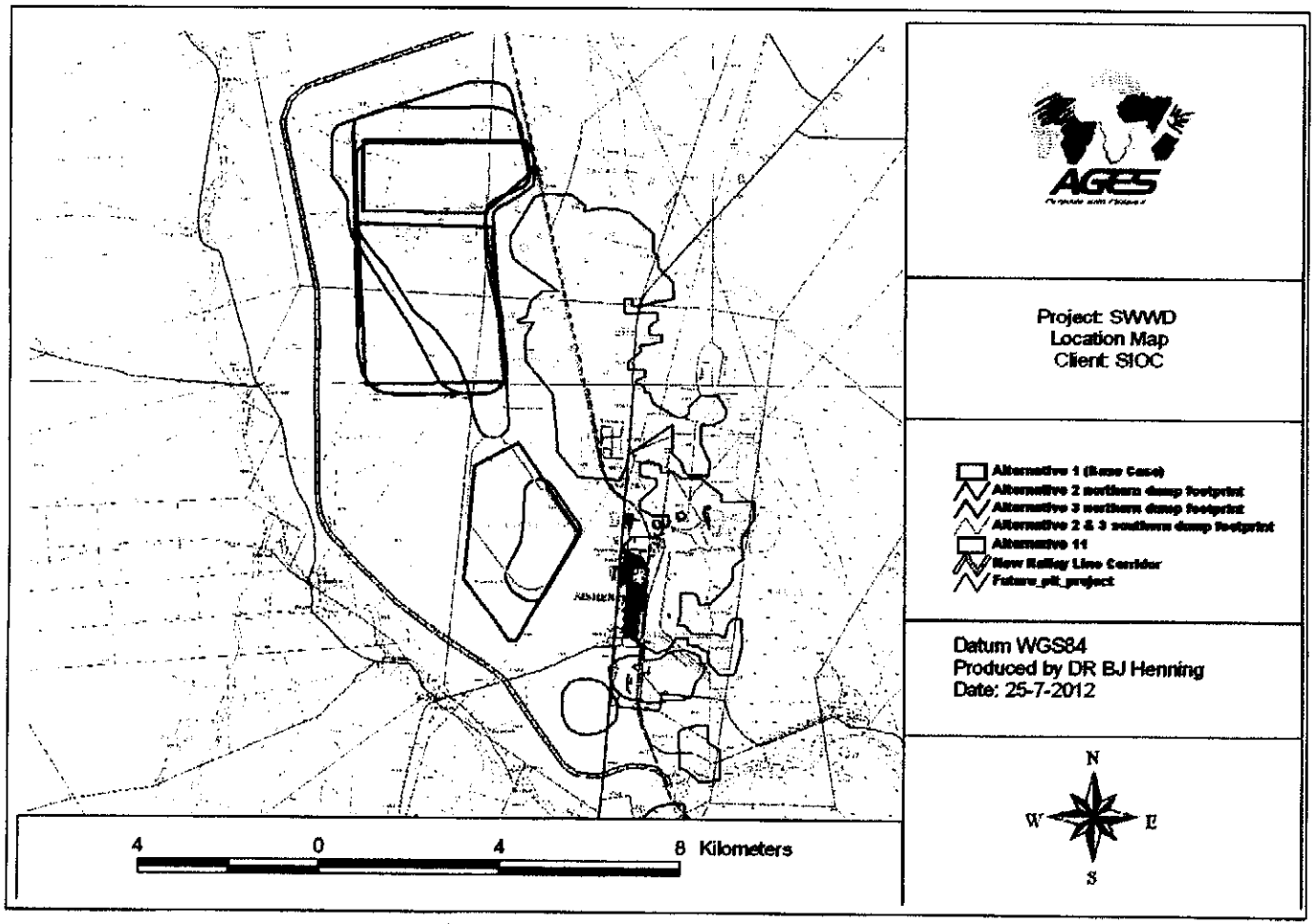
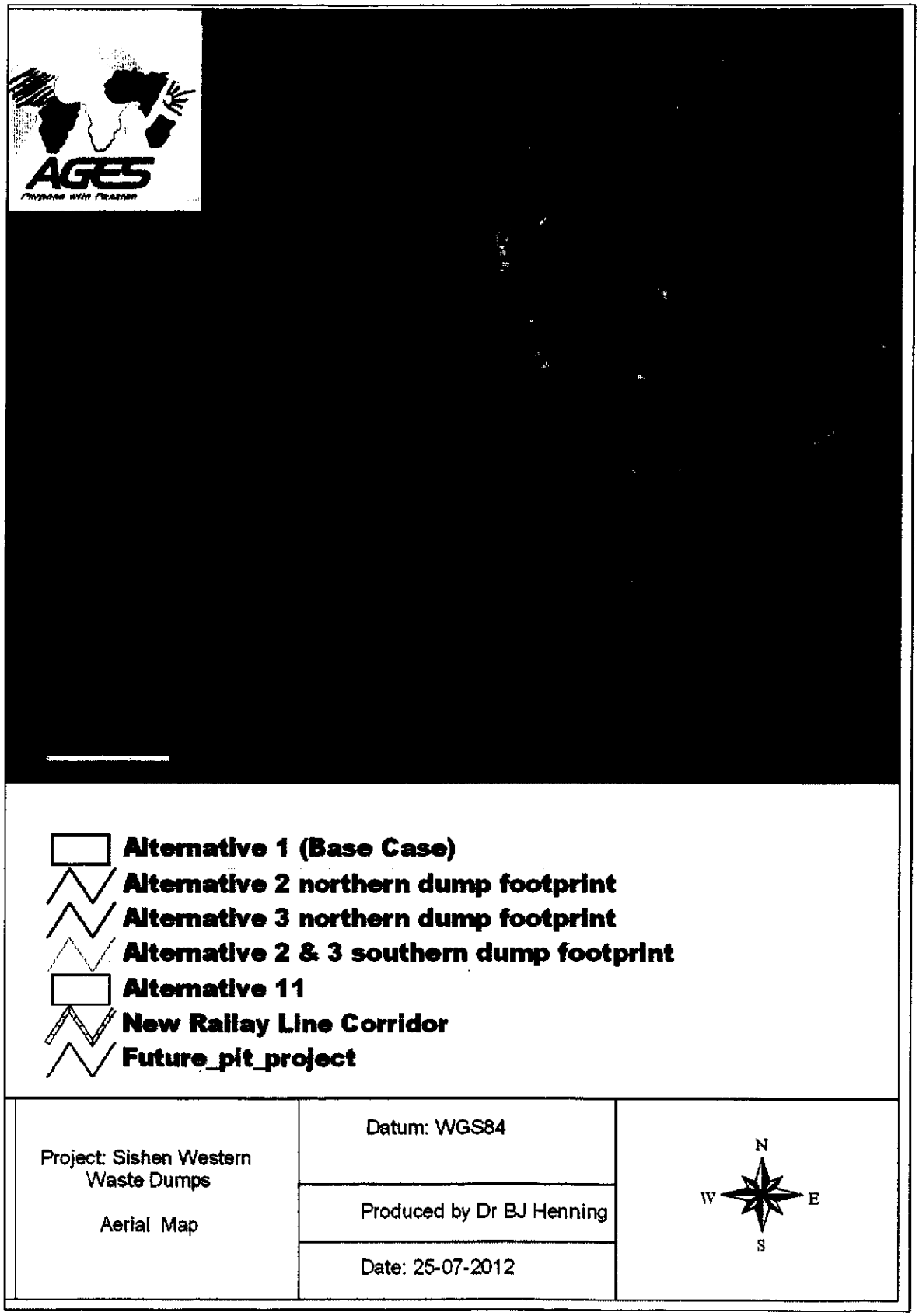


Figure 2.Aerial Image of the study area indicating the proposed WRD alternatives



3.2 Climate

Climate in the broad sense is a major determinant of the geographical distribution of species and vegetation types. However, on a smaller scale, the microclimate, which is greatly influenced by local topography, is also important. Within areas, the local conditions of temperature, light, humidity and moisture vary greatly and it is these factors which play an important role in the production and survival of plants (Tainton, 1981). In terrestrial environments, limitations related to water availability are always important to plants and plant communities. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). Furthermore, aspects like topography, slope and altitude may further result in differences in precipitation and water availability to plants within the study area. The site receives summer and autumn rainfall with very dry winters and frost that occurs fairly frequent in winter. Mean annual precipitation for the study area ranges from about 220-380mm. This rain usually falls as a result of thunderstorms when tropical thunderstorm activity extends southwards over the Kalahari.

The mean monthly maximum and minimum temperatures for the Sishen area is 37.0°C and -2.2°C for December and July respectively.

3.3 Vegetation types

The development site lies within the Eastern Kalahari Bushveld Bioregion of the Savanna biome which is the largest biome in Southern Africa. A biome is a broad ecological unit that represents a major life zone extending over a large natural area, and reflects the major features of climate (Rutherford & Westfall 1994).The Savanna Biome is characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). The environmental factors delimiting the biome are complex and include altitude, rainfall, geology and soil types, with rainfall being the major delimiting factor. Fire and grazing also keep the grassy layer dominant.

Acocks (1988) classified the vegetation around Sishen as subdivisions of the Vryburg Shrub Bushveld (VT 16b (1&2), Acocks 1988). Recent revisions of the vegetation types of South Africa describe the vegetation around Sishen as Kalahari Plains Thorn Bushveld (VT30, van Rooyen & Bredenkamp 1996) with Kalahari Plateau Bushveld (VT33, van Rooyen & Bredenkamp 1996) to the east of the Sishen farms.

The most recent classification of the area by Mucina & Rutherford (2006) is the Kathu Bushveld vegetation type.

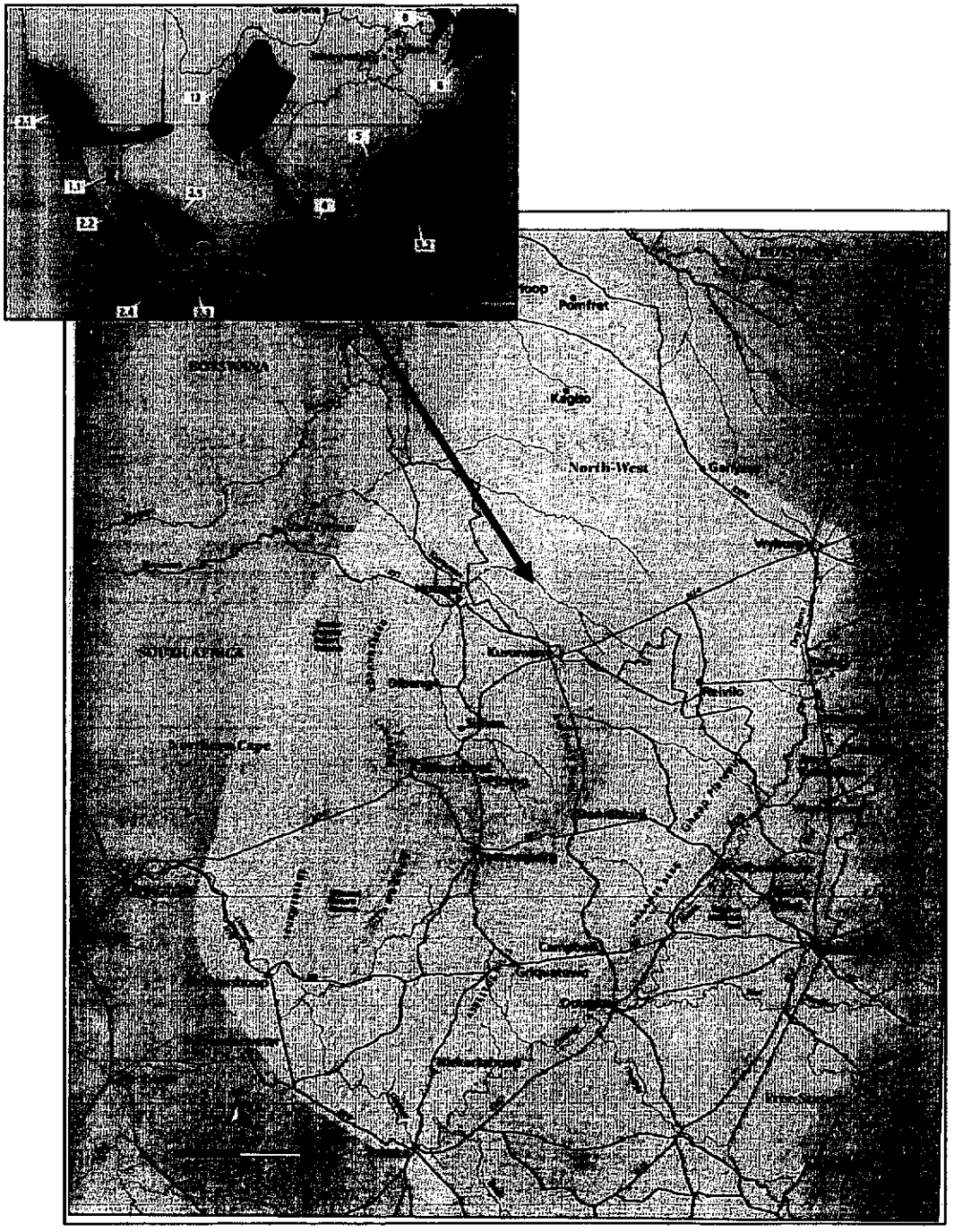
3.3.1 Regional context: The Griqualand West Centre of Endemism

The vegetation around Sishen and Kathu falls into the Griqualand West Centre of Endemism (Van Wyk & Smith 2001). A centre of plant endemism is an area with high concentrations of plant species with very restricted distributions. Centres of endemism are important because it is these areas, which if conserved, would safeguard the greatest number of plant species. They are extremely vulnerable; relatively small disturbances in a centre of endemism may easily pose a serious threat to its many range-restricted species (Van Wyk & Smith 2001). The Griqualand West Centre (GWC) is one of the 84 African centres of endemism and one of 14 centres in southern Africa, and these centres are of global conservation significance. The endemic and near-endemic species make up 2.2% of the total flora, and are mostly from the Asclepiadaceae, Euphorbiaceae and Mesembryanthemaceae families. Some of the endemics are edaphic specialists, adapted to lime-rich substrates.

Endemics and near-endemics include *Searsia tridactyla, Aloinopsis orpenii, Euphorbia planiceps, Euphorbia bergii, Lebeckia macrantha, Lithops aucampiae* subsp. *aucampiae* and *Tarchonanthus obovatus*.

The GWC of endemism is extremely poorly conserved, and is a national conservation priority. Figure 3 shows the extent of the GWC.

Figure 3. Map showing the extent of the Griqualand West Centre of Endemism (light centre). It is centred on the surface outcrops of the Ghaap Group (limestone and dolomite) and those of the Olifantshoek Supergroup (quartzite). From Van Wyk & Smith (2001).



3.3.2 Local Context

a. Kalahari Plains Thorn Bushveld

According to van Rooyen & Bredenkamp (1996), the vegetation of the Sishen farms falls within this vegetation type. The Kalahari Plains Thorn Bushveld is found on undulating to flat sandy plains with deep sandy to loamy aeolian sands, underlain by calcrete. It is characterized by a fairly well-developed tree stratum with Camel Thorn *Acacia erioloba* and Shepherd's Tree *Boscia albitrunca* as the dominant trees, along with scattered individuals of Belly Thorn *Acacia luederitzii* and Silver Clusterleaf *Terminalia sericea,* which may be locally conspicuous (van Rooyen & Bredenkamp 1996). The shrub layer is moderately developed and individuals of Black Thorn *Acacia mellifera,* Candle Thorn *A. hebeclada,* Karee-thorn *Lycium hirsutum, Grewia flava and Acacia haematoxylon* dominate this layer. Grasses such as Lehmann's Lovegrass *Eragrostis lehmanniana,* Sour Bushmangrass *Schmidtia kalihariensis* and Silky Bushman grass *Stipagrostis uniplumis* are conspicuous. Grazing by livestock influences the structure of this vegetation type. This vegetation type is very poorly conserved (van Rooyen & Bredenkamp 1996).

b. Kalahari Plateau Bushveld

This vegetation type covers most of the Ghaap Plateau to the east of Sishen, and is found on different types of soils, such as calcareous tufa, dark brown to red sands and acid gravels, all underlain by dolomite (van Rooyen & Bredenkamp 1996).

The vegetation varies from open to closed bushveld, composed mostly of shrubs and some small trees, in mixed grassland. The principal shrubs are Camphor Tree *Tarchonanthus camphoratus*, Threethorn *Rhigozum trichotomum*, Puzzle Bush *Ehretia rigida, Grewia flava* and *Gymnosporia buxifolia*. The tree species present are Wild Olive *Olea europaea subsp. africana*, Umbrella Thorn *Acacia tortilis* and Shepherd's Tree *Boscia albitrunca* (van Rooyen & Bredenkamp 1996). Grasses are tall, and Red Grass *Themeda triandra*, Copperwire Grass *Aristida diffusa* and Silky Bushman Grass *Stipagrostis uniplumis* are common. Thickets of shrubs and trees are present and include Fringed Karee *Searsia ciliata*, Black Thorn *Acacia mellifera* subsp. *detinens*, and Umbrella Thorn *Acacia tortilis*.

This vegetation type is extremely poorly conserved and not represented in a sizeable conservation area (van Rooyen & Bredenkamp 1996).

c. *Kathu Bushveld*

The Kathu Bushveld vegetation type is the most recently classified vegetation type of the area by Mucina & Rutherford (2006) and has a least threatened conservation status, with 1% transformed and none statutorily conserved. The vegetation and landscape characteristics include a medium-tall tree layer with dense stands of *Acacia erioloba* in places, but mostly an open woodland with *Boscia albitrunca* as the prominent tree species, while the shrub layer is dominated by *Acacia mellifera, Lycium hirsitum and Diospyros lycioides*. This vegetation type in its pristine state is characterized by plains with layer of scattered, low to medium high deciduous microphyllous trees and shrubs with a few broadleaved tree species, and an almost continuous herbaceous layer dominated by grass species.

3.4 Geology and soil types

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the study area include the Ag110 land type (Land Type Survey Staff, 1987) (ENPAT, 2001). The landtype, geology and associated soil types is presented in Table 1 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

Table 1. Landtypes, geology and dominant soil types of the proposed development site

Landtype	Soils	Geology
Ag110	Red-yellow apedal, freely drained soils, red, high base status, < 300 mm deep	Surface limestone, alluvium and red wind-blown sand of Tertiary to Recent age with a few occurrences of amygdaloidal andesitic lava (Ongeluk Formation).

The geology of the general area comprises red aeolian sand (Gordonia Formation, Kalahari Group) that forms part of the Kalahari and what is now considered to be a fossil desert. The red sands of the Kalahari are often underlain by calcrete of Tertiary to Recent age which in turn overlies andesitic or basaltic lava of the Ventersdorp Group (Visser, 2006). The soils to the west of Kathu are shallow to very shallow with calcrete cropping out at the surface in many places. The soils are therefore generally of the Clovelly and Mispah form in the study area, but may be deeper Hutton form where the sand is deeper and the calcrete is not near or at the surface.

3.5 Hydrology & drainage

The project area is situated within the quaternary catchment D41J, which is located in the Lower Vaal WMA. There are no perennial rivers in the area. The local quaternary catchment D41J covers an area of 3 847 km2. The catchment system is endoreic with the Gamagara River flowing into the Kuruman River close to Hotazel. The Kuruman River flows into the Molopo River at Andriesvale south of the Kalahari Gemsbok Park. From there, the Molopo flows into the Abiekswasputs pans north of the town of Noenieput.

4 METHODS

4.1 VEGETATION SURVEY

Two basic methods were used during the vegetation survey:

- Line transects were walked on the site surveyed to record the plant species present. Rare and threatened plant species and any botanically sensitive sites or habitats were searched for in the various vegetation units.
- The Braun-Blanquet survey technique to describe plant communities as ecological units was also used for this study as well as. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area.

The vegetation survey was conducted on site during December 2011. The vegetation

was in a moderate to good condition and most species could be identified (a photographic guide is included to indicate the state of the vegetation). The vegetation units (plant communities) were mapped at a 1:5000 scale based on field observations and orthophotos.

4.1.1 Data recorded included:

Plant names used in this report are in accordance with Arnold & De Wet (1993), with the exception of a few newly revised species. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence as well as potential fauna habitat that might occur. The previous vegetation studies conducted by Tanya Anderson were also used as part of the literature review and background to the surveys.

4.1.2 Red data species

A species list of the red data species previously recorded in the vicinity of the proposed development was obtained from the South African Biodiversity Institute (SANBI), South Africa as classified by the IUCN red data list categories.

4.1.3 Data processing

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the vegetation units include the tree, shrub and herbaceous layers.

Conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Northern Cape Province, as well as the Griqualand West Centre of Endemism and Savanna Biome of South Africa.

The following four conservation priority categories were used for each vegetation

unit:

- High: Ecologically sensitive and valuable land with high species richness that should be conserved and no development allowed.
- Medium: Land that should be conserved but on which low impact development could be considered with the provision of mitigation measures.
- Medium-low: Land that has some conservation value but on which development could be considered with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation be maintained.
- Low: Land that has little conservation value and that could be considered for developed with little to no impact on the vegetation / ecosystem.

4.2 FAUNA SURVEY

The fauna survey was conducted as follows:

- A site survey was done to identify potential habitats after identifying the vegetation units. Fauna observed on site or any specific indication of species was noted as confirmed in the species lists.
- A scoping survey was then conducted by comparing the habitat types identified with the preferred habitats of species occurring in the area.
- If necessary a detailed survey was then conducted by a specialist after consultation.

4.2.1 Data recorded included:

A list of all species of fauna and their status as observed on the site or that could potentially occur on the site. Notes were made of any specific sensitive or specialized habitats that occur on the site.

4.2.2 Red data species lists

A species list of the red data species of the different faunal classes was obtained from the following references:

- Red Data Book of the Mammals of South Africa (Friedman & Daly, 2004)
- The Atlas of the Southern African Birds - digital data on quarter degree grid data (Avian Demography Unit, University of Cape Town)
- Atlas and red data book of the frogs of South Africa, Lesotho and Swaziland (Minter et al. 2004)
- South African Red Data Book – Reptiles and Amphibians. National Scientific Programmes Report no. 151

4.2.3 Data processing

A comparison of the habitats (vegetation units) occurring on the property was made to the preferred habitats of the faunal species. In addition to species observed on the site, lists of the potential mammal, bird, reptile, amphibian and insect species were compiled and mitigating measures recommended if needed.

4.3 IMPACT ASSESSMENT PROCEDURE

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need.

The significance of the impacts will be determined through a synthesis of the criteria below (Plomp, 2004):

Probability. This describes the likelihood of the impact actually occurring:

Improbable:	The possibility of the impact occurring is very low, due to the circumstances, design or experience.
Probable:	There is a probability that the impact will occur to the extent that provision must be made therefore.
Highly Probable:	It is most likely that the impact will occur at some stage of the development.

Definite: The impact will take place regardless of any prevention plans, and there can only be relied on mitigatory actions or contingency plans to contain the effect.

Duration. The lifetime of the impact

Short term: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.

Medium term: The impact will last up to the end of the phases, where after it will be negated.

Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.

Permanent: Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

Scale. The physical and spatial size of the impact

Local: The impacted area extends only as far as the activity, e.g. footprint.

Site: The impact could affect the whole, or a measurable portion of the above mentioned properties.

Regional: The impact could affect the area including the neighbouring residential areas.

Magnitude/ Severity. Does the impact destroy the environment, or alter its function.

Low: The impact alters the affected environment in such a way that natural processes are not affected.

Medium: The affected environment is altered, but functions and

processes continue in a modified way.

High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance. This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.

Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.

Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.

High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights will be assigned to each attribute:

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
Duration	Short term	1

Aspect	Description	Weight
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8
Significance	**Sum(Duration, Scale, Magnitude) x Probability**	
	Negligible	<20
	Low	<40
	Moderate	<60
	High	>60

The significance of each activity will be rated without mitigation measures and with mitigation measures for the proposed SWWD development.

4.4 Sensitivity Assessment

The ecological sensitivity of any piece of land is based on its inherent ecosystem service and overall preservation of biodiversity.

4.4.1 Ecological function

The ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g. wetlands) or overall preservation of biodiversity.

4.4.2 Conservation importance

Conservation importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

4.4.3 Sensitivity scale

- High – sensitive ecosystem with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems or with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should be protected.
- Medium – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems or ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species; and
- Low – Degraded and highly disturbed / transformed systems with little ecological function and are generally very poor in species diversity.

5 RESULTS

5.1 Flora assessment

The study area is mostly characterized by slightly undulating to flat plains and the dominant vegetation entity on the site is microphyllous woodland dominated by various *Acacia* species. No prominent drainage features other than the endorheic pans occur on the site. Vegetation units were identified during the ecological surveys according to plant species composition, previous land-use, soil types and topography. The state of the vegetation of the proposed development site varies from being natural to completely modified (old fields). The land-use on the farm is livestock grazing. The farms surrounding this farm are primarily used for cattle and game

farming.

The vegetation communities identified on the on the proposed development site during the ecological surveys are classified as physiographic physiognomic units, where physiognomic refers to the outer appearance of the vegetation, and physiographic refers to the position of the plant communities in the landscape. The physiographic-physiognomic units will be referred to as vegetation units in the following sections. These vegetation units are divided in terms of the land-use and soil differences that had the most definitive influence on the vegetation units. Each unit is described in terms of its characteristics. A species list for each of the units identified during the field surveys and photographs of the woody structure is included. Six main distinctions were made in terms of vegetation units of the study area. The aim of the study was to determine the suitability of the area from an ecological perspective for the proposed waste rock dumps, haul roads and stockpiles. The survey focused on the proposed footprint areas, but also over a larger area to find the most suitable footprint sites from an ecological sensitivity perspective.

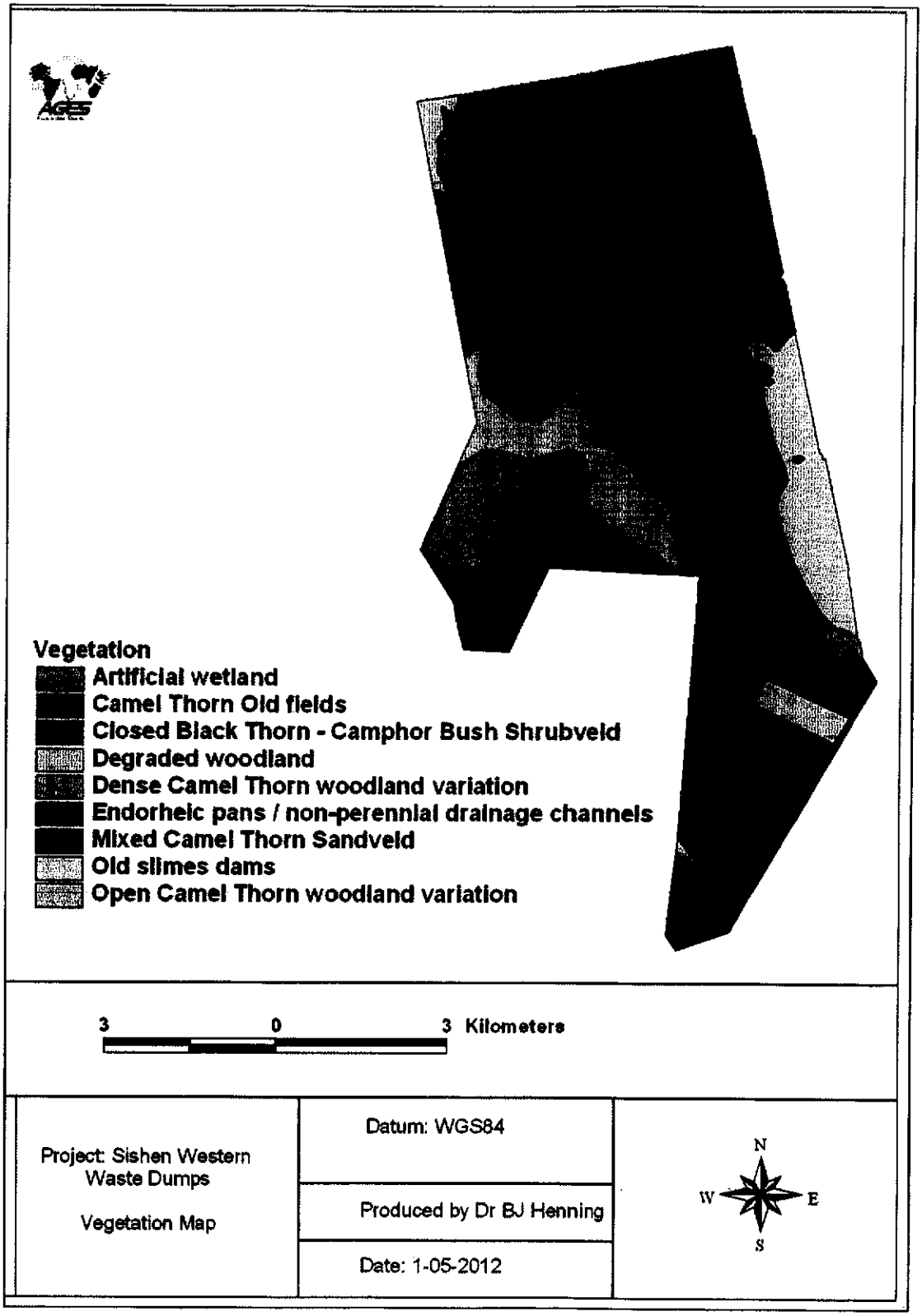
Description of natural vegetation

After the initial ecological surveys of the study area, the analysis of the data resulted in the identification of six major vegetation units on the proposed development footprints and surrounding areas. The detailed species list for the site and surrounding areas is included in Appendix A, while the state of the vegetation is included in the Photographic Guide. A vegetation map was also compiled (figure 4).

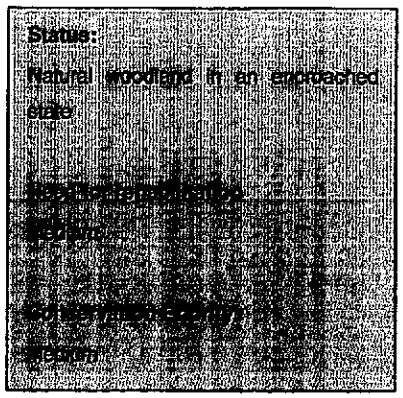
The following vegetation units were identified:

1. *Acacia mellifera- Tarchonanthus camphoratus* closed shrubland
2. *Acacia erioloba* woodland
    a. Open woodland variation
    b. Camel Thorn – Camphor Bush woodland variation
    c. Dense Camel Thorn woodland
3. Endorheic Pans / small non-perennial drainage channels
4. Degraded microphyllous woodland on Sishen mine periphery
5. Artificial wetlands associated with mine seepage
6. *Acacia erioloba* Old fields

Figure 4. Vegetation Map of the study area



1. ***Acacia mellifera – Tarchonanthus camphoratus* shrubland**



Soil	Shallow calcareous soils with surface limestone	**Rockiness**	10-15
Dominant spp.	*Acacia mellifera, Tarchonanthus camphoratus, Rhigozum trichotomum,*		

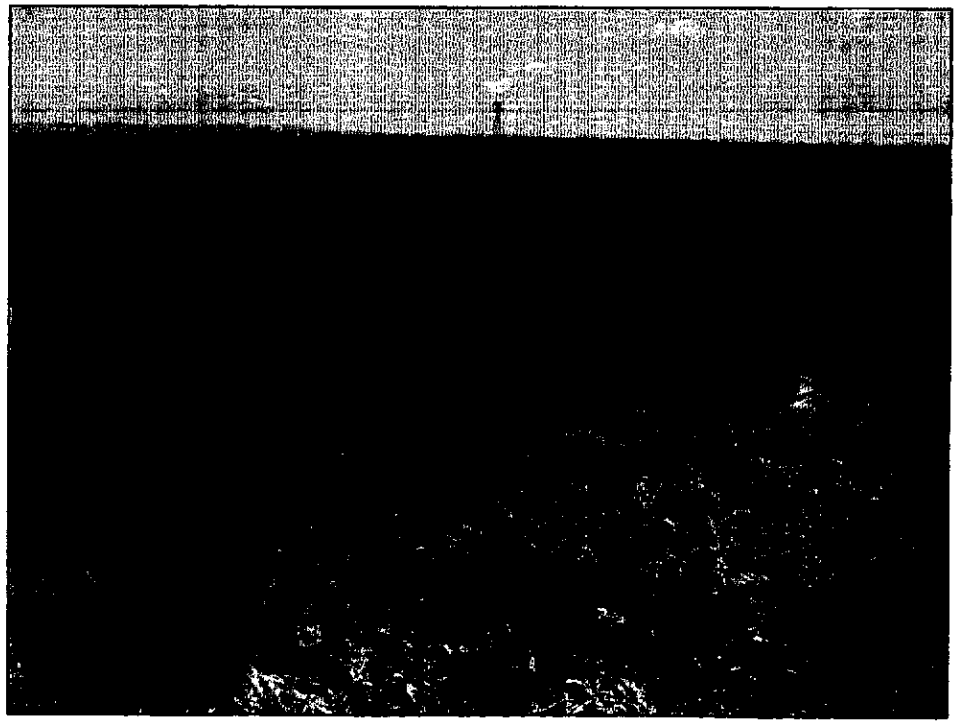
This vegetation unit is the most common and dominant natural vegetation entity occurring throughout the western section of the proposed development site and surroundings (see vegetation map). Anderson (2003) describes this vegetation unit as "Closed Camphor Bush Woodland. It is mostly a closed bushveld dominated by camphor bush *Tarchonanthus camphoratus* shrubs and black thorn *Acacia mellifera* subsp. *detinens*. Other common large shrubs include blue bush *Diospyros lycioides*, puzzle bush *Ehretia rigida* and raisin bush *Grewia flava*, and small buffalo thorn *Ziziphus mucronata* trees. Shepherd's tree *Boscia albitrunca* occurs at intervals throughout this vegetation unit. Camel thorn *Acacia erioloba* and sweet thorn *Acacia karroo* are rare in this vegetation unit and mostly associated with the small temporary pans. Patches of driedoring *Rhigozum trichotomum* occur particularly where gravels surface on limestone, often on contours. The dwarf shrub layer is dominated by *Pentzia calcarea, Chrysocoma ciliata* and *Felicia muricata*. The grass layer consists predominantly of *Eragrostis lehmanniana* and *Schmidtia pappophoroides* (Anderson, 2003).

The characteristics of this vegetation unit are presented in table 2 while the state of the vegetation is presented in photograph 1:

Table 2. Botanical analysis and characteristics of *Acacia mellifera – Tarchonanthus camphoratus* woodland

Location:	Throughout the study area, but particularly directly to the west of the current waste dumps. Associated with shallow limestone in study area.
State of the vegetation:	Natural (further away from current WRD) to slightly degraded (closer to mine due to dust from WRDs).
Characteristics	This vegetation unit is characterized by the dominance of black thorn and camphor bush shrubs forming dense stands throughout its distribution in the local context.
Density of woody layer	Trees: 10% (avg. height: 3-6m) Shrubs: 30-50% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 40-50% (avg. height: 0.8-1.2m) Forbs: 2-5 (avg. height: 0.8m)
Sensitivity	Moderate – indigenous woodland with a widespread status
Red data species	None observed; although some isolated individuals was previously observed by Anderson (2003).
Protected tree species	Isolated individuals of *Acacia erioloba* and *Boscia albitrunca*

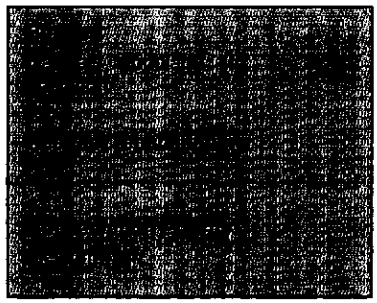
Photograph 1. Dense *Acacia mellifera – Tarchonanthus camphoratus* shrubland



The following are recommended for the management of this vegetation unit:

- This vegetation unit has a moderate sensitivity mostly due to the fact that the vegetation unit as an entity occurs widespread throughout the Savanna Biome.
- The pristine state of this vegetation unit makes the conservation of sections of this woodland type in combination with vegetation from the surrounding areas as a corridor important.
- The SWWD and associated infrastructure can be supported in the area, provided the specific mitigation and rehabilitation measures stipulated under the specific impacts are adhered to.
- Any eradication of the other protected tree species would need a license application from Department of Forestry.

2. Acacia erioloba woodland



Soil	Deep sandy to loamy aeolian sands (red to yellow apedal sands with a high base status), underlain by calcrete	**Rockiness**	<1%
Dominant spp.	*Acacia erioloba, Boscia albitrunca, Grewia flava, Searsia ciliata, Tarchonanthus camphoratus, Diospyros lycioides*		

This vegetation type is most similar to the Kalahari Plains Thorn Bushveld classified by Van Rooyen & Bredenkamp in Low & Rebelo (1996). It is characterized by a fairly well-developed tree stratum with camel thorn *Acacia erioloba* and shepherd's tree *Boscia albitrunca* as the dominant trees. The shrub layer varies from an open to closed bushveld. Vaalkameel *Acacia haematoxylon* is present, but is not frequent and is a small tree. The shrub layer is moderately developed and individuals of

candle thorn *A. hebeclada,* black thorn *Acacia mellifera, Searsia ciliata, Tarchonanthus camphoratus, Diospyros lycioides* and *Grewia flava* dominate this layer. Grasses such as Lehmann's lovegrass *Eragrostis lehmanniana,* sickle grass *Pogonarthria squarrosa, Eragrostis pallens* and silky bushman grass *Stipagrostis uniplumis* are conspicuous. Dwarf shrubs include *Indigofera species, Elephantorrhiza elephantina, Asparagus species, Felicia muricata* and *Pollichia campestris* (Anderson, 2003).

Three different variations of this vegetation unit was identified according to the following characteristics:

- Woody structure
- Soil depth
- Plant species composition

The characteristics of the vegetation unit variations are discussed below in table 3. The state of the herbaceous layer is in all of these variations is a subclimax to climax state.

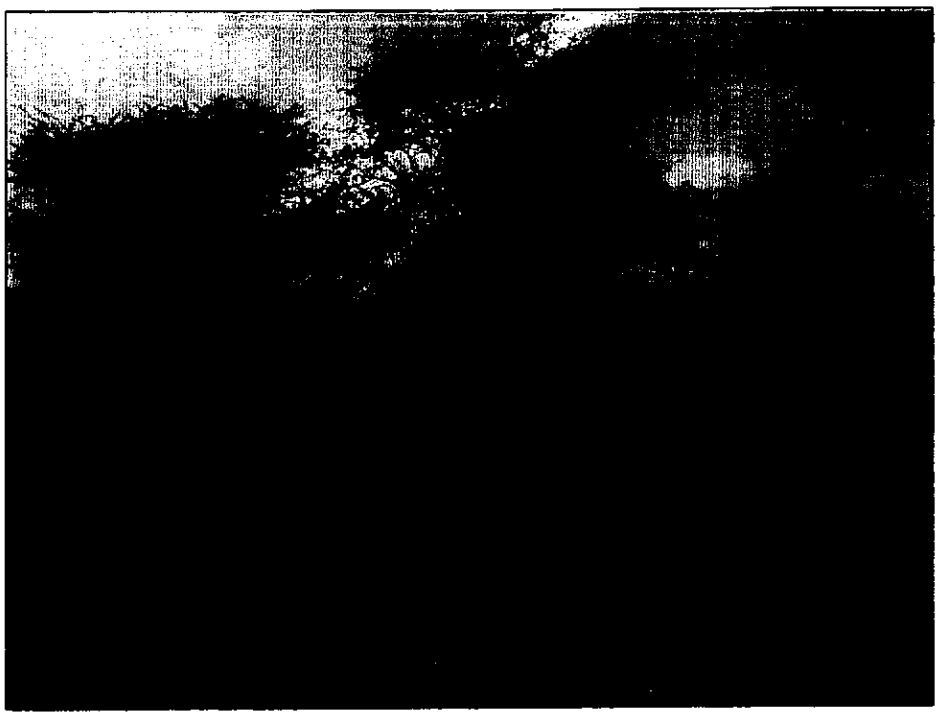
Table 3. . Botanical analysis and characteristics of *Acacia erioloba* woodland

	Open Camel Thorn woodland	Camel Thorn – Camphor Bush woodland	Dense Camel Thorn Woodland
Location:	Small isolated section of the study area in the southern and northern sections of the proposed site for the SWWD. Large areas occur in the game camps of the farm Fritz.	Mostly on the sandy soils to the directly to the east of the Gamagara River as well as other areas with red sandy soils of medium depth (see vegetation map).	Occurs in a transitional zone between the limestone and deep Aeolian soils in the central section of the development site to the east of the previously cultivated land (spil points)
State of the vegetation:	Pristine state	Pristine state	Slightly encroached
Characteristics	Open woodland with a well developed grass layer. The landscape has a high value in terms of grazing for game species. The woodland is associated with deep red sandy soils. See photograph 2.	Open woodland with a well-developed shrub layer and dense grass layer. This woodland variation occurs on deep sandy soils, although camphor bush becomes more prominent in the shrub layer where the limestone occurs closer to the surface and the soil has a medium depth. See photograph 3.	Dense woodland that often forms a closed canopy structure in certain section. The woodland lies in a transitional zone between the limestone soils to the west and the deep red aeolian sands to the west, although the soils are mostly deep sandy Aeolian soils typical of the Kalahari. Many young trees occur in the area. See photograph 4.
Density of woody layer	Trees: 15-20% (avg. height: 3-6m) Shrubs: 5-10% (avg. height: 1-2m)	Trees: 15-20% (avg. height: 3-6m) Shrubs: 15-20% (avg. height: 1-2m)	Trees: 20% (avg. height: 3-6m) Shrubs: 20-25% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 80-90% (avg. height: 1.2m) Forbs: <1 (avg. height: 0.5m)	Grasses: 70-80% (avg. height: 1.2m) Forbs: <1 (avg. height: 0.5m)	Grasses: 60-70% (avg. height: 1.2m) Forbs: <1 (avg. height: 0.5m)
Sensitivity	Moderate - high – indigenous woodland with dense stands of protected tree species		
Red data species	See section on red data species		
Protected tree species	*Acacia erioloba, Acacia haematoxylon, Boscia albitrunca*		

Photograph 2.Woody structure of the open *Acacia erioloba* woodland variation

Photograph 3. Woody structure of the Camel Thorn-Camphor Bush woodland variation

Photograph 4. Woody structure of the dense Camel Thorn woodland variation



The following recommendations should be adhered to for the area:

- The area has a moderate-high sensitivity and represents unique, pristine woodland with dense stands of protected tree species. This area could be utilized as a 'Biodiversity Offset Area' due to its biodiversity value.
- A license should be obtained from the Department of Forestry for the eradication of the protected tree species on site, should the layout plan impede on this area.
- The Camel Thorn woodlands should be considered as a potential 'Biodiversity Offset area' due to its uniqueness and value as a corridor (see section 10 of the report).

3. Endorheic pans / non-perennial drainage channels

Status:	
Open shrubland along periphery / short grassland in endorheic pans	
[redacted]	
Low	
[redacted]	
Medium	

Soil	Shallow calcareous soils overlying calcrete	**Rockiness**	2-5%
Dominant spp.			

This vegetation unit includes the endorheic pans and small, non-perennial drainage channels occurring throughout the study area. Southern Africa is well endowed with endorheic pans or depressions (Allan, Seaman and Kaletja 1995), depending on drainage and aridity. They occur on plains of low relief, as a result of which drainage is poor. Their bases are impervious to downward (vertical) drainage. The base is often calcrete as observed in the study area (see Photograph 5). Some drainage occurs laterally, both into and out of the pan. Geomorphological processes, including wind-driven deflation, lead to the formation of depressions, which hold water for varying periods (Walsmley, 2003).

Though a variety of pans was examined, including pans in the area intended to be destroyed when the waste dumps are expanded, with varying sediment types, it is apparent that there is no specific faunal character to the pans in the proposed SWWD area. No rare or threatened species were found, which might be of specific conservation importance (Walmsley, 2003).The plant species diversity is less at these pans and there are few dense clusters of shrub species on the pan fringes. However, a cluster of pans on the farm Woon support a localized, dense population of *Nerine laticoma*, a protected amaryllid species. This species was not located elsewhere at any pans or moist situations.

Anderson (2003) noted that the pans could be threatened by disturbances common to other land use practices in the area, such as trampling by livestock which transforms well-vegetated pan shorelines to open mud. The Mesquite, *Prosopis*