South Africa

Barberton Makhonjwa Mountains

Nomination Dossier in terms of the Convention concerning the protection of the World Cultural and Natural Heritage

January 2017

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List of Acronyms

BGB	**Barberton Greenstone Belt (synonym to BML, Barberton Mountain Land)**
BATOBIC	**Barberton Tourism and Biodiversity Corridor**
CARA	**Conservation of Agricultural Resources Act**
CPA	**Communal Property Association**
DAC	**Department of Arts and Culture**
DEA	**Department of Environmental Affairs**
DMR	**Department of Mineral Resources**
GSSA	**Geological Society of South Africa**
IDP	**Integrated Development Plans**
IMP	**Integrated Management Plan**
KNP	**Kruger National Park**
LED	**Local Economic Development**
MA	**Management Authority**
MDEDET	**Mpumalanga Department of Economic Development, Environment and Tourism**
MoA	**Memorandum of Agreement**
MOUNTAINLANDS NR	**Barberton Nature Reserve**, Phase 3
MTPA	Mpumalanga Tourism and Parks Agency
ND	Nomination Dossier
NEMBA	National Environmental Management: Biodiversity Act
NEMPAA	National Environmental Management: Protected Areas Act
NGO	Non-Government Organization
NHRA	National Heritage Resources Act
NR	Nature Reserve
OUV	Outstanding Universal Values
PA	Protected Area
PHRA	Provincial Heritage Resources Authority
SAFCOL	South African Forest Company Limited

SAHRA	South African Heritage Resources Agency
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHCA	World Heritage Convention Act
WHS	World Heritage Site

Acknowledgments

BATOBIC would like to thank the Mpumalanga Provincial Government for funding the project through its several phases. Thanks are also due to all members of the Concession Creek compiling team, the Scientific Advisory Group and GSSA, the Project Steering Committee and DEA officials, landowners and local colleagues in the geology and tourism sectors for their inputs. It has been an inspiring group effort and we feel sure it has justified the energy and enthusiasm expended and will ultimately succeed.

Executive Summary

State Party

Republic of South Africa

State, Province or Region

Mpumalanga Province

Name of Property

Barberton Makhonjwa Mountains

Geographical Coordinates to the Nearest Second

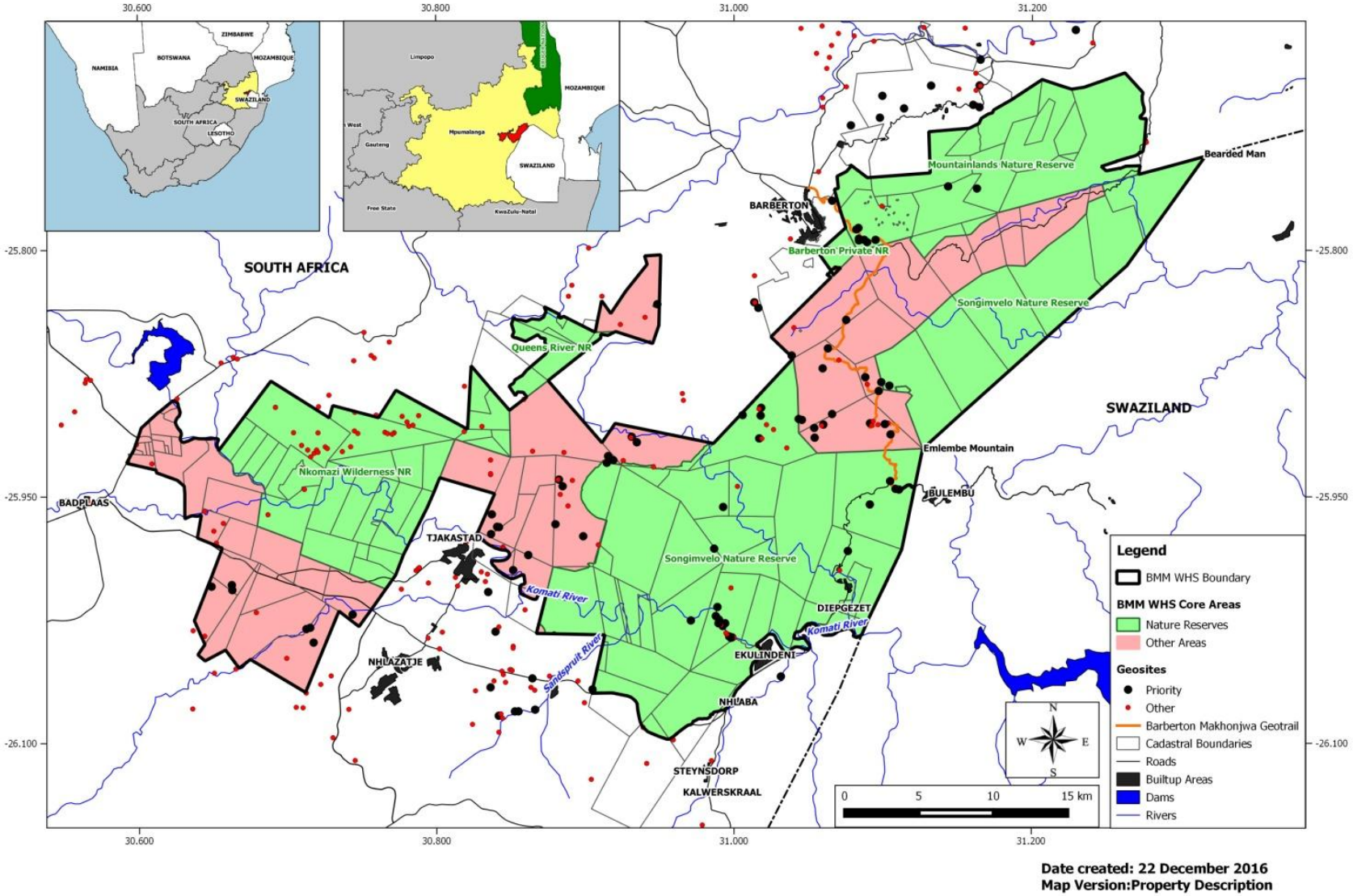
Central Point and highest peak ('Shokholwa' – 1900 m): S 25 ° 58' 26'' E31 ° 00' 50''

Textual Description of the Boundary(ies) of the Nominated Property

Starting at the South Africa/Swaziland boundary trig beacon at Bearded Man, the boundary follows the International boundary southwest to Emlembe mountain, then southwards until it crosses the Komati River. It then follows the Komati river to the west of Ekulindeni village and then follows the Songimvelo Nature Reserve southern boundary game fence to a point on the main road where it crosses an eastern tributary of the Sandspruit River near Enkhaba village. Here it turns north along the Songimvelo Nature Reserve (NR) boundary to the main entrance gate and further west and north until it returns to the Komati River. It continues from here westwards to include the Nkomazi NR and farming land up to the R38 just north of Badplaas, then returning eastwards to include the Queens River NR and part of the southern part of Barberton NR (Mountainlands) and back to the starting point. A complete list of all boundary-defining coordinates is given in **Appendix R.**

In summary the Property includes the whole of Songimvelo and Nkomazi NRs, the Queens River NR and most of the southern portion of Barberton NR. Included are the timber growing properties that lie between these protected areas and two enclaves of communal land in the Komati Valley. Detailed maps of all boundaries are attached separately as **Appendix A.**

THE NOMINATED PROPERTY: BARBERTON MAKHONJWA MOUNTAINS



Date created: 22 December 2016
Map Version:Property Description

Criteria Under Which Property is Nominated

Criterion viii.

Draft Statement of Outstanding Universal Value

a. Brief Synthesis

Summary of facts: The Barberton Makhonjwa Mountains are referred to geologically as the Barberton Greenstone Belt (BGB). They are located in north-eastern South Africa, against the north-western border of Swaziland. This approximately 120 x 30 km stretch of rugged mountain terrain is substantially untransformed and includes a wide variety of Archaean rocks (from 3.6 to 3.25 Ga) that are highly accessible all year round. The 113 137 ha Property encompasses about 40% of the BGB, is protected by four major Nature Reserves and includes minor components of timber growing and livestock grazing lands (~15% each). Geoheritage values are identified at 300 registered geosites of which 51% (n=154) are encompassed within the Property. A 38 km motorised geotrail linking key geosites was built with illustrated information panels at lay-bys along a public road in 2014.

Summary of values: *The Barberton Makhonjwa Mountains contain the best-preserved, oldest and most diverse sequence of volcanic and sedimentary rocks on Earth. These well researched outcrops provide a globally unique source of information about the earliest measurable conditions of the Earth's gradually solidifying oceanic crust, from 3.5 billion years ago. From these rocks, more has been learned than from anywhere else about the surface processes at work as the Earth cooled from a molten body, to the creation of the primitive biosphere. This is the field repository for the genesis of life.*

Protected from beneath by rising plutons of granite, and later buried by a thick layer of Transvaal sediments, this 340 million year sequence of Archaean lavas and sediments has escaped both subduction and erosion for all of that time. They provide earliest evidence of the chemical nature of our oceans and atmosphere and of the way continents are formed – all unique attributes of our planet. Their outstanding universal value lies in both their remarkable state of preservation and in the variety of sites conveniently grouped together. That they occur in attractive surroundings with a comfortable climate, easy to access by researchers and the visiting public, extends their remarkable geological heritage value. Combined, they form a growing outdoor education facility at all levels and for many aspects of our present and past environments. There are literally hundreds of geosites of interest which, when their information is combined, allow the Barberton Makhonjwa Mountains to tell a richly consistent and as yet only partly explored story of how life on Earth began.

An inventory of all significant geosites within and associated with the BGB, has been compiled by a select group of geological scientists and researchers most familiar with the region. These data clearly show the number, distribution and variety of outcrops that have contributed so significantly to our understanding of the Archaean Eon. The project database records about 380 geosites representing the extraordinary variety of evidence available on what our planet was like three and a half billion years ago. Interpretation of most of these sites is formally recorded in more than 2 500 refereed scientific papers that have been published since the 1960s. As only about half the BGB has been thoroughly mapped by geologists, there is the potential for a similar number of new geosites to be added.

These special and spectacular features have the potential to enhance geo-heritage tourism. The findings of cutting-edge geological research, appropriately interpreted in dramatic mountainous landscapes with abundant wildlife and interesting cultural and historical features, provides an exciting and fascinating destination for visitors. The Property is a rich and inspiring outdoor education and recreation resource.

b. Justification for Criteria

The Property is proposed for inscription under **Criterion VIII,** given that it contains the best, most diverse and outstanding examples of rock outcrops from the Archaean stage of Earth's history. Its rocks have revealed the earliest record of single-celled life forms as well as the earliest and most significant geomorphic features, including detailed evidence of the processes involved in the evolution of the originally oxygen-free oceans and atmosphere, and creation of the first continental landforms**.**

Inscription is justified because the BGB is a truly unique remnant of the ancient Earth's crust, containing among the oldest, and undoubtedly the best-preserved sequence of volcanic and sedimentary rocks on Earth. These highly accessible ancient exposures present a continuous 340 million year sequence of rocks, starting 3 600 million years ago. Their physical and chemical characteristics provide an unparalleled source of scientific information about the early Earth. The outstanding value of these rocks lies in the large number of sites and features that, when combined, provide a unique, and as yet only partially explored, scientific resource.

The outstanding universal value of these rocks is due largely to their remarkable state of preservation. They are not entirely unaltered, but large areas exist where original components are intact for most rock types in a thick Archaean sequence. Geologists and paleo-biologists have learned more about the Earth's early history from these rocks than from any other comparable site elsewhere. Since the description of komatiites in 1969 a global network of researchers in the field of Archaean geology has been steadily producing new discoveries and testing new theories concerning the Earth's early evolution. More than 2500 geological papers on the BGB have been published in refereed research journals since the 1960s. Although rocks of similar age and even slightly older are known from elsewhere, none combines the outstanding and diverse characteristics of the Barberton Greenstone Belt. For more detail see **Appendix C.**

c. Statement of Integrity

The geology of the Property has not been significantly damaged by human activities and the environment is substantially in a natural untransformed state. It includes no medium to large settlements, residential, mining, or any industrial areas. The entire 113 137 ha property lies within the BGB and covers some 40% of that geological formation. Nature Reserves that are natural and largely undeveloped comprise some 68% of the Property. Of the remainder, 17% comprises timber plantations and a further 15% comprises livestock grazing on untransformed natural pastureland. These three land-use zones are sustainably managed incompliance with the country's conservation, forestry and agriculture laws. Where the geology has been disturbed historically by a few small-scale mines and minor road cuttings, the scars have re-vegetated and stabilised naturally.

The Property's boundary encloses a fully representative sample of 154 registered rock outcrops (n= 300, i.e. 51% of geosites considered for inclusion).The distribution of all geosites (**Figure 3**) and the information they convey define a landscape of the highest scientific value in terms of Earth's earliest discernable history. The variety of geological processes, evident both as chemical signatures and as more visible physical structures within the rocks are also unmatched in any comparable area (see S**ection 3.2**).

Of the many outstanding geological features of the BGB, the following have contributed most prominently to scientific knowledge and understanding of the evolution of the early earth:

- Evidence of the Earth's earliest life forms, including microfossils, stromatolites, biomats and other biologically derived material.

- Evidence of the earliest continent-forming processes showing how land masses emerged from the hot and murky Archaean oceans that dominated the planet's surface, with only scattered volcanic peaks aligned as island arcs in an otherwise endless sea.
- Evidence of the earliest large meteorite impact events occurring as spherule beds of molten rock droplets from a period of intense meteorite bombardment.
- Chemical and physical evidence of the nature of the Archaean atmosphere and oceans, the oxygen-free chemical soup that supported abundant single-celled life and created vast ocean-floor deposits of chemical sediments such as banded iron formations and coastal sand deposits showing tidal intervals and the earliest moon-Earth interactions.
- The 'type-locality' of the distinctive komatiite volcanic rocks, and pillow lavas, the komatiites being the hottest lavas by far to have ever emerged on the Earth's surface.
- Volcanic lapilli embedded in chert, appearing as pea-sized 'hailstones' of accreted volcanic ash and vaporised rock, that have settled into chert sediments on the Archaean sea floor. These extensive deposits signify the presence of airborne volcanism as compared to the more common under water lava flows occurring at this time.
- Oldest migmatites at the Greenstone Belt margins, abundant exposures occur in the contact zones between the dark basaltic Archaean lavas and the plutons of lighter silica-rich granite rising beneath them. Spectacular patterns show evidence of melting and recrystallization due to intense pressures and extreme temperatures generated around the contact area.

Most Archaean lavas and sediments elsewhere in the world have been reheated or otherwise deformed (metamorphosed) in the slow but incessant movements of the Earth's outer shell. Such altered rocks no longer relate closely to the conditions at their site of origin at the Earth's surface. They therefore have substantially less value as sources of evolutionary information. This is not the case in BMM where rocks remain substantially untransformed.

The purpose of protecting these sites is to safeguard their globally significant scientific and educational values, and to provide controlled access to them by the public and by scientists and researchers. At the most accessible geosites geological information has been interpreted for the benefit of visitors as part of an ongoing educational and tourism development programme. The vision for protecting and publicizing these sites is to maximize their combined scientific and educational value for all, and through creative development of this specialized niche in the tourism market, to benefit local communities through sustainable tourism.

d. Protection and Management Requirements

It is necessary to consider all three types of land use in order to protect and manage the exceptional geological heritage of the Property. Management provisions and plans for the Property are set out in the Integrated Management Plan (IMP) in **Section 5.e** and **Appendix N**. The applicable legislation is listed, together with the norms of land management in each of the three types of land use. All land owners have been made aware that Inscription of UNESCO WHS status for their land will result in this status also being endorsed on each property's Title Deeds in perpetuity.

In summary the Nature Reserves will continue to be managed for nature conservation and tourism by their present management agencies (see **Section 5a**), each with their existing staff and budgets. The additional task of protecting and providing access to geosites will be easy for them to manage without significant increase in cost or effort. It will however, require some increased staff attention to the geosites on their

land: to their location and their potential access by the public, and to the interpretation of the stories emanating from the most significant geosites in terms of popular visitor interest.

The same applies to timber plantations and farming/ grazing land, only here there are no budgets or staff to protect geosites and manage visitor access. In these areas this task falls to the Management Agency of BMM who will achieve protection via the National Heritage Resources Act (1999) and coordinate visitor access via the individual Memoranda of Agreement signed by each land owner. All these legal and operational arrangements have already been agreed to in principle and will be formalised by negotiation with each land owner separately. The basis of any management protocols drawn up will be that each land-owner can continue to derive income from their land using existing or current land uses, save only that they must not have any negative impact on the UOVs of the Property. Detail on these matters is set out in IMP, in particular in **Section 7.**

The IMP describes the need to protect specific geosites (rock outcrops) and geological landscapes, and includes lists of what is, and what is not permitted to protect the OUVs of the Property. It also deals with visitor access and how to balance the promotion of tourism and safeguarding privacy and land-owner rights. Along with the relatively straight forward management tasks to protect rocks, the IMP also deals with monitoring needs, both of geosites and of visitors, and with more technical matters of the interpretative needs at geosites and their educational value, both to visitors and to local community members. Marketing the OUVs of the Property is also dealt with, as is the role of scientific advisors in having technical oversight for all scientific/ geological aspects of the Property. Finally the IMP lists staffing requirements with an indicative budget and future development priorities.

The National Heritage Resources Act (1999) is the appropriate legislation for geosite protection on non-Protected Area land. Its implementing agency, South African Heritage Resources Agency (SAHRA), has approved the protection of the geosites and is in the process of registering these as described in **Section 1.e**, under 'Buffer Zones'. In recognition of the socio-economic circumstances of the region SAHRA has proposed an efficient and innovative way of legally defining these National Heritage Sites. In addition, this buffering mechanism for geosites outside PAs, will be registered on the Integrated Development Plan (IDP) and Spatial Development Framework (SDF) required by all Local Municipalities, thereby ensuring that all developments registered within their jurisdiction will be formally assessed to further protect such locations in terms of environmental and heritage impact regulations applied on a municipal level.

e. Long Term Challenges for the Property

Geoheritage protection and its resultant geotourism are new and untested concepts in South Africa. They are being developed without the benefit of tailor-made legislation, nor any appropriate institutional home save for being regarded as part of nature conservation in general and vesting with the well mandated and reasonably resourced conservation agencies for which conservation legislation amply provides. In the light of these special circumstances, the long term challenges for the Property include:

a) To develop geotourism as a growing and sustainable form of land use;
b) To develop the expertise to provide the interpretative interface between the geoheritage resource and the visitor.

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1. Identification of the Property

1.a Country

Republic of South Africa

1.b Province

Mpumalanga Province

1.c Name of Property

Barberton Makhonjwa Mountains

1.d Geographical Coordinates

Central Point and highest peak ('Shokholwa' – 1900 m): S 25 ° 58' 26'' - E31 ° 00' 50''

1.e Maps and Plans (showing the boundaries of the Nominated Property)

- The maps that accompany this Nomination Dossier are in Appendix A:
- Map 1 of the Nominated property - two sheets at a scale of 1 : 50000
- Map 2 of the Geology - two sheets at a scale of 1 : 50000

No Need For Buffer zones in Protecting Geological OUV's

Conventional perimeter buffer zones are not mandatory for WHSs and may be omitted if good reasons are provided to do so. The purpose of buffer zones is to protect and enhance the OUVs and the integrity of the Property, especially from external threats. This function is routinely prescribed for Protected Areas, primarily in response to the needs of biodiversity-based and scenically-based features. Perimeter buffer zones and corridors allow for ecosystem dynamics – movement of biota responding to climate change and other environmental pressures. There is also scenic protection from the visible transformation of nearby landscapes. Where these two criteria are not applicable, the necessary protective or buffering function can more effectively be provided by management interventions other than the conventional buffer zone. In general, geosites are only threatened by direct in situ impacts, so buffer zones protecting against *external threats* are redundant. In a large property no OUV benefits can be obtained from a surrounding buffer.

In respect of properties nominated under Criteria vii, ix and x, the spatial buffering or protection function is clearly justified, understood and acknowledged. These functions may also be needed for Criterion viii (geological) sites but, because they are in-animate, immobile and mostly almost indestructible, the protective or buffering function for geosites and geological landscapes are more effectively provided by other means. Within Protected Areas, both point-based geosites and their related natural landscapes, are protected by existing legislation and conservation management practices (ref. appended IMPs for included PAs). To extend spatial protection and cover a wider area provides no added benefits, only costs and complications. In addition there is a 40 km international border with Swaziland that makes provision of a full perimeter buffer zone impractical.

Geosites in farming or timber growing landscapes require a more specific approach to protection. Different legislation is involved and more varied and specific management interventions are more effective than the simplistic and expensive perimeter buffer zone. The National Heritage Resources Act (1999) provides the appropriate legislation and its implementing agency, SAHRA, is in the process of registering these geosites.

This is being achieved by prescribing local protection zones of 20 m to 50 m radius per geosite within which all surface disturbances will be prohibited (radius from GIS-registered centre-point, dependent on size of each outcrop). In addition, this protection mechanism for geosites outside PAs, will be registered on the IDP and SDF plans required by all Local Municipalities, thereby ensuring that all developments registered within their jurisdiction will be formally assessed to avoid such locations in terms of environmental and heritage impact regulations.

Conventional perimeter buffer zones are not mandatory for WHSs and may be omitted if good reasons are provided to do so. Because geosites and their access by visitors cannot benefit from such zones, and as the protective function of buffering a geosite can be achieved by other more effective and less expensive means, no perimeter buffer zones are prescribed for this WHS.

1.f Area of Nominated Property (ha.)

Area of nominated property: 113 137 ha

2. Description

2.a Description of Property

The Property lies within a sub-tropical lowland region in the north-east of South Africa adjacent to Swaziland

Figure **1**). The region is primarily agricultural (livestock, timber and fruit), with gold mining and wildlife conservation land use for commercial tourism. The Property is highly heterogeneous in terms of its geology, topography, soils and climatic conditions. Summers are warm and winters cooler, with average highs around 27^{o}C in January and average lows at night of 6^{o}C in the month of June. The region experiences mainly summer rainfall, averaging 800 mm/yr in lowlands and up to 1500 mm/yr in the high grasslands.

Three biomes (Forest, Savanna, and Grassland) and eight vegetation types occur within this relatively small area. The Savanna Biome is generally restricted to areas below 1000 m asl and covers an area 47502 ha (42%) of the Property, whilst the Grassland Biome is generally found above the 1000 m asl elevation and covers an area of 63205 ha (55.9%). The Forest Biome is the smallest being 2 431 ha (2.1%). It consists of numerous small pockets of forest found in steep valleys or rocky areas that are protected from fires.

Four vegetation types occur within the Savanna Biome namely the Kaalrug Mountain Bushveld, Legogote Sour Bushveld, Swaziland Sour Bushveld, and the Barberton Serpentine Sourveld. The Property has significant areas of the Barberton Serpentine Sourveld, and Swaziland Sour Bushveld all classified as Vulnerable. The Legogote Sour Bushveld covers an area of 92ha and is considered as being endangered. Fire and grazing are important components of the grasslands. Large areas of grasslands have been transformed in the region by plantation forestry, agriculture, mining and urban expansion. Two grassland vegetation types occur within the Property namely the Barberton Montane Grassland and the KaNgwane Montane Grassland. Both of these vegetation types are classified as Vulnerable (Mucina *et.al*., 2006). The Forest Biome comprises two vegetation types namely the Northern Mistbelt Forests consisting of tall evergreen afro-temperate mistbelt forests and the Scarp Forests which are multi-layered and species-rich. The Northern Mist-belt and Scarp Forests are both classified as Least Threatened.

The Property has a high species biodiversity (**Appendix H**) with more than 1500 plant species, over 30 of which are endemic making it a centre of floristic endemism. The area is also rich in fauna species with 27 amphibian, 415 bird, 134 mammal, 23 fish and 106 reptile species. Mineralised soils (e.g. Mg- and Cr-rich serpentine and talcose soils) which are mildly toxic to some plant species have given rise to the Barberton Centre of Plant Endemism (Van Wyk and Smith (2001), Van Wyk and Smith, 2002), one of 18 centres of floristic endemism in southern Africa

The Property is located largely within the Barberton Greenstone Belt (BGB). This formation is composed of the varied and complex, folded rock-types of the Barberton Supergroup (**Figure 2**), that gives rise to the deeply incised mountainous terrain. The hills are steep and rocky, with moist grassy uplands and forested valleys. The altitude ranges from 600 to 1900 metres asl. This formation is about 120 km long by 10-30 km wide and includes many separate properties. It extends from the Lochiel Plateau in the south-west to Malelane in the north-east, and from Badplaas and Kaapsehoop in the west and across the international border into Swaziland in the east. To the south it extends well south of the Komati River and up to the de Kaap catchment in the north, including small parts of the Mahlambanyathi and Crocodile River catchments in the north east. The landscape and land cover is mostly in its natural state although substantial areas have been planted to pine trees.

The Property lies to the south of South Africa's premier protected area the Kruger National Park and 44 km south of Nelspruit, the administrative capital of the province which is also a major commercial and industrial centre. The region is served by the Kruger Mpumalanga International Airport. The principal town near the Property is Barberton to the immediate northwest and small villages or settlements include Badplaas, Tjakastad, and Ekulindeni that lie outside of the Property to the south. Resident human populations are small and their occupation of the land is largely restricted by the mountainous terrain (**Figure 1**). Land uses comprise several proclaimed nature reserves, plantation forests, rural grazing and agriculture areas. Infrastructure includes major roads such as the 38 km long R40 from Barberton to the Josefsdal-Bulembu Border Post with Swaziland that passes through the Property along which a Geotrail for tourists has been developed.

The area and boundaries of the Property were determined by a process that relied on expert opinion by four international leading geologists selected for their extensive research and publications on the BGB and their knowledge of other comparable greenstone regions elsewhere in the world.

They were asked to describe and list all surface outcrops that revealed the full range of geological values contained in the BGB. This exercise resulted in 380 geological sites of importance being identified and recorded in a database. Their distribution, in combination with areas of appropriate land use, provided the basis for selecting the properties for inclusion within the WHS perimeter (see **Section 4**).

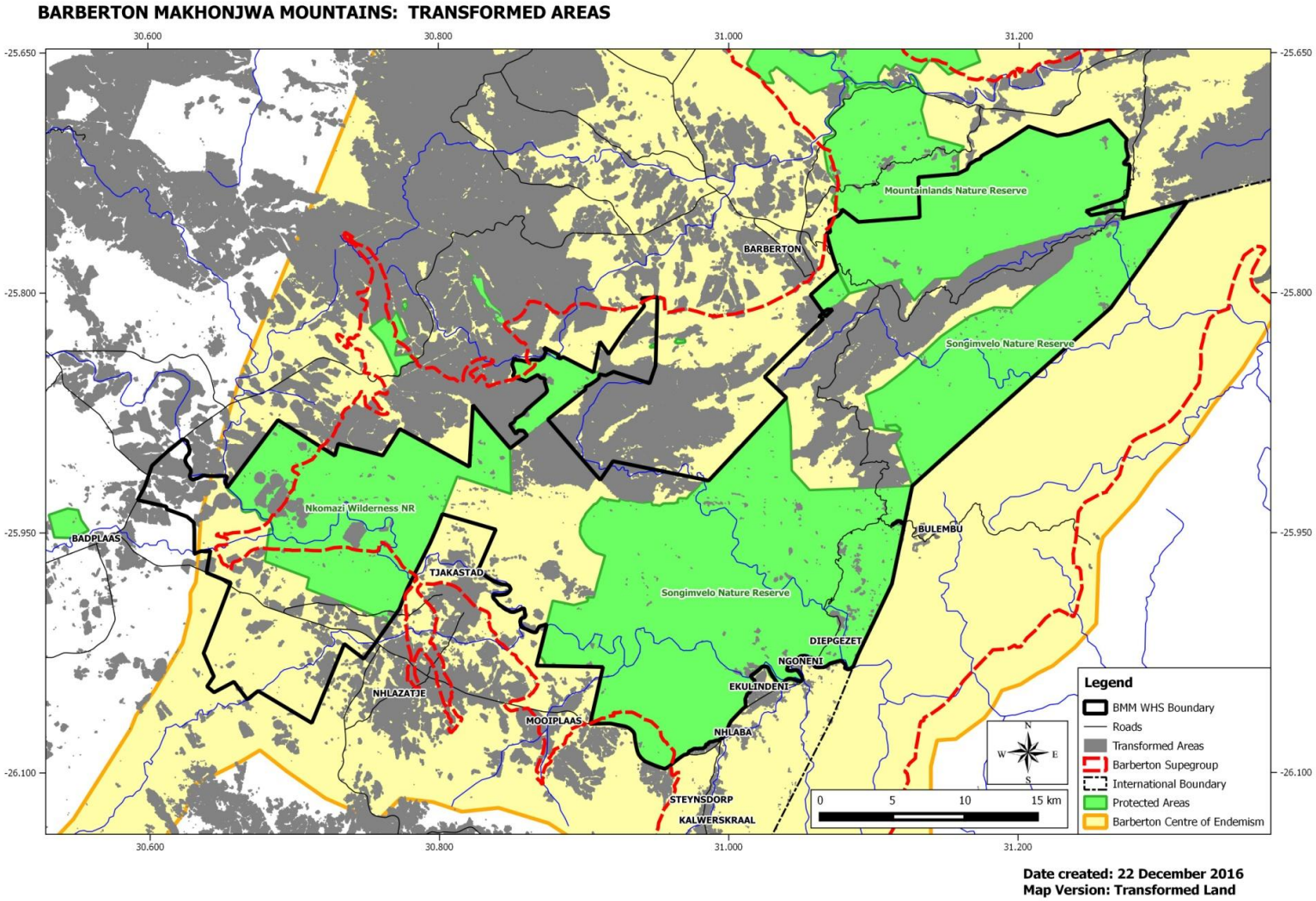

Figure 1. Land cover of the region, including protected areas. Areas depicted as transformed areas are predominantly plantations.

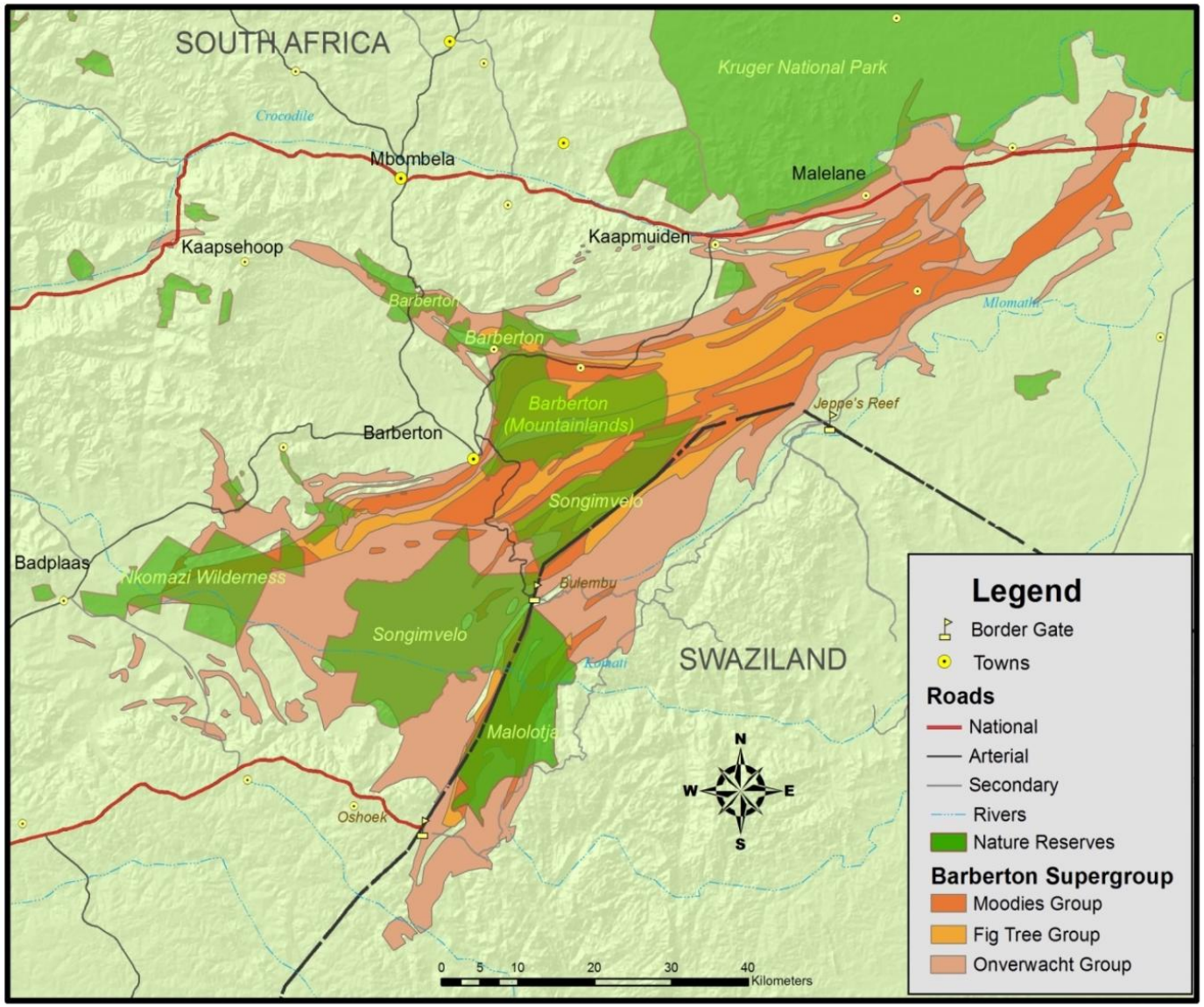

Figure 2. Simplified geological map of the Barberton Greenstone Belt (a higher resolution, more detailed map is attached separately as **Appendix A**).

2.b History and Development

History

There are many archaeological sites present throughout the area, including ochre mines, stone-age chert tools and related artefacts, as well as San rock art present in caves (Boshier and Beaumont, 1972).Interestingly the oldest record of ancient mining anywhere in the world is located nearby in Swaziland. The Lion Cavern ochre mine, at Ngwenya Mines (Swaziland's WHS Tentative List for cultural heritage, 2008) was initially dated at 41 250 BC – some seven times older than the oldest known flint mines of Western Europe (Boshier and Beaumont, 1972). Very similar but un-investigated ochre mine sites are known to occur in Songimvelo Nature Reserve.

Oral and recorded history suggests that through the 1700s and 1800s the Property was sparsely occupied by Swazi and other local pastoral people, together with their livestock. At the time of European arrival in the 1860s the region had become a contested border zone. Land deals were struck between the Swazi king and Transvaal colonists, the echoes of which remain to this day. Barberton burst onto the world stage in 1883 when alluvial gold was found in the de Kaap valley, which led to the Moodie's, Barber's Reef, and Sheba strikes. The subsequent gold rush was as spectacular as it was brief, with Barberton's birth soon being dwarfed by the gold discoveries on the Witwatersrand in 1886. The history of Barberton has been immortalized in the very widely read biography of "Jock of the Bushveld'. The area has a rich contemporary history of dynamic local African cultures; pre-colonial power struggles; colonization; early gold mining (Bornman, 1995) and is a location of important activities by modern political heroes in the struggle for majority rule.

In 1966 research geologists described by far the earliest geological record so far, of tiny fossilised bacterial threads, visible in 3.35 billion year-old black chert from the Barberton Mountain Land. Another famous discovery followed shortly afterwards; that of the twin brothers and student geologists, Richard and Morris Viljoen, who in 1969 described distinctive new Archaean lavas from the Komati River valley, now known throughout the world as komatiites. They described a new class of volcanic rocks of a hitherto unknown chemical and mineral composition, formed at temperatures of around 1650°C – the hottest ever described for volcanic rocks at the Earth's surface. These landmark discoveries initiated intensive geological research that has continued and contributed to a greater understanding of the early evolution of the Earth.

Scientific and Geological History

The BGB strata are remarkably well preserved, having been protected from subduction by rising granites and buried under Transvaal sediments for 2.5 Ga. Their physical and chemical characteristics are substantially unaltered from their time of origin. As a result, scientists from all parts of the world have come to Barberton including: paleobiologists and space researchers interested in the origins of life; volcanologists interested in the composition and flow patterns of volcanic melts from deep within the Earth's mantle; petrologists studying the formation of continents and many more. The large variety of rock types represents a comprehensive sample from the 340-million-year-long 'time window' through which researchers have investigated the processes and surface conditions peculiar to the Archaean. This research window is at the physical limit of the scientifically recordable history of our planet – and life was already present.

Through nearly fifty years of field work, geological researchers have located several hundred geosites in the BGB and have documented:

- Microfossil evidence of the earliest life on Earth, dispersed as abundant traces of organic material and as microscopic cells in black chert;

- Super-hot, water-like “komatiite” lavas that grew giant crystals when shock-cooled in contact with sea water;
- Spherule beds of molten rock droplets, generated by gigantic meteorite impacts on Earth;
- Shallow-water biomats, the evidence of which can be seen with the naked eye and followed for many kilometres;
- Pillow lavas, extruded from depth, like mattresses of petrified balloons, indicating widespread volcanic eruptions under water;
- Chemical precipitates of red iron oxide minerals in banded-iron formations giving clues to the composition of the early oceans, biosphere and atmosphere;
- Thick deposits of volcanic lapilli (‘hailstones’) formed from volcanic ash in the atmosphere settling through water onto the sea floor;
- Sediments that record river and estuarine flows and wide sandy tide-dominated shorelines that record the Moon’s orbit at the dawn of time;
- Crystal lawns of barite, grown on the Archaean sea floor.

After the Property was placed on the Tentative List in 2008 a process was undertaken to identify those geological sites considered to be of the highest value, that is, the most scientifically important, superb, and diverse. Four leading geologists were asked to advise the process, identified for their extensive published research on the BGB and familiarity with comparable regions elsewhere in the world. They are, Professors C.R. Anhaeusser (University of the Witwatersrand, South Africa), D.R. Lowe (Stanford University, USA), G.R. Byerly Louisiana State University, USA) and C. Heubeck (Jena University, Germany), who identified the most significant geosites that in their experience encompassed the full range of scientific values to be found in the BGB (n = ~380 registered geosites). This resulted in 300 sites being considered for inclusion within the Property. After listing and description in a database, all geosites were classified into two classes:

a) **“Essential”**(Grade 1) geosites:- the most outstanding and important sites containing exceptional examples of particular geological formations or processes, and
b) **“Important”** (Grade 2) geosites:- sites that are similar to an 'essential' site but providing additional scientific evidence and insight into a particular geological formation or process.

Of these sites, 95 'Essential' and 205 'Important' sites were considered for inclusion (**Table 1** below and in IMP **Section 7**). A process of boundary demarcation followed so as to include the largest number of 'Essential' sites. Many of these sites were subsequently checked for accessibility and interpretative value before final registration. The proposed Property includes 75% of all ‘Essential‘ geosites and 64% of all geosites considered for inclusion. All 380 geosites have been registered and recorded in a database which may be added to as new sites are assessed.

Table 1. Geosite Distribution Statistics

GEOSITE DISTRIBUTION TABLE	Total Geosites considered for WHS Inclusion	Total Geosites Included within WHS	Total Geosites Excluded from WHS	Total Geosites located Within PAs	Total Geosites located Outside Pas	Percentage of each class of Geosite within WHS
“Essential”	95	71	24	33	38	71/95 = 75% Ess Gs
“Important”	205	83	122	49	34	83/205 = 40% Imp Gs
Total	**300**	**154**	**146**	**82**	**72**	**Essential Geosites Located outside PAs (38/71) = 54%**
Total %	100%	154/300 = **51%**	146/300 = 49%	82/154 = 53%	72/154 = 47%	

- Of 380 geosites in the project database, the most central 300 (95 of them Grade 1 sites) formed the parent population of accessible sites for defining the proposed boundary of the Property.
- Final boundary location included 75% (n = 71) of Grade 1 sites and 51% (N = 83) of Grade 2 sites;
- Grading was requested of the researchers who first identified each site, and later was adjusted by the planning team on practical grounds such as accessibility, visual impact and rarity;
- The planning target was to include 70 to 80% of Grade 1 sites to ensure full representivity and thereby ensure the integrity of the WHS;
- 25% of Grade 1 sites fall within the Property but outside PAs, hence the need to invoke the National Heritage Resources Act to register these as having National Heritage status, to ensure their protection in terms of SA law.

25% of 'Essential' sites occurring within the Property fall outside PAs, hence the need to invoke the National Heritage Resources Act to register these as having National Heritage status, to ensure their protection in terms of SA law.

History of Development

The steeply broken terrain has restricted conventional land use and development which, before the 1900s was limited to seasonal livestock grazing. With the discovery of gold in 1883 prospecting and mining dominated the local economy, supported by parallel increases in livestock and general farming. Road and rail connections linking Barberton to national transport networks and the port of Maputo in Mozambique, gave the region an initial developmental advantage. Later this shifted to Nelspruit, located in a better suited area. From the 1950s arable farming became more diversified and timber plantations (pine and eucalyptus species) were established on high lying areas. To the present day, fruit and orchard farming, together with timber production, dominate the agricultural sector.

A variety of small scale mines, often in very remote mountain locations, had limited life during the last century, most ceasing production with minimal environmental impact or rehabilitation. Gold and asbestos mines proved more sustainable until the last asbestos operations closed in the late 1990s and gold mining was reduced to one or two strong operations, with a similar number struggling to survive at present. The largest asbestos mine (Havelock, est. 1939 to 1999) was at Bulembu in Swaziland adjacent to the Property and operated a 21 km aerial cableway to the rail-head in Barberton.

The most recent development was enabled by the surfacing of the R40 road from Barberton to Bulembu in 2009. This became the first geological tourist attraction of its kind when the Barberton-Makhonjwa Geotrail was developed by BATOBIC, and completed in 2014. It encompasses about 20 geosites and exposures at road cuttings where a remarkable variety of the special geological features of the BGB are displayed in road-side lay-bys with interpretative displays and a guide book for the public. This impressive display of some of the Property's most significant geological assets comprehensively represents and displays a sample of the Outstanding Universal Values of the BGB. For more detail see **Section 5.e**, the IMP (**Appendix N**) and the Geotrail Guide Book (**Appendix S)**.

Areas with agricultural potential in the Komati Valley were occupied by commercial farmers in the early 1900s. These farmers were strongly supported by the apartheid government and in due course many farms

became well developed and productive. Many were later expropriated to implement the government's 'homeland' policy resulting in the creation of the semi-autonomous Kangwane homeland. These areas rapidly filled with people. To cater for these people, infrastructure was provided such as urban centres, roads, power, sanitation and water distribution networks and an administrative service. The Kangwane homeland ceased to exist when it was re-incorporated into South Africa in 1994.

Most of the remote mountain landscape is unsuited for agriculture or settlement and in mid 1980's large sections were proclaimed as Nature Reserves. By 2002 the BGB had been repeatedly assessed as containing high biodiversity values, especially for plants, which confirmed the appropriateness of the Nature Reserves, which are now managed by the Mpumalanga Tourism and Parks Agency. Since 1994 several land claims against properties in the Komati valley and elsewhere have been lodged and have included areas such as parts of Songimvelo Nature Reserve. This land claim has still to be fully resolved. However in terms of Government policy, the ownership of claimed land may change but for proclaimed Nature Reserves the land use cannot be changed. These claimed Nature Reserves will therefore remain as legally managed protected areas.

3. Justification for Inscription

3.1.a Brief Synthesis

Summary of facts: The Barberton Makhonjwa Mountains are referred to geologically as the Barberton Greenstone Belt (BGB). They are located in north-eastern South Africa, against the north-western border of Swaziland. This approximately 120 x 30 km stretch of rugged mountain terrain is substantially untransformed and includes a wide variety of Archaean rocks (from 3.6 to 3.25 Ga) that are highly accessible all year round. The 113 137 ha Property encompasses about 40% of the BGB, is protected by four major Nature Reserves and includes minor components of timber growing and livestock grazing lands (~15% each). Geoheritage values are identified at 380 registered geosites of which 51% (n=154) are encompassed within the Property. A 38 km motorised geotrail linking key geosites was built with illustrated information panels at lay-bys along a public road in 2014.

Summary of values: *The Barberton Makhonjwa Mountains contain the best-preserved, oldest and most diverse sequence of volcanic and sedimentary rocks on Earth. These well researched outcrops provide a globally unique source of information about the earliest measurable conditions of the Earth's gradually solidifying oceanic crust, from 3.5 billion years ago. From these rocks, more has been learned than from anywhere else about the surface processes at work as the Earth cooled from a molten body, to the creation of the primitive biosphere. This is the field repository for the genesis of life.*

Protected from beneath by rising plutons of granite, and later buried by a thick layer of Transvaal sediments, this 340 million year sequence of Archaean lavas and sediments has escaped both subduction and erosion for all of that time. They provide earliest evidence of the chemical nature of our oceans and atmosphere and of the way continents are formed – all unique attributes of our planet. Their outstanding universal value lies in both their remarkable state of preservation and in the variety of sites conveniently grouped together. That they occur in attractive surroundings with a comfortable climate, easy to access by researchers and the visiting public, extends their remarkable geological heritage value. Combined, they form a growing outdoor education facility at all levels and for many aspects of our present and past environments. There are literally hundreds of geosites of interest which, when their information is combined, allow the Barberton Makhonjwa Mountains to tell a richly consistent and as yet only partly explored story of how life on Earth began.

An inventory of all significant geosites within and associated with the BGB, has been compiled by a select group of geological scientists and researchers most familiar with the region. These data clearly show the number, distribution and variety of outcrops that have contributed so significantly to our understanding of the Archaean Eon. The project database records about 380 geosites representing the extraordinary variety of evidence available on what our planet was like three and a half billion years ago. Interpretation of most of these sites is formally recorded in more than 2 500 refereed scientific papers that have been published since the 1960s. As only about half the BGB has been thoroughly mapped by geologists, there is the potential for a similar number of new geosites to be added and further ground-breaking discoveries to be made.

These special and spectacular features have the potential to enhance geo-heritage tourism. The findings of cutting-edge geological research appropriately interpreted in dramatic mountainous landscapes with abundant wildlife and interesting cultural and historical features, provides an exciting and fascinating destination for visitors. The Property is a rich and inspiring outdoor education and recreation resource.

Long Term Challenges for the Property

Geoheritage protection and its resultant geotourism are new and untested concepts in South Africa. They are being developed without the benefit of tailor-made legislation, nor any appropriate institutional home. In the light of these special circumstances, the long term challenges for the Property include:

a) To develop geotourism as a growing and sustainable form of land use;
b) To develop the expertise to provide the interpretative interface between the geoheritage resource and the visitor.

3.1.b Criteria Under Which Inscription is Proposed

The Property is proposed for inscription under **Criterion VIII,** given that it contains the best, most diverse and outstanding examples of rock outcrops from the Archaean stage of Earth's history. Its rocks have revealed the earliest record of single-celled life forms as well as the earliest and most significant geomorphic features, including detailed evidence of the processes involved in the evolution of the originally oxygen-free oceans and atmosphere, and creation of the first continental landforms**.**

Inscription is justified because the BGB is a truly unique remnant of the ancient Earth's crust, containing among the oldest, and undoubtedly the best-preserved sequence of volcanic and sedimentary rocks on Earth. These highly accessible ancient exposures present a continuous 340 million year sequence of rocks, starting 3 600 million years ago. Their physical and chemical characteristics provide an unparalleled source of scientific information about the early Earth. The outstanding value of these rocks lies in the large number of sites and features that, when combined, provide a unique, and as yet only partially explored, scientific resource.

The outstanding universal value of these rocks is due largely to their remarkable state of preservation. They are not entirely unaltered, but large areas exist where original components are intact for most rock types in a thick Archaean sequence. Geologists and paleo-biologists have learned more about the Earth's early history from these rocks than from any other comparable site elsewhere. Since the description of komatiites in 1969 a global network of researchers in the field of Archaean geology has been steadily producing new discoveries and testing new theories concerning the Earth's early evolution. Close to 3 000 geological papers on the BGB have been published in refereed research journals since the 1960s. Although rocks of similar age and even slightly older are known from elsewhere, none combines the outstanding and diverse characteristics of the Barberton Greenstone Belt. For more detail see **Appendix C.**

3.1.c Statement of Integrity

The geology of the Property has not been significantly damaged by human activities and the environment is substantially in a natural untransformed state. It includes no medium to large settlements, residential, mining, or any industrial areas. The entire 113 137 ha property lies within the BGB and covers some 40% of that geological formation. Nature Reserves that are natural and largely undeveloped comprise some 68% of the Property. Of the remainder, 17% comprises timber plantations and a further 15% comprises livestock grazing on untransformed natural pastureland. These three land-use zones are sustainably managed incompliance with the country's conservation, forestry and agriculture laws. Where the geology has been disturbed historically by a few small-scale mines and minor road cuttings, the scars have re-vegetated and stabilised naturally.

The Property's boundary encloses a fully representative sample of 154 registered rock outcrops (n= 300, i.e. 51% of geosites considered for inclusion).The distribution of all geosites (**Figure 3**) and the information they convey define a landscape of the highest scientific value in terms of Earth's earliest discernible history. The variety of geological processes, evident both as chemical signatures and as more visible physical structures within the rocks are also unmatched in any comparable area (**see Section 3.2**).

Of the many geological features, unique to the BGB, several key features which contribute to the unique scientific knowledge and information of what the early environment of the Earth was like during this period, are described below.

The Barberton/Makhonjwa geological sequence includes:

- Evidence of the Earth's earliest life forms, including microfossils, stromatolites, biomats and other organically derived material. Strata in sandstone layers found at various localities contribute to unravelling the puzzle of how life began. The rocks show, in very well preserved detail, some of the earliest evidence of life on Earth visible to the naked eye. Microscopic and chemical examination has shown the presence of crinkly layers consisting of highly compacted organic carbon. Most geologist agree that these laminations represent fossilized microbial mats, that is, common thread like microorganisms that are aggregated and interwoven so that they adhere to each other. Their irregularly wavy lines show "domes and tufts" protruding in the same direction, always upwards. Their orderly spacing may be due to some rhythmic feature of the sedimentary process, possibly caused by lunar tides (the moon-Earth relationship is a further source of scientific evidence portrayed in these rocks). The sediments are suggestive of deposition in a wide, shallow sinuous tidal channel. Single-celled colonial microorganisms formed these biomats and covered individual grains of sand and gravel in very shallow, warm, oxygen-free water, probably along the shore line.

  Modern photosynthetic cyanobacteria develop similar microbial mats and structures that bulge upward towards the light. These microbial mats do not answer how life began, but indicate where and when it thrived, a relatively short time after it began. Single cell organisms were the only biological feature for most of the Precambrian. For about 2 billion years they produced enough oxygen to weather rocks, oxidized vast quantities of iron, and then slowly fuelled the atmosphere to allow for the evolution of higher life forms. Detailed studies of these rocks are sure to reveal more information on the origins of life.

- Tidal sandstones and conglomerates are preserved at two extensive, well preserved and accessible localities, and at a number of other sites in the BGB and can be followed for over 11 km. The internal structures of sandstones are clearly visible to the naked eye, indicating distinctive patterns that the

original sand was deposited in tidal zones with strong currents. These 3.2 billion year old, shoreline deposits are so well preserved, that if unknown to the viewer, could have been deposited recently. Features such as 'foresets', show the direction of the tidal currents, and even the waxing and waning intensity of the water. These deposits relate to the gravitational pull of the Sun and Moon and from measurements it is known that the Moon is gradually moving away from the Earth at 4cm/yr. In the Archaean, the Moon would have been considerably closer to the Earth appearing much larger in the skies; it would have orbited faster and had a much stronger pull on the oceans. In addition, and as also determined from research on these deposits, the tides would have been more frequent, of a shorter duration, with more energy reaching further inland than at the present. The absence of large continents indicate that the swell of two to three tides a day was uninterrupted by large landmasses, allowing for more erosive energy, which in turn created extensive flat coastal environments and abundant coarse, pebble layers, now preserved in the Moodies Group of the BGB. The studies and reconstruction of the tidal deposits in the BGB are similar to modern day processes.

- Formation of the earliest continental crust
  The Archaean Earth's surface was covered by endless murky oceans with scattered volcanic peaks aligned in island arcs and occasional small land masses supported from beneath by plutonic rocks: the beginnings of future continents. Preserved evidence at numerous localities in the BGB are suggestive of different continental-forming and plate tectonic processes, to those observed today. These studies are an important aspect of the present ongoing research in the BGB.

- Evidence of the earliest large meteorite impact events
  It is known that the meteorite impact frequency was much higher during this early period of the Earth's history. In the Archaean, meteorite impacts would have peppered the planet. The lack of evidence of these meteorite impact craters is an indication of the processes also responsible for the obliteration of the Archaean rock record. Evidence of these large meteorite impacts at that time, is seen in numerous spherule beds of once molten rock droplets. These layers are ideal candidates for early solar system meteorite impact studies.

- Chemical and physical nature of the Archaean atmosphere and ocean, including tidal intervals and related lunar measurements for the earliest moon-Earth interactions. Large outcrops of bedded, and often tightly folded strata of banded iron stone and ferruginous chert were deposited by the settling of clay particles and chemical precipitation of iron oxide and silica in deep, stillwaters of the early oceans. Studies of the form and chemical composition of these sediments has given an insight to the composition and processes occurring in the oceans at that time. Baryte deposits, a precipitate of barium sulphate formed in a similar way, that occurs when dissolved barium from hot submarine vents mixed with sea water enriched with sulphate. Various forms of this chemical precipitate have contributed to the knowledge of these ancient deep water deposits.

  The wide spread banded iron formations represent the 'rusting of the earth', as scarce free oxygen at that time bonded with dissolved iron and settled out on the sea floor. This process no longer occurs because oxygen is now plentiful in the atmosphere and mixes readily with sea water which is now virtually iron-free. These characteristics indicate that the ancient ocean basins were dominated by chemical precipitation, were mostly far from land, and probably enriched by input of iron into the sea from volcanic ash falls and from submarine vents that released hot fluids containing dissolved minerals: a very different environment from that of the present day.

- The ‘type-locality’ of the distinctive komatiite volcanic rocks, and pillow lavas. The property exhibits perfect exposures of the famous komatiite rocks, with a composition suggestive of formation temperatures of about 1,650ºC; the hottest ever described for volcanic rocks at the Earth’s surface. Various types and forms of pillow lavas, a common and characteristic structure in basalts, were formed when red-hot molten lava erupted from fissures on the sea floor. Rapid underwater cooling gave the extruded lava a hard, balloon-shaped outer skin or crust, which has a glassy, finer-grained structure than the slower-cooling inner body of the pillow. The lava flow is usually continuous, forcing its way upward between the older hardening pillow, so that the youngest pillows occupy the top of the stack.

- Volcanic lapilli, occurring at a number of sites, and especially well exposed at one of the geotrail sites occur in varieties of chert, a hard chemical sediment with a high silica content. Although most of the Onverwacht Group lavas were erupted under water, these deposits show that significant airborne volcanism, erupting in bursts of activity, was present in the Archaean. Over a 200 million year period large volumes of this airborne ejecta would have contributed to the land surface and environment at that time. Pea-sized clasts in these violent eruptions would have formed in a turbulent, hot, moist, volcanic cloud, high in the Archaean atmosphere. Steam and other gases would have caused smaller particles to coalesce and grow like hailstones, until they rained onto the ocean surface. This allowed for a crude sorting of the particles as they descended through the water at different speeds. Thereafter chemical precipitation of chert bound them into the deposit we see today. These units can be followed for over 10 km, indicating that these eruptions were much larger and more powerful than eruptions seen today, such as that of the modern, comparatively small-scale examples of St. Helens and Pinatubo

- Oldest migmatites at the Greenstone Belt margins, abundant exposures occur in the contact zones between the dark basaltic Archaean lavas and the plutons of lighter silica-rich granite rising beneath them. Spectacular patterns show evidence of melting and recrystallization due to intense pressures and extreme temperatures generated around the contact area.

Most Archaean lavas and sediments elsewhere in the world have been reheated or otherwise deformed (metamorphosed) in the slow but incessant movements of the Earth’s outer shell. Such altered rocks no longer relate closely to the conditions at their site of origin at the Earth’s surface. They therefore have substantially less value as sources of evolutionary information. This is not the case in BMM where certain characteristics of the rocks remain substantially untransformed.

The purpose of protecting these sites is to safeguard their globally significant scientific and educational values, and to provide controlled access to them by the public and by scientists and researchers. At the most accessible geosites geological information has been interpreted for the benefit of visitors as part of an ongoing educational and tourism development programme. The vision for protecting and publicizing these sites is to maximize their combined scientific and educational value for all, and through creative development of this specialized niche in the tourism market, to benefit local communities through sustainable tourism.

3.1.d Statement of Authenticity

(Not applicable to a Natural WHS)

3.1.e Protection and Management Requirements

It is necessary to consider all three types of land use and their separate conservation and management frameworks in order to protect and manage the exceptional geological heritage of the Property. Management provisions and plans for the Property are set out in the Integrated Management Plan (IMP) in **Section 5.e** and **Appendix N**. The applicable Acts of legislation are listed, together with the norms of land management in each of the three types of land use. All land owners (**Table 2** and **Table 5**) are aware that Inscription of UNESCO WHS status for their land will result in this status being endorsed on each property's Title Deeds in perpetuity.

Songimvelo and Barberton NRs are managed in terms of their individually prescribed Management Plans (**Appendices D & E**). All monitoring of management effectiveness and trends is done in terms of the country-wide application of a Management Effectiveness Tracking Tool (METT) system (Appendix V: METT-SA). METT-SA is currently designed to monitor management and trends in conventional biodiversity-based nature reserves, but it is highly adaptive and will have geoheritage monitoring integrated into it for local application when the BMM WHS Management Agency becomes effective (see also **IMP Section 6**). For non-protected areas within the Property (timber plantations and farming land) the National Heritage Resources Act (1999), applied in concert with municipal and agricultural development regulations (SDFs and IDPs), will be used to identify and protect all registered geosites (see **IMP Section 6** for more detail).

Table 2. Summary of Existing Structures and Functions.

Existing Structures & Functions					
	Land Use	**PROVINCIAL PROTECTED AREAS** **MTPA Oversight** 75 694 ha 67%		**TIMBER PLANTATIONS**	**FARMING & TOURISM**
	Managed by	**MTPA Managed** 59 401 ha 53%	**Owner Managed (4)** 16 293 ha 14%	**Owner Managed (2)** 18 703 ha 16,5%	**Owner Managed (7)** 18 739 ha 16,5%
	Existing Functions	• Park management (Parks) • Biodiversity management (Parks and Provincial) • Tourism development (Parks) • Tourism marketing (Provincial) • Access control (Parks) • Law enforcement (Parks and Provincial)	• Park management • Biodiversity management • Tourism development • Tourism marketing • Access control	• Forestry management • Sustainability management • Access control	• Farming • Sustainability management • Tourism development • Tourism Marketing • Access control
	New Function	**MTPA as Management Authority for BMM (New)** • Record, protect and promote geosites			

WHS Management Authority

The Tentative Listed WHS comprises all five formally proclaimed Protected Areas (PAs) which amount to a total of ~76 000 ha, representing 67% of the proposed property. All of these 'included' PAs are managed directly or indirectly by the Mpumalanga Tourism and Parks Agency (MTPA) which has the mandate to either directly manage or oversee the management of all Protected Areas in Mpumalanga in terms of the National Environmental Management Protected Areas Act, 2003 (NEMPAA), the Mpumalanga Nature Conservation Act, 1998 (NMCA) and the Mpumalanga Tourism and Parks Agency Act, 2005 (MTPAA). World Heritage Sites are also recognised as Protected Areas on par with Nature Reserves in terms of NEMPAA. The South African World Heritage Convention Act, 1999 (WHCA) provides that an existing state agency can be mandated to manage a WHS.

This comprehensive legal mandate for PA management within Mpumalanga Province means that MTPA could also be mandated to function as the Management Authority for this WHS Property. The land-owners involved have signed a resolution (**Appendix J**) committing themselves and their properties to support the proposed WHS on condition that they are afforded formal representation on all decision-making structures and that their land ownership rights are protected. Most of these land owners have also signed agreements for their identified properties to be included within the proposed WHS Property.

MTPA manages 27 State owned Nature Reserves throughout the Province, and a number of other PAs with multiple ownership totalling 290 000ha (this excludes the ~950 000ha of the Kruger National Park within the Province). These responsibilities are carried out with an annual budget of R377.4 million and a staff complement of 674 employees, of which 574 are employed in the Park Management Division / Biodiversity Conservation Programme (MTPA Annual Report, 2016/2016).

The proclaimed Nature Reserves within the Property are owned by various entities (State; private/corporate; communal trusts and CPA (Communal Property Association), see **Table 5**, **Section 5.a** below. Most are managed by MTPA, including on behalf of some communal and private owners. The existing staff complement and annual budget for these PA responsibilities are detailed in the IMP (**Section 9**). The management activities routinely undertaken in these properties are listed in **Section 7.1** of the IMP. They include all the most costly and labour intensive tasks that contribute to basic conservation/protection and support for tourism within each PA. The requirement to manage for geoheritage protection over and above these functions already provided is minimal. It is in fact limited to the monitoring of geosites and interpretative and visitor management tasks identified in **Section 8** of the IMP, which task also will fit under the existing tourism development and marketing mandate of the MTPA. Because many geosites occur in communally owned land with many local residents, these additional functions also involve extension and social liaison work. MTPA also already has a community liaison function related to its park management and provincial biodiversity conservation mandate which could be extended to fulfil this role. The staff and funding needs required to carry out these additional duties throughout the Property amount to an initial provision of four or five staff at a cost of R7.2 million per annum as detailed in **IMP Section 9**. Commitment to provide these additional resources to make the WHS MA fully effective is inherent in the support for this WHS Inscription provided by the Mpumalanga Provincial Cabinet and Premiers office. MTPA has already made some budget provision in their MTEF (Medium Term Expenditure Framework).

Integration of Geoheritage Management

In summary the Nature Reserves, comprising 67% of the Property, will continue to be managed for nature conservation and tourism by their present agencies, each with their existing staff and budgets. The additional task of protecting and providing access to geosites (registered rock outcrops) will be inexpensive and easy for them to manage without significant increase in cost or effort. It will however, require some increased staff attention to the geosites on their land: to know their location, provide for access by the public, and to provide attractive interpretation of the stories emanating from the most significant geosites to stimulate popular visitor interest. These tasks are easily accomplished under the existing management frameworks.

The limited nature of the task of protecting geosites also applies to timber plantations (16.5% of the Property) and farming/tourism land (16.5% of the Property); only here there are no existing budgets or staff to protect geosites and manage visitor access. In these areas this task falls to the Management Agency who will achieve protection via the National Heritage Resources Act (1999) and coordinate visitor access via the individual Memoranda of Agreement signed by each land owner. On site protection will be done though collaboration with the land owners, whilst monitoring and reporting will be done by the MA. All these legal and operational arrangements have already been accepted. The basis of all future management protocols will be that every land-owner can continue to derive income from their land using existing or current land uses,

save only that such land uses may not have any negative impact on the UOVs of the Property. Detail on these matters is set out in the IMP, in particular in Section 7 and will be finalised by re-negotiation with land owners once UNESCO WHS status is achieved.

The IMP describes the need to protect specific geosites and geological landscapes, and includes lists of what is, and what is not permitted to protect the OUVs of the Property. It also deals with visitor access and how to balance the promotion of tourism and safeguarding privacy and land-owner rights. Along with the relatively straight forward management tasks to protect rocks, the IMP also deals with monitoring needs, both of geosites and of visitors, and with more technical matters of the interpretative needs at geosites and their educational value, both to visitors and to local community members. Marketing the OUVs of the Property is also dealt with, as is the role of Scientific Advisors in having technical oversight for all scientific/ geological aspects of the Property.

The National Heritage Resources Act (1999) provides the appropriate legislation for geosite protection on non-Protected Area land (33% of the Property). Its implementing agency, SAHRA, is in the process of registering these geosites as described in **Section 1.e**, under 'No Need for Buffer Zones in Protecting Geological OUVs'. In recognition of the socio-economic circumstances of the region SAHRA has proposed an efficient and innovative way of legally defining these National Heritage Sites. In addition, this buffering mechanism for geosites outside PAs, will be registered on the IDP and SDF plans required by all Local Municipalities, thereby ensuring that all developments registered within their jurisdiction will be formally assessed to avoid such locations in terms of environmental and heritage impact regulations.

Long Term Challenges for the Property

Geoheritage protection and its resultant geotourism are new and untested concepts in South Africa. They are being developed without the benefit of tailor-made legislation, nor any appropriate institutional home. In the light of these special circumstances, the long term challenges for the Property include:

a) To develop geotourism as a growing and sustainable form of land use;
b) To develop the expertise to provide the interpretative interface between the geoheritage resource and the visitor.

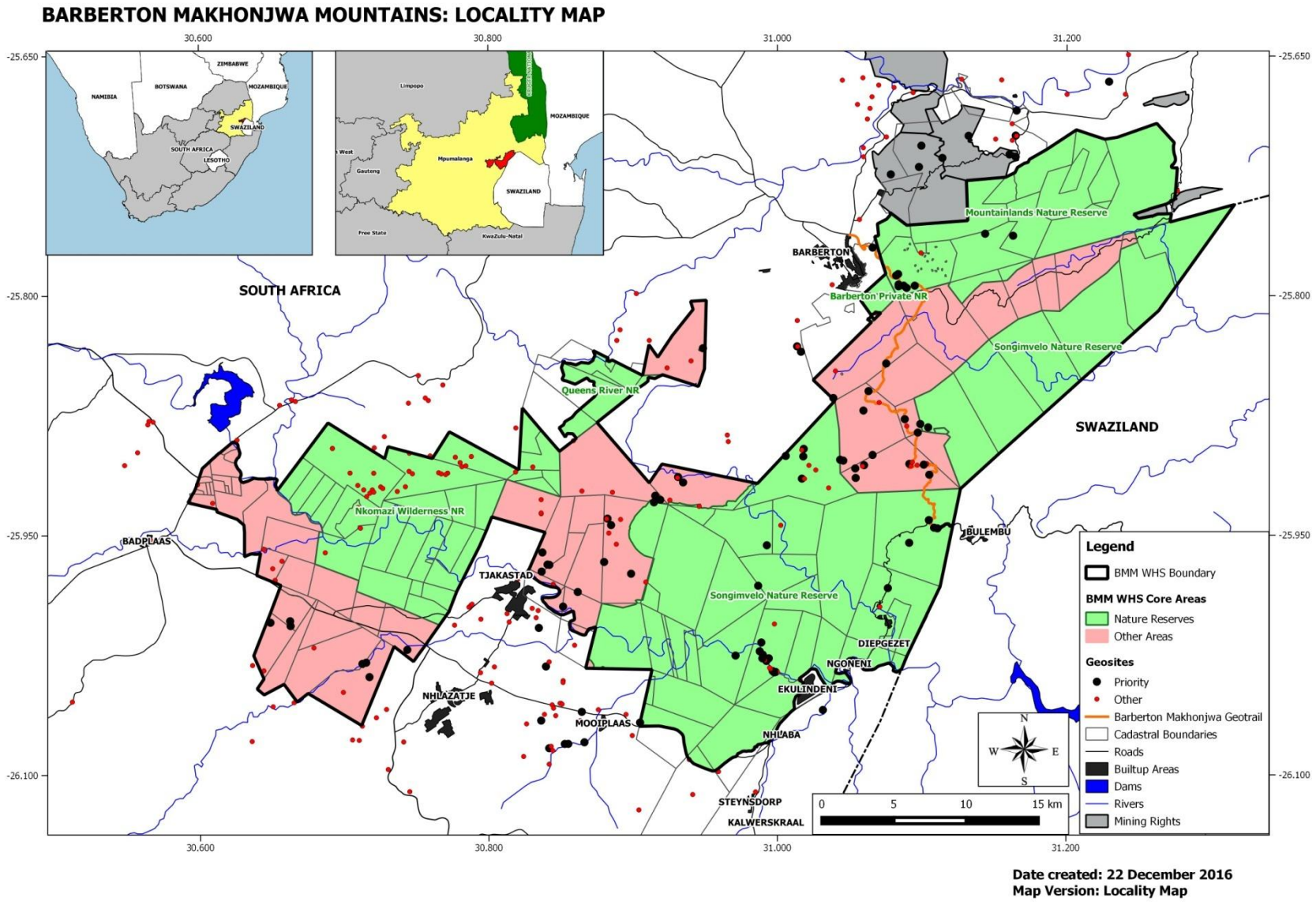

Figure 3. All geosites considered for inclusion within the WHS (300 out of the 380 geosites in the database).

3.2 Comparative Analysis

Greenstone belts exist throughout Earth's geological record and occur with plutonic rocks in the basements of all continents. The following section compares the Barberton Greenstone Belt (BGB) with similar features worldwide and shows what makes the BGB unique and outstanding. Nowhere else on Earth do geological outcrops allow for reliable, representative information about the surface conditions of the early Earth in such rich context and in such high concentration. The BGB contains the oldest well preserved geology ever proposed for WHS listing by about a billion years. Its high value lies in the remarkable and exceptional state of preservation and its diversity of rocks that allow for interpretation and description of the earliest history of Earth. The BGB presents an intact 340 million-year-long sequence of Archaean rocks that is unmatched anywhere. As the geologically defined 'Barberton Supergroup' they have unsurpassed Outstanding Universal Value for this reason.

To date no other greenstone belt, preserving the conditions of the early Earth has been inscribed under Criterion (viii) of UNESCO's selection criteria. **Table 3** lists all the sites presently inscribed under this criterion, and exhibits the lack of such a site in the list.

Table 3. List of WHSs inscribed for exclusively meeting Criterion (viii) of UNESCO's selection criteria.

	WHS Name	***Significance***	***Approximate Age (Ma)***
1.	*Mistaken Point, Canada*	***Fossil site***	***580-560***
2.	*Stevns Klint, Denmark*	***Fossil site***	***65***
3.	*Mount Etna, Italy*	***Volcanic activity***	***0.5***
4.	*Chengjiang Fossil site, China*	***Fossil site***	***530***
5.	*Lena Pillars Nature Park, Russia*	***Fossil site***	***570-530***
6.	*Joggins Fossil Cliffs, Canada*	***Fossil Site***	***300***
7.	*Swiss Tectonic Arena Sardona, Switzerland*	***Structural geology***	***300-0.034***
8.	*High Coast / Kvarken Archipelago, Finland and Sweden*	***Post-glacial rebound***	***0.020***
9.	Vredefort dome, South Africa	***Meteorite impact structure***	***2023***
10.	Wadi Al-Hitan (Whale Valley), Egypt	***Fossil site***	***0.049-0.036***
11.	Monte San Gorgio, Italy and Switzerland	***Fossil Site***	***237-247***
12.	Dorset and East Devon Coast, UK-Ireland	***Well-preserved stratigraphic unit***	***252-0.660***
13.	Ischigualasto / Talampaya Natural Parks, Argentina	***Fossil site***	***245-208***
14.	Isole Eolie (Aeolian Islands), Italy	***Volcanic activity***	***1.3-present***
15.	Miguasha National Park, Canada	***Fossil site***	***382-372***
16.	Caves of Aggtelek Karst and Slovak Karst, Hungary and Slovakia	***Cave system***	***2-present***
17.	Messel Pit Fossil Site, Germany	***Fossil site***	***0.057-0.036***
18.	Hawaii Volcanoes National Park, USA	***Volcanic Activity***	***0.2-present***

Data on many other greenstone belt sites, the best of which are listed below in **Table 4**, were considered. Most are considerably younger or poorly preserved when compared to the BGB and are therefore not generally comparable in age and or quality.

Table 4. Greenstone Belts used as a comparison for the BGB.

Comparable Greenstone Belts	Comparison to the Barberton Greenstone Belt
Pietersburg and other Southern African Greenstone belts	Lower lithologic variability, higher metamorphic grade, higher degree of stratal disruption, lower quality of outcrop.
Lake Victoria and Zimbabwean Greenstone belts	Younger, fewer rock types and lower degree of preservation.
Abitibi Greenstone belt (Quebec/Ontario, Canada)	Poor accessibility, poorly preserved, low relief, 500 Ma younger.
Nuvuaqqituq Greenstone belt (Quebec, Canada)	Smaller, poor accessibility, few rock types, low relief.
Superior (Canada)	Much larger, low relief, poorly exposed, restricted number of rock types, poor accessibility.
Isua Greenstone Belt (Greenland)	Almost inaccessible, smaller, highly metamorphosed, fragmented and in parts poorly exposed; reduced variety of rock types: 300 Ma older.
Pilbara Greenstone belts (Western Australia)	Spread over large area and dominated by volcanic rocks; less komatiites, poor accessibility and lower topographic relief.

Along the Labrador Coastal Strip (opposite West Greenland) and in the Slave Province (NW Territories of Canada) sites are older with 4,000-2,800 million year old (Ma) rocks. There are also sites in West Greenland in the Fiskenaesset and Nuuk regions, where the Amitsoq gneisses are located as part of the North Atlantic Craton; some exposures there have an age range of 3,870-3,380 Ma. The Isua Greenstone Belt is the oldest known greenstone belt in the world, but is strongly metamorphosed, fragmented and poorly exposed, being partly covered by the Greenland ice sheet. (pers. comm. with C.R. Anhaeusser).As such these sites are more fragmented and metamorphosed and do not provide a fully comprehensive record of conditions when they were formed (McCarthy and Rubidge, 2005).

The world's very oldest volcanic and sedimentary rocks are between 3,850 and 3,700 Ma and occur in Greenland, Canada, North China and northern Finland. They constitute the world's earliest surface recorded but have without exception been heated, disrupted and deformed to such a degree by the Earth's interior forces that virtually all information about former surface processes (such as eruption style, sedimentation rates, water depth, composition or state of oceans and atmosphere) has been lost by recrystallization or partial melting of the minerals. Any textural context, for example, which would allow scientists to estimate

the lateral change of some original environmental parameters has been lost from these rocks, and only few datable minerals and laminations testify to their original nature. The degree to which these other greenstone occurrences, most prominently from the Isua Greenstone Belt and the Akilia Enclave of western Greenland, record reliable and representative surface information, if at all, regularly creates vigorous debates among geologists in the scientific literature.

Slightly younger greenstone belts and greenstone belt remnants, generally between ca. 3,600 and 3,100 Ma, exist in North China, India, northwest Australia, South Africa, Swaziland and the USA . Of these, strata in only two regions (Pilbara, Australia and Barberton, South Africa) are well-preserved, meaning that they allow for the interpretation of significant surface parameters of the early Earth, such as depositional setting, weathering intensity, oxygen levels, moon-Earth interactions, ancient tides etc. This is because they have not undergone any thermal overprint and recycling of the rocks by plate tectonic processes for the past three billion years and because outcrop conditions allow geologists to follow strata for considerable distances. These aforementioned two places include firstly the largest of the greenstone belts of South Africa's Kaapvaal Craton (the BGB: **Figure 4**) and the subject of this proposal and secondly the greenstone belts of the Pilbara region of northwest Australia. Greenstone belt strata in the Pilbara are distributed and spread out over a far greater area than those of the BGB and are also dominated by volcanic rocks, rather than the abundant variety of different rock types of the BGB. It is not stratigraphically continuous and has a partial and fragmented record of conditions. In addition, the region is more difficult to reach and has a lower topographic relief than Barberton, indicating a more advanced state of weathering and erosion. However, strata in both regions have contributed greatly to our knowledge of Archaean surface conditions and the habitat of early life: although the BGB far outweighs the quantity and quality of areas contributing to our understanding of early life.

In summary, the only other contender for the best Archaean greenstone occurrences is the Pilbara Greenstone belt, however, as mentioned, this site is poorly exposed, deeply weathered and includes a much lower diversity and a smaller age range than that available in the BGB.

Figure 4. The BGB terrain showing the excellent state of conservation of the mountainous area.

A younger generation of greenstone belts, ca. 2,800-2,500 Ma old, forms part of the basements of a number of continental nuclei, among them in Finland, northern Canada, Siberia, India, Brazil, Zimbabwe, south-western Australia, and Antarctica. Their considerable regional extent is somewhat offset by a low topographic relief and/or by deep weathering. Aside from a few exceptions, this younger generation of greenstone belts has in general attracted somewhat less scientific attention because thick, easily accessible, under-formed, nearly flat lying strata of the same age on the Kaapvaal Craton of South Africa and the Hamersley Basin of northwest Australia are available to provide detailed environmental information instead.

A particular and advantageous trait of the BGB is its current geomorphologic location just below the Drakensberg Escarpment. Along this escarpment, nearly flat lying younger cover strata are gradually receding continent-wards (at a mean rate of approximately 1 mm/a), suggesting that the region of the BGB has only recently been stripped of its protective cover yet still lies within the realm of significant topographic gradient. In a worldwide comparison the outstanding preservation (**Figure 1**) is incomparable to other greenstone belts elsewhere.

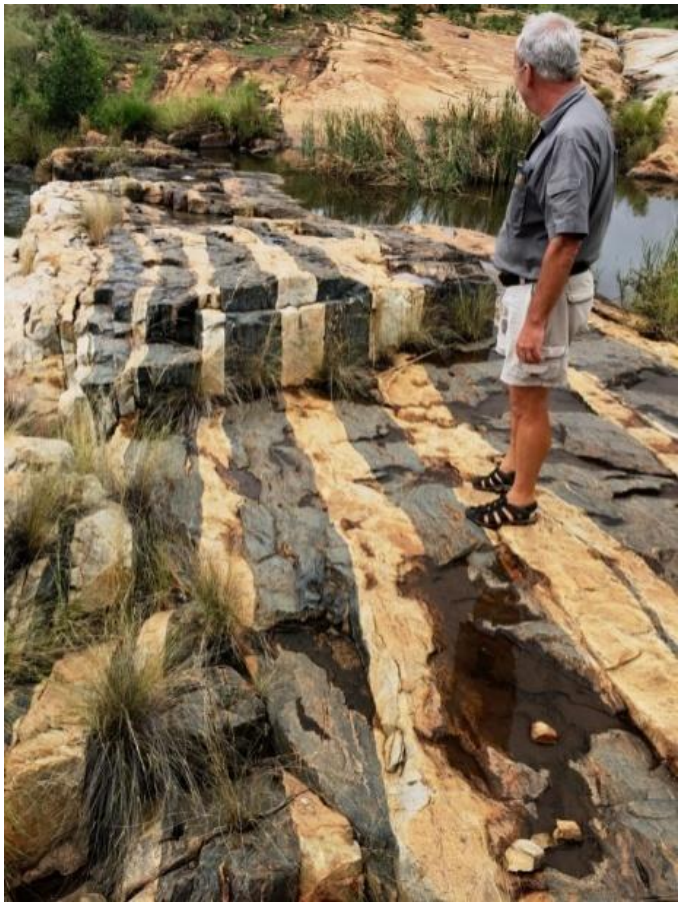

Figure 5. Examples of well preserved, pristine outcrops (migmatites and pillow lavas, respectively) occurring in the BGB.

A more detailed account of this section is given in **Appendix K.**

3.3 Proposed Statement of Outstanding Universal Value

- **Brief Synthesis**

Summary of facts: The Barberton Makhonjwa Mountains are referred to geologically as the Barberton Greenstone Belt (BGB). They are located in north-eastern South Africa, against the north-western border of Swaziland. This approximately 120 x 30 km stretch of rugged mountain terrain is substantially untransformed and includes a wide variety of Archaean rocks (from 3.6 to 3.25 Ga) that are highly accessible all year round. The 113 137 ha Property encompasses about 40% of the BGB, is protected by four major Nature Reserves and includes minor components of timber growing and livestock grazing lands (~15% each). Geoheritage values are identified at 300 registered geosites of which 51% (n=154) are encompassed within the Property. A 38 km motorised geotrail linking key geosites was built with illustrated information panels at lay-bys along a public road in 2014.

Summary of values: *The Barberton Makhonjwa Mountains contain the best-preserved, oldest and most diverse sequence of volcanic and sedimentary rocks on Earth. These well researched outcrops provide a globally unique source of information about the earliest measurable conditions of the Earth's gradually solidifying oceanic crust, from 3.5 billion years ago. From these rocks, more has been learned than from anywhere else about the surface processes at work as the Earth cooled from a molten body, to the creation of the primitive biosphere. This is the field repository for the genesis of life.*

Protected from beneath by rising plutons of granite, and later buried by a thick layer of Transvaal sediments, this 340 million year sequence of Archaean lavas and sediments has escaped both subduction and erosion for all of that time. They provide earliest evidence of the chemical nature of our oceans and atmosphere and of the way continents are formed – all unique attributes of our planet. Their outstanding universal value lies in both their remarkable state of preservation and in the variety of sites conveniently grouped together. That they occur in attractive surroundings with a comfortable climate, easy to access by researchers and the visiting public, extends their remarkable geological heritage value. Combined, they form a growing outdoor education facility at all levels and for many aspects of our present and past environments. There are literally hundreds of geosites of interest which, when their information is combined, allow the Barberton Makhonjwa Mountains to tell a richly consistent and as yet only partly explored story of how life on Earth began.

An inventory of all significant geosites within and associated with the BGB, has been compiled by a select group of geological scientists and researchers most familiar with the region. These data clearly show the number, distribution and variety of outcrops that have contributed so significantly to our understanding of the Archaean Eon. The project database records about 380 geosites representing the extraordinary variety of evidence available on what our planet was like three and a half billion years ago. Interpretation of most of these sites is formally recorded in more than 2 500 refereed scientific papers that have been published since the 1960s. As only about half the BGB has been thoroughly mapped by geologists, there is the potential for a similar number of new geosites to be added.

These special and spectacular features have the potential to enhance geo-heritage tourism. The findings of cutting-edge geological research, appropriately interpreted in dramatic mountainous landscapes with abundant wildlife and interesting cultural and historical features, provides an exciting and fascinating destination for visitors. The Property is a rich and inspiring outdoor education and recreation resource.

- **Criteria Under Which Inscription is Proposed**

The Property is proposed for inscription under **Criterion VIII,** given that it contains the best, most diverse and outstanding examples of rock outcrops from the Archaean stage of Earth's history. Its rocks have revealed the earliest record of single-celled life forms as well as the earliest and most significant geomorphic features, including detailed evidence of the processes involved in the evolution of the originally oxygen-free oceans and atmosphere, and creation of the first continental landforms**.**

Inscription is justified because the BGB is a truly unique remnant of the ancient Earth's crust, containing among the oldest, and undoubtedly the best-preserved sequence of volcanic and sedimentary rocks on Earth. These highly accessible ancient exposures present a continuous 340 million year sequence of rocks, starting 3 600 million years ago. Their physical and chemical characteristics provide an unparalleled source of scientific information about the early Earth. The outstanding value of these rocks lies in the large number of sites and features that, when combined, provide a unique, and as yet only partially explored, scientific resource.

The outstanding universal value of these rocks is due largely to their remarkable state of preservation. They are not entirely unaltered, but large areas exist where original components are intact for most rock types in a thick Archaean sequence. Geologists and paleo-biologists have learned more about the Earth's early history from these rocks than from any other comparable site elsewhere. Since the description of komatiites in 1969 a global network of researchers in the field of Archaean geology has been steadily producing new discoveries and testing new theories concerning the Earth's early evolution. Close to 3 000 geological papers on the BGB have been published in refereed research journals since the 1960s. Although rocks of similar age and even slightly older are known from elsewhere, none combines the outstanding and diverse characteristics of the Barberton Greenstone Belt. For more detail see **Appendix C.**

- **Statement of Integrity**

The geology of the Property has not been significantly damaged by human activities and the environment is substantially in a natural untransformed state. It includes no medium to large settlements, residential, mining, or any industrial areas. The entire 113 137 ha property lies within the BGB and covers some 40% of that geological formation. Nature Reserves that are natural and largely undeveloped comprise some 68% of the Property. Of the remainder, 17% comprises timber plantations and a further 15% comprises livestock grazing on untransformed natural pastureland. These three land-use zones are sustainably managed incompliance with the country's conservation, forestry and agriculture laws. Where the geology has been disturbed historically by a few small-scale mines and minor road cuttings, the scars have re-vegetated and stabilised naturally.

The Property's boundary encloses a fully representative sample of 154 registered rock outcrops (n= 300, i.e. 51% of geosites considered for inclusion).The distribution of all geosites (**Figure 3**) and the information they convey define a landscape of the highest scientific value in terms of Earth's earliest discernable history. The variety of geological processes, evident both as chemical signatures and as more visible physical structures within the rocks are also unmatched in any comparable area (see **Section 3.2**).

Of the many outstanding geological features of the BGB, the following have contributed most prominently to scientific knowledge and understanding of the evolution of the early earth:

- Evidence of the Earth's earliest life forms, including microfossils, stromatolites, biomats and other biologically derived material.
- Evidence of the earliest continent-forming processes showing how land masses emerged from the hot and murky Archaean oceans that dominated the planet's surface, with only scattered volcanic peaks aligned as island arcs in an otherwise endless sea.
- Evidence of the earliest large meteorite impact events occurring as spherule beds of molten rock droplets from a period of intense meteorite bombardment.
- Chemical and physical evidence of the nature of the Archaean atmosphere and oceans, the oxygen-free chemical soup that supported abundant single-celled life and created vast ocean-floor deposits of chemical sediments such as banded iron formations and coastal sand deposits showing tidal intervals and the earliest moon-Earth interactions.
- The 'type-locality' of the distinctive komatiite volcanic rocks, and pillow lavas, the komatiites being the hottest lavas by far to have ever emerged on the Earth's surface.
- Volcanic lapilli embedded in chert, appearing as pea-sized 'hailstones' of accreted volcanic ash and vaporised rock, that have settled into chert sediments on the Archaean sea floor. These extensive deposits signify the presence of airborne volcanism as comparised to the more common under water lava flows occurring at this time.
- Oldest migmatites at the Greenstone Belt margins, abundant exposures occur in the contact zones between the dark basaltic Archaean lavas and the plutons of lighter silica-rich granite rising beneath them. Spectacular patterns show evidence of melting and recrystallization due to intense pressures and extreme temperatures generated around the contact area (see cover photo).

Most Archaean lavas and sediments elsewhere in the world have been reheated or otherwise deformed (metamorphosed) in the slow but incessant movements of the Earth's outer shell. Such altered rocks no longer relate closely to the conditions at their site of origin at the Earth's surface. They therefore have substantially less value as sources of evolutionary information.

The purpose of protecting these sites is to safeguard their globally significant scientific and educational values, and to provide controlled access to them by the public and by scientists and researchers. At the most accessible geosites geological information has been interpreted for the benefit of visitors as part of an ongoing educational and tourism development programme. The vision for protecting and publicizing these sites is to maximize their combined scientific and educational value for all, and through creative development of this specialized niche in the tourism market, to benefit local communities through sustainable tourism.

- **Protection and Management Requirements**

It is necessary to consider all three types of land use in order to protect and manage the exceptional geological heritage of the Property. Management provisions and plans for the Property are set out in the Integrated Management Plan (IMP) in Section 5.e and **Appendix N**. The applicable legislative Acts are listed, together with the norms of land management in each of the three types of land use. All land owners have been made aware that Inscription of UNESCO WHS status for their land will result in this status also being endorsed on each property's Title Deeds in perpetuity.

In summary the Nature Reserves will continue to be managed for biodiversity conservation and tourism by their present agencies (see **Section 5.a**), each with their existing staff and budgets. The additional task of protecting and providing access to geosites will be easy for them to manage without significant increase in cost or effort. It will however, require some increased staff attention to the geosites on their land: to their

location and their access by the public, and to the interpretation of the stories emanating from the most significant geosites in terms of popular visitor interest.

The same applies to timber plantations and farming/ grazing land, only here there are no budgets or staff to protect geosites and manage visitor access. In these areas this task falls to the Management Agency of BMM who will achieve protection via the National Heritage Resources Act (1999) and coordinate visitor access via the individual Memoranda of Agreement signed by each land owner. All these legal and operational arrangements have already been agreed to in principle and will be formalised by negotiation with each land owner separately. The basis of any management protocols drawn up will be that each land-owner can continue to derive income from their land using existing or current land uses, save only that they must not have any negative impact on the UOVs of the Property. Detail on these matters is set out in IMP, in particular in **Section 7**.

The IMP describes the need to protect specific geosites (rock outcrops) and geological landscapes, and includes lists of what is, and what is not permitted to protect the OUVs of the Property. It also deals with visitor access and how to balance the promotion of tourism and safeguarding privacy and land-owner rights. Along with the relatively straight forward management tasks to protect rocks, the IMP also deals with monitoring needs, both of geosites and of visitors, and with more technical matters of the interpretative needs at geosites and their educational value, both to visitors and to local community members. Marketing the OUVs of the Property is also dealt with, as is the role of Scientific Advisors in having technical oversight for all scientific/ geological aspects of the Property. Finally the IMP lists staffing requirements with an indicative budget and future development priorities.

The National Heritage Resources Act (1999) provides the appropriate legislation for geosite protection on non-Protected Area land. Its implementing agency, SAHRA, has approved the protection of the geosites and is in the process of registering these geosites as described in **Section 1.e**, under 'Buffer Zones'. In recognition of the socio-economic circumstances of the region SAHRA has proposed an efficient and innovative way of legally defining these National Heritage Sites. In addition, this buffering mechanism for geosites outside PAs, will be registered on the IDP and SDF plans required by all Local Municipalities, thereby ensuring that all developments registered within their jurisdiction will be formally assessed to avoid such locations in terms of environmental and heritage impact regulations.

Long Term Challenges for the Property

Geoheritage protection and its resultant geotourism are new and untested concepts in South Africa. They are being developed without the benefit of tailor-made legislation, nor any appropriate institutional home. In the light of these special circumstances, the long term challenges for the Property include:

a) To develop geotourism as a growing and sustainable form of land use;
b) To develop the expertise to provide the interpretative interface between the geoheritage resource and the visitor.

4. Statement of Conservation & Factors Affecting the Property

4.a Present State of Conservation

The current state of conservation of the Property is considered to be good to excellent, given the existence of relatively large protected areas which are managed by the provincial conservation agency, MTPA and private landowners. The timber plantations are well managed by national standards and the farming and grazing lands show little sign of soil erosion or over-use and are generally compliant with applicable legislation. All protected areas are routinely patrolled with an emphasis on monitoring the wellbeing of wildlife populations, rare and endangered species and ecosystem functioning. All the larger protected areas have been re-stocked with selected large mammals native to the region and attractive to visitors. Visitor facilities are provided by the state and by private owners and commercial tenants. Further detail on the state of environmental conservation is not provided here as it has little bearing on the Property's OUVs.

'Conservation' as applied to geological assets has a different meaning compared to its conventional use as applying to living resources. Active protection of rock outcrops has not been part of the Property's history but damage to known geosites has been limited and superficial. The status quo in this regard is that the lack of any history of protection has had very little negative impact on the value and appearance of known geosites. In many instances, such 'damage' has provided considerable net gain in geosite visibility and understanding, such as from research sampling of rocks.

There is evidence of prospecting, trenching and small scale mining, dating from the last 80 to 120 years. But this activity has ceased and the evidence is no longer obvious, having been reclaimed by natural vegetation. Some outcrops had economic value such as the baryte in 'Baryte Valley' and a neighbouring small outcrop of an unusual silicified conglomerate nicknamed 'pudding-stone', which was mined for decorative purposes in the 1940s. These two shallow quarried outcrops occur outside formal PAs and have become rehabilitated naturally. There are no mining rights granted on the Property. However, there have been some objections by mining companies asserting that their future exploration and expansion may be inhibited by the WHS.

4.b Factors Affecting the Property

There are few factors that affect the Property's geological assets. The major impacts on the land and environment have come from the land management practices as implemented by MTPA and land owners in the Nature Reserves; the timber companies that comply with the forestry legislation, and farmers who comply with the agriculture legislation. Adverse factors that have environmental impacts on the Property, but not its geological heritage, include: spread of alien invasive species; increased soil erosion; reduced water yield from catchments, road excavation and bridge construction; small borrow-pit areas for building materials and some youthful vandalism.

The National Environmental Management: Protected Areas Act (2003) ensures that no mining, agricultural tillage and timber growing can take place within protected areas. Mining in protected areas is also specifically prohibited by the MPRDA (Minerals and Petroleum Resources Development Act, 2003).

Nature Reserve management plans provide for alien plant control. The state provides widely funded alien plant control programmes. These are long established job-creation initiatives that fund invasive and alien plant control projects throughout the country, with PAs identified as priority areas.

Major road and bridge construction is considered to be a minimal threat at present as the current network is adequate. For a tabulated summary of these factors, refer to **Appendix N.**

(i) Development Pressures

There are no significant development pressures on the Property. Old deep mining adits extend underground into the Barberton Nature Reserve but these have no effect on the environment or its surface geology. There is pressure to obtain new prospecting rights within Barberton Nature Reserve, which are currently being opposed by MTPA and associated land owners through the courts on the basis of the prohibitions on mining contained in NEMPAA and MPRDA.

(ii) Environmental Pressures

There are no detectable impacts on the geology from environmental pressures such as pollution, climate change and desertification. As far as climate change is concerned, broad predictions suggest that the eastern escarpment edge of South Africa will probably get warmer and wetter as a result of climate change. Several studies suggest that the mountainous terrain of the BGB is an important climate change refuge for biodiversity. To some extent, photographic evidence is available to suggest that the vegetation changes over the last century support this prediction, in that there has been an increase in woody vegetation and a decrease in open grasslands.

(iii) Natural Disasters and Risk Preparedness

There are no indications that natural disasters that merit special risk preparedness are at all likely. The landscape is extremely stable, i.e. seismically inactive and is structured in such a way that flood or fire disasters are assessed as having very low associated risk, except that is, for timber plantations. Control measures are in place in the event of any wildfires that may occur and all land users are well versed in their implementation. Timber companies, the state and nature reserve management authorities all have access to well established and regulated fire fighting capacity.

(iv) Responsible visitation at World Heritage Sites

Due to the nature of the topography, the proximity of developed wildlife attractions such as Kruger NP, as well as relatively few access roads being present, the Property is considered not suitable for high density tourism. Mountainous broken country evokes a strictly wilderness sense of place. This implies low visitor densities, undeveloped surroundings, and low-tech access facilities. With the advent of the Barberton Makhonjwa Geotrail and several tourism developments outside of the Property it is anticipated that geo-tourism will continue to develop and grow. The Integrated Management Plans for the Property's Nature Reserves include proposals for building visitor accommodation and other facilities.

A Trans-Frontier Conservation Area (TFCA) was brought into being in 2006 involving Songimvelo (South Africa) and Malolotja (Swaziland) Nature Reserves. The objective of the TFCA initiative is:

> *"conservation areas that straddle national borders, of sufficient extent to incorporate entire biomes; of sufficient integrity to restore the ancient patterns of diverse ecological communities, and of*

sufficient vision to reconnect the shared cultures of tribal peoples, dislocated when colonial rulers arbitrarily imposed Africa's borders." (Peace Parks Foundation)

In 2005 management plans for both properties were updated (and since reviewed) and a trans-border planning exercise was commissioned to plan for the mutually beneficial development of the joint property for tourism. This was completed in 2006, listing key attractions and recommending access routes and accommodation and adventure facilities suitable for the sustainable use of the area to generate income. The tourism plan is illustrated below by the synoptic map of the overall recommendations (**Figure 6**). Progress has been made with agreements between the two countries to enable cross border functionality to be realized. The potential is for possible future extension of protection for the shared geological heritage of this region given that the BGB extends into Swaziland, and hopefully in the future a trans-frontier WHS.

(v) Number of Inhabitants within the Property

Current records show the following known residents in the two state managed Nature Reserves:

- Songimvelo NR: approximately 25 families; initiatives are underway to provide security of tenure for these families.
- Barberton (Mountainlands) NR: 8 families; formal arrangements to provide security of tenure for these families outside the Property are in place and relocation is in process.

The number of people resident in communal areas in the Komati valley has not yet been established. Each locality (and property) has multiple owners and unknown numbers of dependents, often with uncertain or multiple residency. As an estimate, in the Theespruit area it would amount to less than 50, and in the Tjakastad area probably around 250 people.

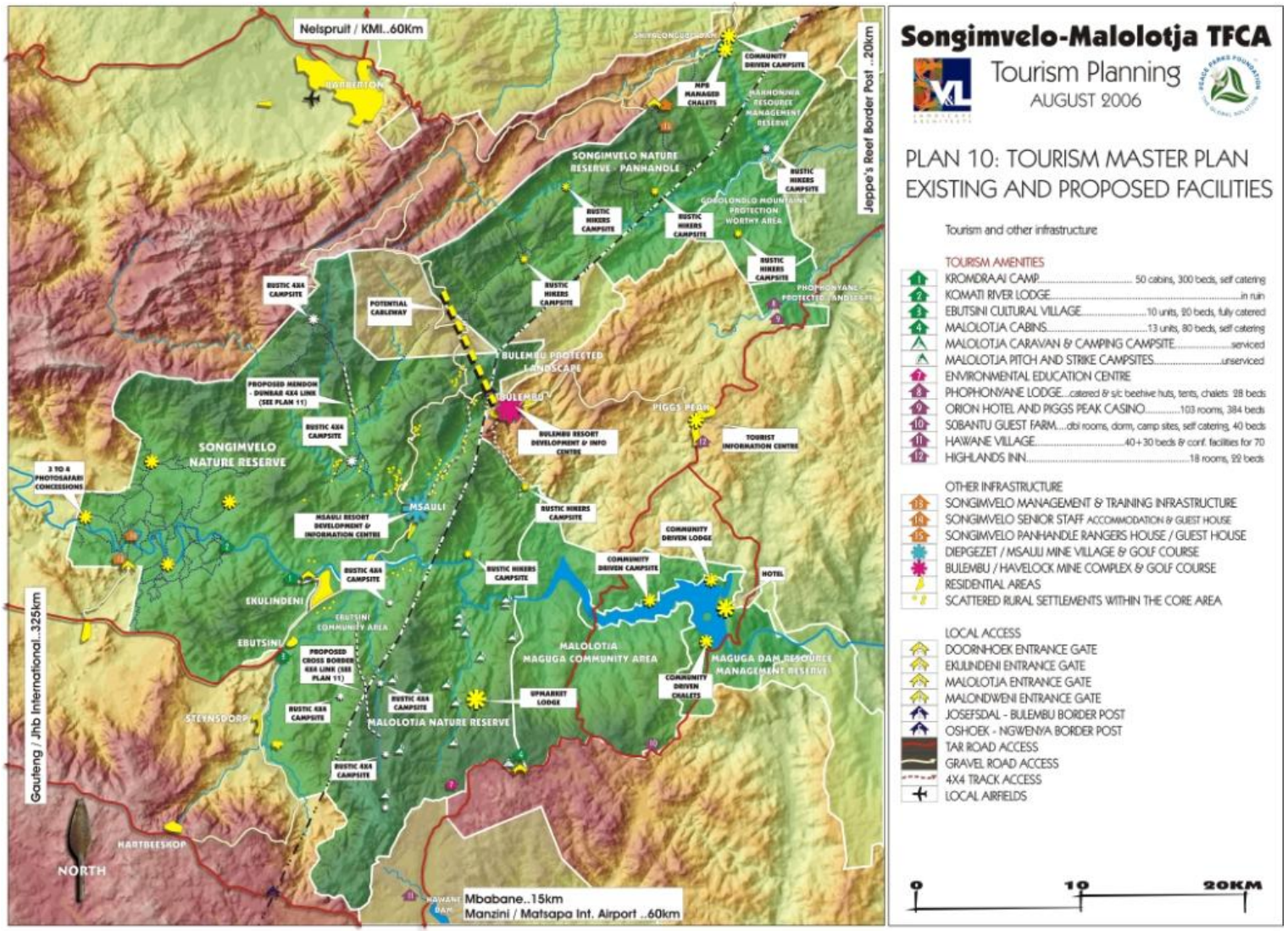

Figure 6. Songimvelo-Malalotja TFCA – Tourism Master Plan**.**

5. Protection and Management of the Property

5.a Ownership

Three categories of land ownership occur within the Property: State, private, and communal ownership (see **Table 5**).

Figure 7 & **8** indicate the location, extent and general distribution of these different ownerships of land within the Property. Estimates of the number of people resident within the two municipalities in the region are provided in **Table 6.**

From 2009 a process to create awareness among land owners and other local and national stakeholders, regarding the intention to achieve UNESCO World Heritage Site status for the Property, has been undertaken and is ongoing. This effort looked to gain the support for the nomination by local communities, businesses and state and municipal authorities at all levels. These efforts were remarkably successful until a hiatus in funding occurred in 2010. This interruption resulted from the co-incidence of a National election in 2009 and the moving of institutional responsibility for World Heritage from the National Dept of Arts and Culture, back to the Dept of Environmental Affairs as part of a routine exchange of responsibilities. These events changed all the role players at both national and provincial levels causing the interruption of funding and reassessment of institutional priorities. The role of the land owners and BATOBIC in re-establishing these priorities has been noteworthy and successful. It has resulted in firm written support from all parties from DEA, the Provincial Premier, through Local Municipalities and individual land owners (see **Section 3.1.e**).

The Property covers a large geographical area and crosses two municipal boundaries resulting in a large number of stakeholders. A comprehensive, multi-faceted, and flexible communications strategy has been undertaken and records kept of all meetings, etc. The communication programme included engagements with land owners, state departments, municipalities, land claimants, local communities, traditional leaders, business owners and the general public (**see Appendix J**)**.**

From 2015, additional interested and affected parties (I&APs) were identified and their details and views recorded. Although the consultation process was interrupted by several years, landowners and communities readily returned to resume the process through meetings and discussions that rapidly restored dialog and understanding. Renewed funding in 2015 allowed for more thorough and intensive stakeholder engagement second time around. Three main groups of I&APs were identified and each engaged through letters, emails, and meetings. They included: (i) owners and custodians of land with potential for inclusion such as: state and corporate land owners, private individuals and communal land owners, tenants, traditional councils, provincial and municipal authorities; (ii) tourism operators/service providers and indirectly affected parties such as interested business owners; (iii) the general public, engaged generally through the media and public meetings. A summary and record of these engagements is provided in **Appendix J.** This quite intensive activity has resulted in widespread support from most stakeholders consulted about this WHS initiative, to the extent that the land owners involved can now be seen to have played a vital role in reviving the support necessary to get the project re-funded and back on track.

The only formal objections have come from mining companies whose operations are situated close to the WHS boundaries. Two companies adjacent to the Property have objected, both of which have been in operation for several decades before the nature reserves were proclaimed. Although their existing mining rights areas have been specifically excluded from the WHS, their objections are based on WHS status restricting their ability to prospect and expand in the future. Current legislation provides for the conditional continuation of mining rights obtained before the prohibition on mining in protected areas, was imposed by NEMPAA and MPRDA in 2003. The effect is that no new mining or prospecting rights may be issued on nature reserves or other protected areas, including WHSs. The areas to which these objections pertain would in any event not have been legally exploitable for mining due to being in nature reserves. These objections are being responded to via appropriate administrative and legal channels in terms of existing legislation.

Table 5. Classification of land uses and ownership

Land use	Owner	Area Totals
Conservation and Tourism - Barberton Nature Reserve (Mountainlands)	MTPA	**13 078 ha**
	Mountainlands Estate Owners Association (and associates)	
	Simply See (Pty) Ltd	
	Way Prop Two (Pty) Ltd	
	Lomshiyo Trust	
Songimvelo Nature Reserve	MTPA	**33 798 ha**
		12 476 ha
Nkomazi Wilderness and Komati Springs	Dubai World (and associates)	**14 268 ha**
	Don & Andre Shirley & Partner	**349 ha**
Queens River Nature Reserve	DARDLEA	**1625 ha**
Barberton Private Nature Reserve	Mbombela Municipality (Prev. Umjindi)	**164 ha**
	SAPPI Manufacturing	**236 ha**
Cythna Letty, Ida Doyer and Tinie Louw Nature Reserves	MTPA	**49 ha**
Intensive Tourism Area – 'Cradle of Life'	Mountainview Investments (Pty) Ltd	**922 ha**
	Sub-Total	**76 965 ha**
Timber plantations	SAPPI Manufacturing	**17 342 ha**
	York Timbers	**1 361 ha**
	Sub-Total	**18 703 ha**
Livestock & farming **Western Area**	Vergelegen Trust / J D van Schalkwyk	**1858 ha**
	Ndwandwe Trust / Jerry Mashinini	**569 ha**
South Western Area	Mashoba Community Trust	**8520 ha**
	Inkalane Communal Property Assoc.	
	Mswati Communal Property Assoc.	
	Nkomazi Properties. Pty Ltd	
	Mr du Plessis / Theeboom	
	Albert Luthuli Local Municipality	
South central Area	Albert Luthuli Local Municipality	**5 460 ha**
		1 061 ha
	Sub-Total	**17 469 ha**
	GRAND TOTAL	**113 137 ha**

A comparative analysis of Census Data between 2001 and 2011 has shown an increase in population levels of each local municipality except for Albert Luthuli where a slight decrease (from 187,936 in 2001) is evident. The most significant increase over the 10 year period is in Umjindi (25% population growth), followed by Mbombela (24% population growth) and then Nkomazi (18% population growth). The average household size, of between 3 and 4, is common across the province and has not seen a significant adjustment in the last 10 years. A detailed baseline socio-economic report, and economic impact analysis is given in **Appendices L & M,** respectively.

Table 6. Population Profile of the two Local Municipalities within which the Property falls (from Stats SA, 2011).

Socio-Economic Indicators	***Umjindi Local Municipality***	***Albert Luthuli Local Municipality***
Total number of people	*67,146*	*185,988*
Total number of households	*19,557*	*47,691*
Average size of households	3	4

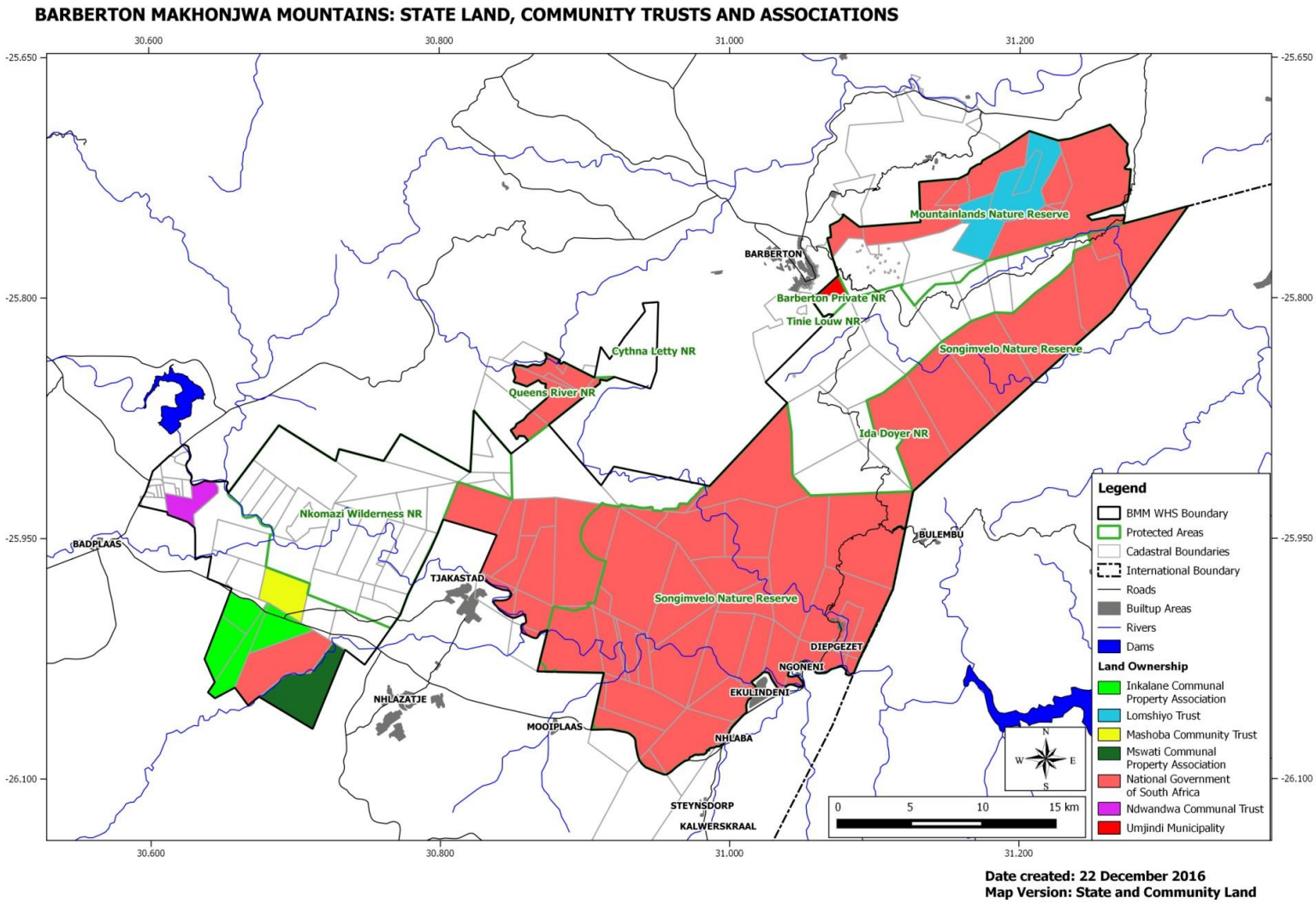

Figure 7. Land ownership map – State Land, Community Trusts and Communal Property Associations.

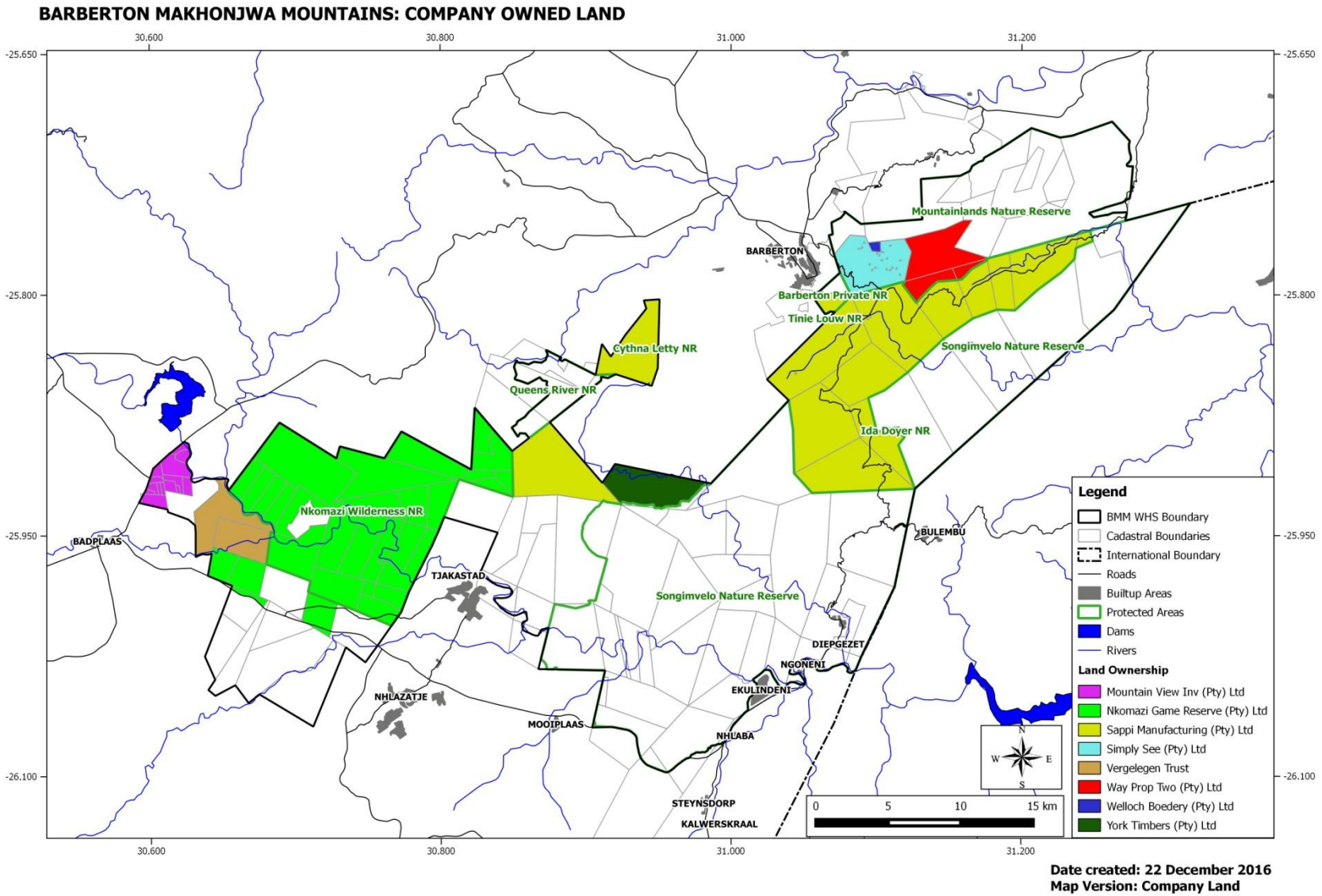

Figure 8. Land ownership map – Private and Corporate.

5.b Protective Designation

The following areas are acknowledged in terms of the National Environmental Management: Protected Areas Act 2003 to be Nature Reserves and Protected Areas:

Songimvelo Nature Reserve (two sections)	46210 ha
Barberton Nature Reserve, Phase 3 (Mountainlands)	Remaining area = 13080 ha
Nkomazi Wilderness	14267 ha
Queens River Catchment Reserve	1625 ha
Three small Botanical Reserves & Barberton Private NR	449 ha

5.c Means of Implementing Protective Measures

In terms of the Constitution of the Republic of South Africa nature conservation is a concurrent responsibility at all levels of government. The principle legislative Acts under which Protected Areas are promulgated and managed therefore include both national and provincial laws: Those applicable to this proposed World Heritage Site are listed in Section 3 of the Integrated Management Plan (ref **Section 5.e** below). For geosites occurring within the Property but outside protected areas the National Heritage Resources Act (1999) is invoked by SAHRA in a process that is ongoing, and is intended to include all significant geosites in due course. In addition, all development is required to be assessed in terms of the National Environmental Management Act (1998) and its Environmental Impact Assessment regulations. These procedures are referred to with more detail in the IMP (**Appendix N**)

5.d Existing Plans Related to Municipality and Region

Biodiversity conservation planning. The Mpumalanga Tourism and Parks Agency (MTPA) is responsible for biodiversity conservation and tourism development throughout the province, and most specifically within Protected Areas for which they are the appointed management authority in terms of NEMPAA. This authority extends in an oversight capacity for private reserves such as Nkomazi Wilderness, the practical management of which remains the responsibility of the land owner. Compilation of Integrated Management Plans (IMPs) is usually outsourced by both state and private management authorities resulting in thorough procedures and professional documents. Such IMPs have been completed for Barberton and Songimvelo Nature Reserves by MTPA and for Nkomazi Wilderness by its owners and are appended to this Nomination Dossier. These IMP's comply with the requirements and standards set by NEMPAA.

MTPA has plans to expand biodiversity protection by way of their systematic Biodiversity Conservation Plan which identifies biodiversity hotspots based on real data that allow for objective setting of regional conservation priorities. The Mpumalanga Protected Area Expansion Strategy (MPAES, 2009) aligns with the National Protected Area Expansion Strategy (NPAES, 2008). Thus far MPAES has indicated two priority areas within the Property [Angle Station" (1155 ha) and "Oosterbeek" (1599 ha)], both of which lie in the belt of Sappi-owned timber plantations between Barberton (Mountainlands) and Songimvelo Nature Reserves. These areas are earmarked for proclamation as nature reserves.

In addition, SAPPI manages other natural areas that include indigenous forest patches, river lines, grassland fire-break belts, high ridges and other areas which could in future be considered for formal protection. This is particularly relevant for the Property as it includes most of the high ridges and peaks where the most prominent rock exposures occur. It also includes river lines required to be kept clear of timber species and other alien plants in terms of the National Forest Act (1998) and in terms of the Forest Stewardship Council rules. Both these "rivers & ridges" features include important geological outcrops at a landscape-scale that are not only highly visible but will be areas kept accessible for geological researchers. In addition, these areas

usually provide important biodiversity links and corridors between nature reserves, thus improving connectivity and sustainability for biodiversity.

The Property falls within the administrative districts of two District Municipalities (DM) and two Local Municipalities (LM):

- Ehlanzeni District Municipality incorporates the newly expanded Mbombela Local Municipality (amalgamation of two local municipalities: Umjindi LM (Barberton) and Mbombela LM (Nelspruit)) and
- Gert Sibande District Municipality incorporates the Albert Luthuli Local Municipality (Carolina).

They all have responsibilities for planning and developing the areas under their control. All Local Municipalities are guided in their development priorities by the relevant national and provincial plans and mandatory planning processes and documents, including:

- Integrated Management Plans (IDPs)
- Spatial Development Frameworks (SDFs) and
- Land Use Management Systems (LUMS).

These approved municipal documents list and track the progress of each municipality's development priorities. All affected Municipalities have been informed about the existence of the BMM WHS initiative and have it registered in all planning documents and have given their support for the project, including delegating high level representatives to attend project meetings.

The Mpumalanga Province is an important destination for both foreign and domestic tourists in South Africa. Leisure is the primary purpose for visiting the province with the length of stay and number of day trips taken by both foreign and domestic visitors increasing compared to previous years.

Umjindi and Albert Luthuli Local Municipality Integrated Development Plans

- The draft Umjindi Integrated Development Plan (IDP - 2015/2016) identified Barberton/Umjindi as an area with the highest potential to grow into a major tourism destination with initiatives such as the development of the Barberton (Mountainlands) Nature Reserve as an anchor project. A well-developed hospitality industry is in place that can support tourism. Local communities are actively involved in tourism opportunities identified and implemented in the region. Tourism officials are to be empowered to develop and implement a generic marketing strategy and network with other organisations with the same objectives. Improvements to services such as sanitation, roads and stormwater management especially at informal rural villages is to be attended to. Environmental management to ensure optimum use of natural resources in the area without endangering the region's suitability for nature based tourism has been identified as a priority. Conservation of biodiversity of the area is seen as being crucial to Umjindi's future economic development.

- The Integrated Development Plan (2014/2015) for the Albert Luthuli Local Municipality found that the municipal area has abundant natural and cultural resources which, if developed, can enhance tourism. Tourism development could be a leading economic sector for the municipality by tapping into emerging local, domestic and international tourist markets and in turn provide income to local people. Currently there are few areas that have been developed for tourism purposes. Songimvelo Nature Reserve is the largest provincial protected area in Mpumalanga and has been linked to Malolotja Nature reserve in Swaziland as a Trans Frontier Conservation Area. This important agreement will, through cooperative development and management, enhance tourism in the region.

5.e Property Management Plan

Appointment of a WHS Management Authority (MA)

For a schematic overview of how the various components of the property are currently managed, mainly for nature conservation and related tourism development, see **Table 2**. This shows 67% of the property currently managed as formal protected areas of which 53% is managed by MTPA and 14% is managed by private landowners under the oversight of the MTPA, all for nature conservation. In a wider sense MTPA also provides provincial level support in fields such as biodiversity and ecosystem management; environmental law enforcement; tourism marketing; biodiversity and sustainability management and research. Add to this array of integrated management functions and it is clear that a de facto Management Authority to a large degree already exists with substantial staff and budget committed to natural resource protection and tourism development. The additional geoheritage management function is a relatively minor addition to the MA's task, focussing as it does on protection of rock outcrops and making them accessible and understandable to visitors. Provision for this relatively small added management capacity will be provided on WHS inscription by MTPA acting as the BMM WHS Management Agency.

Added to the above, the geological significance of the area has been known for many years and gained specific prominence since the 1980's. As such both the MTPA and other MA's of both protected areas and the remaining land of the Property have since then been protecting the geoheritage through their existing management functions anyway and are largely responsible for the current pristine state of the region's geoheritage.

Currently the Property is managed by several agencies, public and private. MTPA and private tourism businesses manage the major functioning nature reserves. Timber plantations have corporate management structures and farm land is managed either by private owner-businesses or by communal ownership structures (Communal Property Associations and Trusts).

The mandate for WHS management in South Africa rests with the Minister of Environmental Affairs. Should the Property be endorsed by UNESCO as a World Heritage Site, this mandate will be delegated to the Mpumalanga Member of the Executive Council (MEC) responsible for the Department of Economic Development and Tourism (DEDT) in terms of the South African World Heritage Convention Act (1999). The MEC will in turn delegate this authority to the MTPA who will act as Management Authority (MA) for the Property. The MTPA is a parastatal agency responsible to the above MEC and funded by provincial government.

Because the WHS interest is focussed on rocks and geology, it is envisaged that all land owners and their management agencies will be free to continue their existing businesses on their land with minimal constraint resulting from WHS status. The MTPA will establish a management board/council that will include representatives of land owners, who will be charged with directing Management Authority functions. These functions will be limited to the care, protection and presentation of geological assets and the co-ordination of common interests between land owners, the authorities and tourism interests. The MA will also have responsibility for developing and marketing tourism over the Property. Management of all Nature Reserves will continue to be undertaken by existing staff with existing budgets in line with their approved Management Plans. These management arrangements will be clarified and form part of an agreement to be entered into between all landowners and the State on WHS Inscription.

<u>Management Plans in General</u>

Management Plans exist for the state owned and managed Songimvelo Nature Reserve, the private Nkomazi Game Reserve and the mixed ownership, Barberton Nature Reserve. The requirements for management plans for Protected Areas in South Africa are set out in NEMPAA (see **IMP Section 3**). Biodiversity conservation, general management and associated tourism development, are described in detail in these

plans which also define the purpose and management objectives for each Protected Area. Current Nature Reserve Management Plans are attached (**Appendices D, E, & F**).

Geological protection is adequately provided for by the normal implementation of nature conservation measures. The existence of the region's unique geology is referred to in the plans and has been implemented for protection of the geology for a number of years. These plans are to be revised and updated in order to further develop geological tourism beyond that of the Geotrail and other similar developments.

All timber growing properties have detailed production and management plans for their core business. For their unplanted areas (~30 to 40% of their collective area) they have plans for natural landscape protection and tourism access to areas of valuable biodiversity and attractive scenery. The most deserving of these natural areas are being actively planned for full nature reserve status. The timber growing properties of SAPPI and York Timbers included in the Property are also certified by the Forest Stewardship Council (FSC) under the certification category for Forest Management. The rigorous certification process which includes both social and environmental responsibility, will more than adequately meet the Property's needs to ensure sound geoheritage management on timber plantations as long as the relevant geosites are clearly identified and listed and brought to the attention of the companies. The Forest Stewardship Council is a non-profit entity that supports environmentally appropriate, socially beneficial and economically viable management of the world's forests. FSC independently tracks and identifies wood fibres through every step of the procurement, manufacturing and printing process, confirming that each supplier in the chain follows rigorous controls, management and reporting practices. These plans and certifications are a key element of modern international forestry companies' business and sustainability models and in this case provide useful incentives for extending nature conservation and supporting outdoor tourism within and to the Property.

Timber production is controlled nationally by the Department of Forestry under a permit system and is fully subscribed in this region. No new areas may be planted as the limit to ensure sustainable water yields has already been reached in these river catchment areas. This ceiling for timber plantations is also the subject of a transboundary water catchment management agreement between South Africa and downstream water users, Swaziland and Mozambique.

<u>Management of the Property</u>

Management and monitoring activities for biodiversity that are the norms for South African protected areas and that apply to the Property, include the following (not an exhaustive list):

- Establish by proclamation, maintain & monitor PA boundaries, which are usually fenced as required,
- Protect, police and monitor the property by means of internal patrolling by trained & equipped staff,
- Control, manage, monitor and minimise all illegal activities,
- Investigate and prosecute those who break the law,
- Develop good neighbour relations and negotiate issues of common concern with communities,
- Develop, maintain and monitor facilities and infrastructure for park management,
- Develop, maintain and monitor facilities and infrastructure for visitors and tourism, including staffing of entrance gates,
- Provide interpretative displays and facilities, materials and services for visitors,
- Provide for a variety of visitor activities for their enjoyment and education,
- Periodically monitor the status of biodiversity (plants & animals),
- Compile and review Biodiversity Management Plans for rare and endangered species,

- Monitor and control invasive alien species,
- Record and monitor all management interventions (animal population control, grazing patterns; fires, etc.),
- Control wildfires and manage habitats as required by relevant management plans,
- Provide and maintain fire breaks and erosion control works,
- Revise and update IMPs at regular intervals.

Implementing the above will guarantee effective protection of both living and non-living assets within the Property. Normal biodiversity and tourism management of the PAs included within the Property will be more than adequate to protect and manage its included geological heritage.

Such management norms and standards and wildlife management procedures are well established in South Africa, both in law and in practice. State managed Songimvelo and Barberton Nature Reserves, as well as the privately managed Nkomazi Wilderness, each have a comprehensive management and development plan (**Appendices D, E, & F**). The shared objective of these plans is to protect and enhance biodiversity and the sustainable functioning of ecosystems for the benefit of future generations and for the enjoyment and education of visitors. Collectively and economically they serve to provide sustainable tourism-based economic benefits to local people.

The actions required to protect rock outcrops can be reduced to a focus on controlling a limited number of human activities. These include activities that involve: construction; excavation; artificial flooding; and any damage to, or defacement of rocks, such as by hammering or painting an outcrop. Achieving control over these activities and other management details are elaborated in the IMP (**Appendix N**).

Management of geoheritage and geotourism

Protection and management of geosites and geological landscapes inside the Property, as well as important registered geosites located outside the Property, will be effected in several ways. As stated above, nature conservation management will be more than sufficient to protect these assets and make them accessible to visitors within PAs. In timber plantations and farming and grazing land both management and access for visitors will need to be a little more personalised to each individual landowner's needs. These details will be the subject of specific Memoranda of Agreement between each land owner and the State.

The existence of geosites and wider geoheritage assets in timber plantations and farming land puts their protection beyond the reach of the environmental legislation applicable to PAs but leaves it in the realm of environmental legislation of general application. This vulnerability, combined with the need for national recognition before WHS inscription, requires these geological assets to be declared in terms of the National Heritage Resources Act (1999). This Act is administered by the South African Heritage Resources Agency (SAHRA) who has already graded the ~50 Grade 1 geosites lying outside PA boundaries but within the Property's perimeter. This has been an unprecedented task undertaken by SAHRA who has expressed the intention of ultimately grading and declaring all significant geosites, both within the Property and beyond its borders. As this process continues, all such geosites will be registered against the title deeds of the relevant properties as National Heritage Sites in terms of NHRA. These procedures are dealt with in more detail in the IMP (**Appendix N**).

These legal protocols and procedures are being implemented by agencies that have little expertise in the science and fieldwork involved in geological exploration. However, the suite of environmental, heritage and land use legislation and policies in South Africa, are considered adequate for the purpose of protecting geoheritage. In due course the implementation of these measures will be the responsibility of the Property's Management Authority who will also have to manage geological research applications and all proposals for

development and changes of land use. These tasks and others specific to the special geological values of this Property and its wider region are dealt with in more detail in the IMP. They will require the MA to establish a wide network of scientific geological advisors so as to gain the necessary experience in these technical matters as quickly as possible.

5.f Sources and Levels of Finance

Most of the properties included in this proposal are supported by current management budgets and associated personnel, tasked with promoting conservation and/or tourism to varying extents. **Table 7.a** lists the estimated annual budgets for these properties and their existing capacity and ongoing commitment to activities that are entirely in line with the objectives of the proposed WHS. These numbers, together with the inventory of personnel involved (**Table 8**) quantify the commitment of the *de facto* Management Agency to natural resource protection and promotion of tourism within the Property.

The agencies that have committed to supporting the WHS project, have wider regional and provincial responsibilities that contribute support from oversight and off-site functions involving additional personnel and access to additional sources of finance (e.g. wider biodiversity protection and tourism promotion; marketing; law enforcement; research etc). It is not possible to apportion specific contributions that directly support the included properties but **Table 7.b** gives a sense of the extent and potential of this commitment. At present the relevance of this support may be smaller for some and larger for other entities, as the planning for WHS inscription has already been incorporated into all their levels of planning to varying degrees. However when WHS Inscription takes place the prominence of the event will hit home and the Property will become a high profile event leading to further reshuffling of priorities at all levels from provincial through to municipal agencies.

Table 7. Sources and Levels of Finances

a) Property specific funding

DESCRIPTION	SOURCE	ANNUAL AMOUNT	WHAT IT PAYS FOR
Songimvelo NR – both sections	State/MTPA and Private tourism operator	R 17 141 569	Protected area management and tourism operations & marketing
Barberton NR (Mountainlands) – overall	State/MTPA & Private landowners	R 4 380 300	Protected area management both entities
Nkomazi GR – overall	Corporate: Dubai World & Nkomati Springs	R 19 687 000	Protected area management, tourism operations & marketing
Cradle of Life	Corporate: Cradle of Life	R 17 781 837	Estate management, tourism operations & marketing
Sappi	Corporate: Sappi	R 4 300 000	Conservation contribution to overall plantation management
	TOTAL	**R 63 290 706 (4 520 764 USD)**	

b) General funding towards conservation and tourism mandates

DESCRIPTION	SOURCE	ANNUAL AMOUNT	WHAT IT PAYS FOR
MTPA – Conservation mandate general	State	R 67 030 000	Provincial Conservation Mandate (i.e excluding PA's)
MTPA – Tourism Development & Marketing Mandate	State	R 30 738 000	Provincial Tourism Development & Marketing
Ehlanzeni District Municipality - Tourism Development & Marketing Mandate	State	R 15 272 188	District Economic Development & Marketing
Mbombela Local Municipality - Tourism Development & Marketing Mandate	State	R 12 144 606	Local Economic Development & Marketing
Gert Sibande District Municipality - Tourism Development & Marketing Mandate	State	R 11 500 010	District Economic Development & Marketing
Albert Luthuli Local Municipality - Tourism Development & Marketing Mandate	State	R 1 349 531	Local Economic Development & Marketing
Kruger Lowveld Chamber of Business and Tourism	Organised business	R 7 112 959	District Tourism Marketing (Limited Development)
Barberton Community Tourism	Organised business	R 450 000	Local Tourism Marketing
BATOBIC	Organised business & State	R 3 295 634	District Tourism Development (Limited Marketing)
	TOTAL	**R 148 892 928 (USD 10 635 209**	

Note: *Figures were obtained from the entities indicated and are considered only as a guideline based on immediate past financial information as available. Only major owners and enterprises were included. The nature of the different enterprises and entities makes comparisons difficult.*

5.g Sources of Expertise and Training

There are more than twelve internationally accredited Universities in South Africa producing the full range of professional graduates in all the fields of expertise that a National Park agency would need. These establishments are supplemented by technical training institutions (Technikons) producing graduates suitable for park and land management and administration, guiding, interpretation, tourism, hospitality etc. The Southern African Wildlife College located near Kruger NP about 120 km north of Nelspruit, trains park managers and administrators from all over Africa.

A major development is planned by BATOBIC for a Visitor Information and Geoheritage Interpretation Centre, located at a key gateway to the Property at Rimer's Creek in Barberton. It will be located just a few hundred meters from the future WHS boundary. Its concept includes developing interpretative skills and relevant geological and integrated park management expertise, linked to national and international institutions and networks for scientific research and education. Although this is at an early planning stage, BATOBIC has already started their capacity building work by helping to train local community leaders and landowners, in their future management role.

Nkomazi GR employs a wide range of staff, all appropriately qualified as graduates of national and regional training facilities as listed above. These personnel, who include experienced senior managers, are accessed through normal human resources marketing procedures. It is an active and very competitive market in South Africa, driven by the large private wildlife tourism sector.

The timber companies on the Property all employ formally trained foresters and other staff with various conservation related training in dedicated sustainability divisions. Several universities offer degree courses in forestry and there is also the Saasveld College of Forestry (now Nelson Mandela Metropolitan University – George Campus, College of Forestry) that has trained foresters in timber production for decades. These institutions offer various courses (full degree or diploma certificate) all of which have strong sustainability and conservation components.

The MTPA employs around 700 people in the various fields related to: conservation, law enforcement, tourism, hospitality and marketing. It has a comprehensive training and skills development programme for staff from administrators to field managers, rangers and assistants. MTPA has a sound track record in most professional and technical areas under its responsibility; in some cases special skills are contracted-in to perform specific tasks. Integrated park planning is one of these.

The community representatives, who are the decision makers and managers of their land included within the Property, have access to some training in the fields of protected area management and development. In practice this is fairly informal and often provided by 'learning-on-the-job'. Training specifically for geo-heritage management and especially for providing interpretative services for geo-tourism, has not yet been provided. Such training is specialised, fairly site-specific and has no local precedent. This will have to be developed on site and will require dedicated support. Here the Geotrail interpretative products and subsequent management and guiding involvement will provide the most appropriate training experience.

5.h Visitor facilities and Infrastructure

Figure 9 'Genesis Route' below gives an indication of the distribution of various attractions, accommodation facilities and essential services located on and around the Property.

Barberton Nature Reserve - Mountainlands (main section)

Only guided entry for visitors is provided and/or by arrangement with owners.

Songimvelo Nature Reserve (Komati River section)

Main public entrance gate and nearby day visitor facility with picnic site and swimming pool, together with a network of +/- 50 km of game viewing roads both north and south of the Komati river.

Ekulindeni entrance gate and Kromdraai Camp: 20 x 4-bed, log cabins with self-contained ablutions; self-catering and swimming pool. Cabins have been recently refurbished. No access to internal game viewing roads but visitors may undertake guided walks, access excellent geosites or fish in the river by arrangement.

Songimvelo Nature Reserve (Panhandle section)

The section is a wilderness area; access is by arrangement only.

Nkomazi Wilderness

One tented camp with 10 luxury tents, twin-beds, baths en suite and swimming pools; a la carte restaurant and personalized service. Entry is by arrangement or via bookings; extensive game viewing road network, all accessible only via in-house guided tours and trails.

Local and regional tourism facilities

Ebutsini Cultural Village, near Ekulindeni: 10 units, 20 beds; self-catering or catering provided by arrangement; rural rustic; 4x4 mountain trail to the south towards the Swaziland border.

Forever Resort in Badplaas: Graded three-star resort hotel with substantial recreational and conference facilities including a spa based on a natural thermal spring and substantial outdoor and adventure facilities.

Cradle of Life Bio-Park, near Badplaas: 15 self-catering units containing a total of 60 beds. It has a restaurant with large event catering capacity and facilities that include game drives, a safari park, animal sanctuary, animal rehabilitation centre, timeline interpretation centre and rock collection. There is also a conference facility for 120 participants.

Numerous 'Bed & Breakfast' and guest house establishments exist in close proximity to the Property. These are both rural roadside establishments mainly along the R38, and urban facilities within Barberton and Badplaas.

Genesis Tourism Route: a public road tourism route linked to 'Genesis of Life', the tourism branding developed by Barberton Chamber of Business (**Figure 9**). Part of the Genesis Route comprises the Barberton Makhonjwa Geotrail, developed as the first dedicated public geo-tourism product in the region. The Geotrail was the result of in-depth regional tourism planning involving state agencies and local stakeholders. It was motivated, implemented and managed by Barberton Chamber of Business as part of their Barberton Tourism & Biodiversity Corridor (BATOBIC) initiative. Several additional projects related to the interpretation, awareness and development of the Property are in various stages from planning through funding and implementation (see **IMP Section 11**).

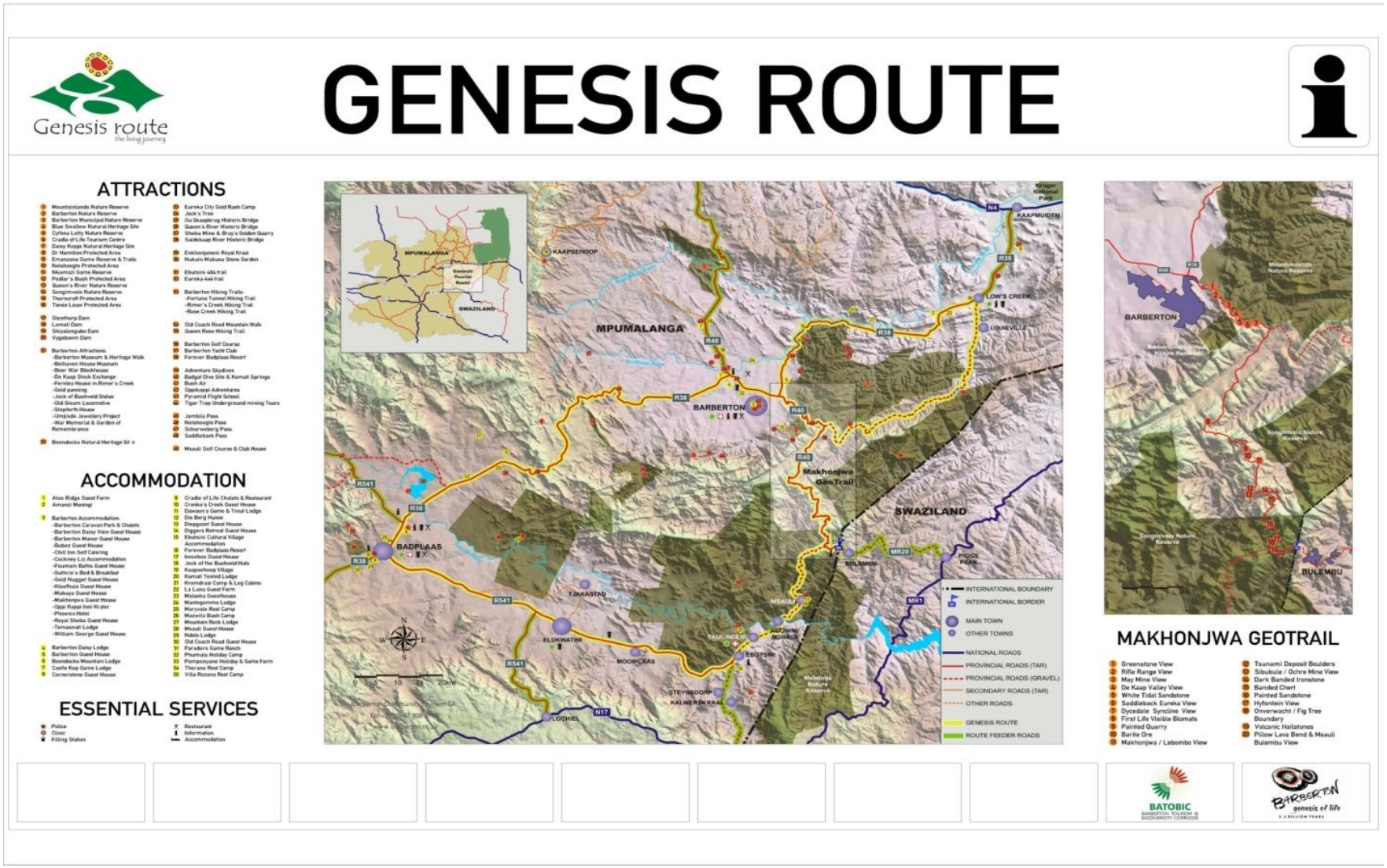

Figure 9. Genesis route map indicating tourism facilities in the area.

5.i Policies and Programmes Related to the Presentation and Promotion of the Property

Barberton Chamber of Business is implementing the Barberton Tourism and Biodiversity Corridor (BATOBIC) programme funded jointly by the National Department of Tourism and Barberton Chamber of Business. This initiative has planned and implemented a tourism and conservation based developmental programme in the local municipal areas of Umjindi, Mbombela, Albert Luthuli and Nkomazi, for economic generation, poverty reduction and long-term inclusive growth. BATOBIC, as an established development and implementation agency in this field, is a public/private partnership. As such it has established Memoranda of Understanding with all municipal and provincial agencies involved in growing outdoor, nature based tourism and related sustainable economic growth. Its track record is summarised in the **IMP Section 11**.

BATOBIC aims to increase economic and social investment in the conservation and tourism sectors of this region, commonly referred to as BATOBIC project area. This aim will be achieved, inter alia, by promoting and facilitating innovative public-private partnerships around state-owned and commercial land assets, and by enabling enhanced linkages between established enterprises in the main economic growth sectors and emerging businesses.

BATOBIC promotes and publicizes the area as a major nature-based tourism destination with good investment potential. In doing so it produces detailed promotional and interpretative material, including that for the Geotrail, as well as for a series of natural resource development projects, including in particular for geology, for both marketing and educational purposes. The motorized Geotrail is the first of its kind in South Africa that has as its central theme geological heritage. This initiative and its eye-catching products are firmly focused on the exceptional and unique geological features of the Property and of the wider BGB.

The geosites within the BGB, set in such a diverse natural landscapes with multiple land-uses and socio-economic and cultural settings, make for many richly textured narratives about science and history, culture and economics, evolution and religion. In combination they provide an exceptional and important outdoor education facility. Specialized guiding and well-crafted interpretive material is essential for effective geo-tourism. This combination has, and will continue to be developed to ensure that these rocks tell their story of the earliest measurable surface conditions on our planet. Building knowledge, understanding and appreciation of the BGB's Archaean geology and what it tells us of the environment in which it was formed, instils a sense of pride, ownership, and belonging especially among local and regional residents.

Local property owners have for many years promoted and marketed their separate tourism businesses. Much of this material can be found on web-sites, in brochures and other advertising media, which tends to focus on traditional visitor or investor attractions such as their wildlife and wilderness assets. More recent material mentions the remarkable geological features of the area and the efforts being made for the nomination of the Property as a UNESCO World Heritage Site. Inscription of the Property will attract additional resources to develop, protect, manage, and produce specific promotional and geo-heritage material for visitors.

Barberton Community Tourism (BCT) is the local tourism organisation for the area which operates an accredited visitor information centre in Barberton. In collaboration with Kruger Lowveld Tourism (KLT - the regional tourism organisation) they function together as the marketing agencies for the

wider region. Both are privately funded with minimal state support while being mandated through the various municipal and provincial tourism policies and legislation. Both also function in concert with the MTPA who is the official tourism marketing agency for Mpumalanga Province.

Most (if not all) local tourism and accommodation business already promote the BGB area and its geological attractions in their brochures and on their websites. The 'Cradle of Life' and its BioPark is a private initiative that also promotes the area with the owner intending to establish a Timeline Interpretation Centre where an impressive rock collection will be displayed. Together with BCT, KLT and MTPA, these tourism based businesses market the entire region, including holding several geological conferences and field trips in recent years. Most also assist geological scientists to access research sites in the area and maintain contact with locally based guides.

Owners of Nkomazi Game Reserve produce sophisticated marketing materials for their property as a 'Big-5 Luxury African Safari' destination, under the corporate banner of Shamwari Group.

5.j Staffing Levels and Expertise (professional, technical, maintenance)

Existing staff complement for the main nature reserves included within the Property is provided below in **Table 8**. This excludes the substantial Head Office staff involved in support services such as marketing, scientific services and law enforcement as referred to in **Section 5.e** above. These services in MTPA and the established tourism businesses operating within the Property are substantial, but detailing their staff complement and budgets would be arbitrary as their local operations are only a small part of much larger regional and national commitments.

In MTPA Reserve Managers and Section Heads require a National Diploma in Nature Conservation. Field Rangers require a National (NQF) Level 2 or Level 5, field guiding certificate. All other staff are trained locally as per their work requirements.

Table 8. Staffing Levels in Nature Reserves

Nkomazi NR	Songimvelo NR	Barberton NR
Managers (All levels) – 10	Managers - 2	Managers - 2
Field staff /rangers /scouts- 38	Field rangers - 27	Field rangers - 3
General workers /foreman /drivers - 21	General workers incl. foreman, drivers - 7	General workers incl. foreman, drivers - 24
Facilities /hospitality - 24	Facilities/ visitor management - 8	Facilities /visitor management - 1

Nkomazi Game Reserve has a staff compliment of 93. This includes all personnel, from experienced reserve manager, highly trained hospitality staff, various technical and maintenance teams, field guides and drivers, human resources specialists, community relations staff, field rangers and labourers. With a high-end reputation to maintain in a very competitive market, training and skills development are rigorously maintained at a high standard. Further details are given in **Appendix N**.

6. Monitoring

6.a Key Indicators for Measuring State of Conservation

MTPA makes use of the widely used Management Effectiveness Tracking Tool (METT) system for monitoring the nature reserves under its control. Endorsed by the World Council for Protected Areas (WCPA) and World Wide Fund for Nature (WWF) the METT system has been adapted to local conditions by South Africa over the last six years (**Appendix V; METT-SA**). METT-SA is currently used to monitor management effectiveness in virtually all the country's 237 terrestrial nature reserves (total area ~6.5 million ha). The periodic application of this system, informs park managers about the trends in management effectiveness as measured against park management objectives; information vital to measure the level of compliance achieved. This locally adapted METT system is still changing to obtain best and most relevant results. Monitoring of geoheritage indicators is not specified in the current METT-SA system, but it will be examined by the BMM WHS MA to include relevant procedures (i.e. integrating some of the indicators in **Table 8** below).

MTPA will continue their METT-based monitoring using existing indicators (mainly biodiversity orientated) but this system and its results are not discussed further here as they have little relevance specifically for geoheritage. Anticipated indicators of geoheritage condition and use are listed below (**Table 8**) and will be given effect mainly by photographic and other database records, suitably tabulated and archived. These can be further developed and incorporated into METT system for the affected PA's. Such monitoring will ensure that no substantial changes in land use, or activities incompatible with the integrity of the Property, or that may damage its geological OUVs, will occur undetected. Vulnerable geosites (most visited and most prone to erosion) will be monitored by frequent inspection and photographic records to ensure that no vandalism or damage has occurred to the features, their displays or any other facilities and access routes provided. Monitoring and law enforcement will be separate functions but their implementation on the ground will need to be fully integrated.

In addition, signage, information, and promotional material will be similarly monitored for use by visitors and for accuracy and clarity of interpretation and promotion of the World Heritage Site and its parent International Convention. This latter component will include monitoring of all media for any reference to the Property and its assets and the scientific literature for published papers on BGB research. A database of geosites will be maintained and any additional sites added to it. Researchers in particular will be monitored to ensure compliance with research permit conditions.

Table 9. Geoheritage indicators and monitoring framework.

	Indicator	Periodicity	Location of Records
1	Total Geosites – maintain database	1 x per annum	BATOBIC then MTPA / MA
2	Geosite condition - natural effects	1 x per 5 years	BATOBIC then MTPA / MA
3	Geological landscape condition – absence of human (visual) impacts	1 x per two years	BATOBIC then MTPA / MA
4	Visitor popularity/ frequency/ access (the most-visited geosites only)	Weekly to monthly	BATOBIC then MTPA / MA
5	Damage/misuse of most-visited geosites	Weekly to monthly	BATOBIC then MTPA / MA
6	Threat of damaging development	Continuous	BATOBIC then MTPA / MA
7	Research activities and results	Continuous	BATOBIC then MTPA / MA
8	Media information/publicity	Continuous	BATOBIC then MTPA / MA
9	Value of Interpretative services & products, including signage (by interview)	Periodic	BATOBIC then MTPA / MA

6.b Administrative Arrangements for Monitoring Property

BATOBIC (see **Section 8**) currently undertakes the monitoring, maintenance, and repair of Geotrail sites. When the Management Agency becomes operational, it will take over both the monitoring responsibility and the archiving function that is an essential component of monitoring. The results of future monitoring will be reported by the Management Agency to all key stakeholders on a regular annual basis. Timber companies have their own monitoring systems that focus on their timber production business. Some companies such as Sappi, also monitor biodiversity assets and tourism activities and will contribute to this framework where appropriate, ultimately integrating these efforts with the METT-SA system.

6.c Results of Previous Reporting Exercises

Monitoring of the Geotrail sites by BATOBIC has allowed for timely maintenance including clean-up of litter, and repair of infrastructure, interpretative panels and open-air displays. Monitoring within the Nature Reserves by MTPA has allowed for management interventions such as wildlife management, species introductions and removals, controlled burning and reduction of alien plant infestations. Volunteer groups of citizen-scientists also monitor species occurrence such as by Bird-Life Africa and the Plant Specialist Group, all linked to national biodiversity networks that monitor biodiversity continuously and country-wide. But none of these activities monitor geoheritage, which means there are no prior reports on geological monitoring significant to the Property's OUVs.

7. Documentation

7.a Photograph Inventory

See **Appendix O** for photograph inventory and digital photographs.

PHOTOGRAPHS AND AUDIO VISUAL IMAGE INVENTORY AND AUTHORIZATION FORM							
Id. No.	**Format (slide/print/ video)**	**Caption**	**Date of Photo (mo/yr)**	**Photographer/ Director of the video**	**Copyright owner (if diff)**	**Contact details of copyright owner**	**Non exclusive cession of rights**
1. General Scenery and Land Use Types							
1	JPEG	Dispersed farming and rural towns	May 2016	Dion Brandt	None	N/A	N/A
2	JPEG	Southern Area of the BMM WHS	May 2016	Dion Brandt	None	N/A	N/A
3	JPEG	Sandspruit River, southern area	June 2016	Dion Brandt	None	N/A	N/A
4	JPEG	Upper Hyslops i.c Faurea	Dec 2014	Tony Ferrar	None	N/A	N/A
5	JPEG	Mountainland wilderness and 3 sisters	Dec 2014	Tony Ferrar	None	N/A	N/A
6	JPEG	Dycedale syncline	Dec 2014	Tony Ferrar	None	N/A	N/A
7	JPEG	Lomati Valley	Dec 2014	Tony Ferrar	None	N/A	N/A
2. Selected Geosites							
8	JPEG	Amphibolite-grade pillowed komatiitic basalts	March 2016	Dion Brandt	None	N/A	N/A
9	JPEG	Kromberg Formation tholeiitic pillow-basalt exposures	March 2016	Dion Brandt	None	N/A	N/A
10	JPEG	Pillow basalt and minor massive basalt	March 2016	Dion Brandt	None	N/A	N/A

PHOTOGRAPHS AND AUDIO VISUAL IMAGE INVENTORY AND AUTHORIZATION FORM							
Id. No.	**Format (slide/print/ video)**	**Caption**	**Date of Photo (mo/yr)**	**Photographer/ Director of the video**	**Copyright owner (if diff)**	**Contact details of copyright owner**	**Non exclusive cession of rights**
11	JPEG	Banded Ironstone	May 2016	Dion Brandt	None	N/A	N/A
12	JPEG	Migmatite exposures	March 2016	Dion Brandt	None	N/A	N/A
3. Geology: Close Up							
13	JPEG	Tsunami Conglomerate	July 2016	Dion Brandt	None	N/A	N/A
14	JPEG	First signs of life visible to the naked eye	Sept 2015	Dion Brandt	None	N/A	N/A
15	JPEG	Meteorite Impact Spherules	November 2016	Tony Ferrar	None	N/A	N/A
16	JPEG	Volcanic lapilli	Oct 2016	Dion Brandt	None	N/A	N/A
17	JPEG	Ancient tidal foresets	March 2016	Tony Ferrar	None	N/A	N/A
18	JPEG	Spinifex texture	Nov 2016	Tony Ferrar	None	N/A	N/A
4. Geotrail Stops							
19	JPEG	Geotrail Biomat Stop	May 2016	Tony Ferrar	None	N/A	N/A
20	JPEG	Geotrail display	March 2016	Tony Ferrar	None	N/A	N/A
21	JPEG	Geotrail stop 1	April 2016	Tony Ferrar	None	N/A	N/A
5. Aspects of Development							
22	JPEG	Tourist game viewing track: Songimvelo NR	June 2016	Tony Ferrar	None	N/A	N/A
23	JPEG	Geotrail sample for display	March 2014	Tony Ferrar	None	N/A	N/A
24	JPEG	Songimvelo NR entrance	April 2016	Tony Ferrar	None	N/A	N/A
25	JPEG	Road through plantation	Nov 2016	Tony Ferrar	None	N/A	N/A
26	JPEG	Forestry	Nov 2016	Tony Ferrar	None	N/A	N/A
27	JPEG	Town Margin	Oct 2016	Tony Ferrar	None	N/A	N/A

PHOTOGRAPHS AND AUDIO VISUAL IMAGE INVENTORY AND AUTHORIZATION FORM							
Id. No.	**Format (slide/print/ video)**	**Caption**	**Date of Photo (mo/yr)**	**Photographer/ Director of the video**	**Copyright owner (if diff)**	**Contact details of copyright owner**	**Non exclusive cession of rights**
6. Negatives							
28	JPEG	Damage to conglomerate outcrop due to scientific sampling	August 2016	Dion Brandt	None	N/A	N/A
29	JPEG	Erosion exposing geological features	June 2015	Dion Brandt	None	N/A	N/A
7. Stakeholder Engagement Activities							
30	JPEG	Household Stakeholder Discussions	May 2016	Dion Brandt	None	N/A	N/A
31	JPEG	Community Stakeholder Meeting	June 2009	Stanford Milanzi	None	N/A	N/A

7.b Texts Relating to Protective Designation, Copies of Property Management Plans or Documented Management Systems and extracts of other plans relevant to the Property

Refer to **Appendices D, E & F.**

7.c Form and Date of Most Recent Records or Inventory of Property

A previous geological site inventory was carried out and finalized in 2010, upon which new updated data and new more recently discovered geosites were added during the 2015-2016 period. This is discussed in detail in **Appendix N**.

7.d Address Where Inventory, Records and Archives are Held

Most inventory and documentary material is presently held by the compilers in a computer and hard-copy files with relevant backups dedicated to this purpose. Per agreement with BATOBIC this will be filed, sorted and indexed and then delivered to BATOBIC for safekeeping upon completion of this nomination dossier, to be passed on to the future Management Authority . BATOBIC will therefore be used as the contact point and repository for these records until the future Management Authority is functional.

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9. Signatory on behalf of the State Party

Signed at Pretoria, Republic of South Africa on.....day.....Month 2017,

.....

Minister of Environmental Affairs.