

# HERITAGE MANAGEMENT PLAN FOR THE PROTECTION OF STROMATOLITES AT THE WATERLOO SOLAR PV FACILITY ON WATERLOO 992-IN, VRYBURG MAGISTERIAL DISTRICT, NORTHWEST PROVINCE

Required under Section 38(8) of the National Heritage Resources Act (No. 25 of 1999).

SAHRA Case ID.: 359

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## EXECUTIVE SUMMARY

A study by van Schalkwyk in 2012 located *in situ* stromatolites (fossil microbial mounds) in the Boomplaas formation on the farm Waterloo 992, some 10 km southeast of Vryburg, Naledi Local Municipality, North-West Province. A 75 MW photovoltaic solar energy facility is to be constructed on the farm.

Since the initial alert, palaeontologist Dr John Almond has conducted a phase 1 palaeontological assessment (2013) and phase 2 mitigation for the recording and collection of Precambrian stromatolites (2017). In January 2018 the South African Heritage Resources Agency (SAHRA) requested that a Heritage Management Plan (HMP) be compiled and a destruction permit application be lodged. SAHRA approved the permit in April 2018 and the management plan is presented here.

This HMP offers a management framework for the long-term conservation and management of the stromatolite-rich area outside the eastern edge of the solar facility project area on the farm Waterloo 992. The palaeontologist (Almond 2013, 2017) and SAHRA (final comment dated 10 January 2018) recommended that the area must be fenced and include a 30 metre buffer. The HMP guides implementation of this management strategy and provides monitoring and reporting guidance. A fossil chance finds procedure must be developed to allow for any further material collected during monitoring or research to be added to the existing collection which is curated in the Precambrian fossil collection at the Council for Geoscience, Bellville. Actions to be implemented include:

- The establishment of a Management Committee;
- Fencing of the sensitive area;
- Monitoring of all works within the 30 m buffer zone; and
- Reporting on the monitoring and state of the fence and fossil site.

To assist with implementation an action plan is provided with timeframes, responsible parties and objectives. Implementation and updating of the HMP as required will ensure that the cultural significance of this important fossil occurrence is retained alongside the Waterloo Solar Energy Facility.

## Glossary

**Archaeology:** Remains resulting from human activity, which is in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

**Authigenic:** Minerals or structures originally formed in their present position.

**Cultural significance:** means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

**Conservation:** In relation to heritage resources, includes protection, maintenance, preservation and sustainable use of places or objects so as to safeguard their cultural significance.

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

**Management:** In relation to heritage resources, includes the conservation, presentation and improvement of a place protected in terms of the NHRA.

**National Estate:** The collective heritage assets of the Nation.

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

## Abbreviations

**APHP:** Association of Professional Heritage Practitioners

**ASAPA:** Association of Southern African Professional Archaeologists

**CRM:** Cultural Resources Management

**ECO:** Environmental Control Officer

**EMP:** Environmental Management Plan

**GP:** General Protection

**GPS:** Global Positioning System

**HMP:** Heritage Management Plan

**NEMA:** National Environmental Management Act (No. 107 of 1998)

**NHRA:** National Heritage Resources Act (No. 25) of 1999

**REDZ:** Renewable Energy Development Zone

**SAHRA:** South African Heritage Resources Agency

**SAHRIS:** South African Heritage Resources Information System

**SWOT:** Strengths, Weaknesses, Opportunities and Threats.

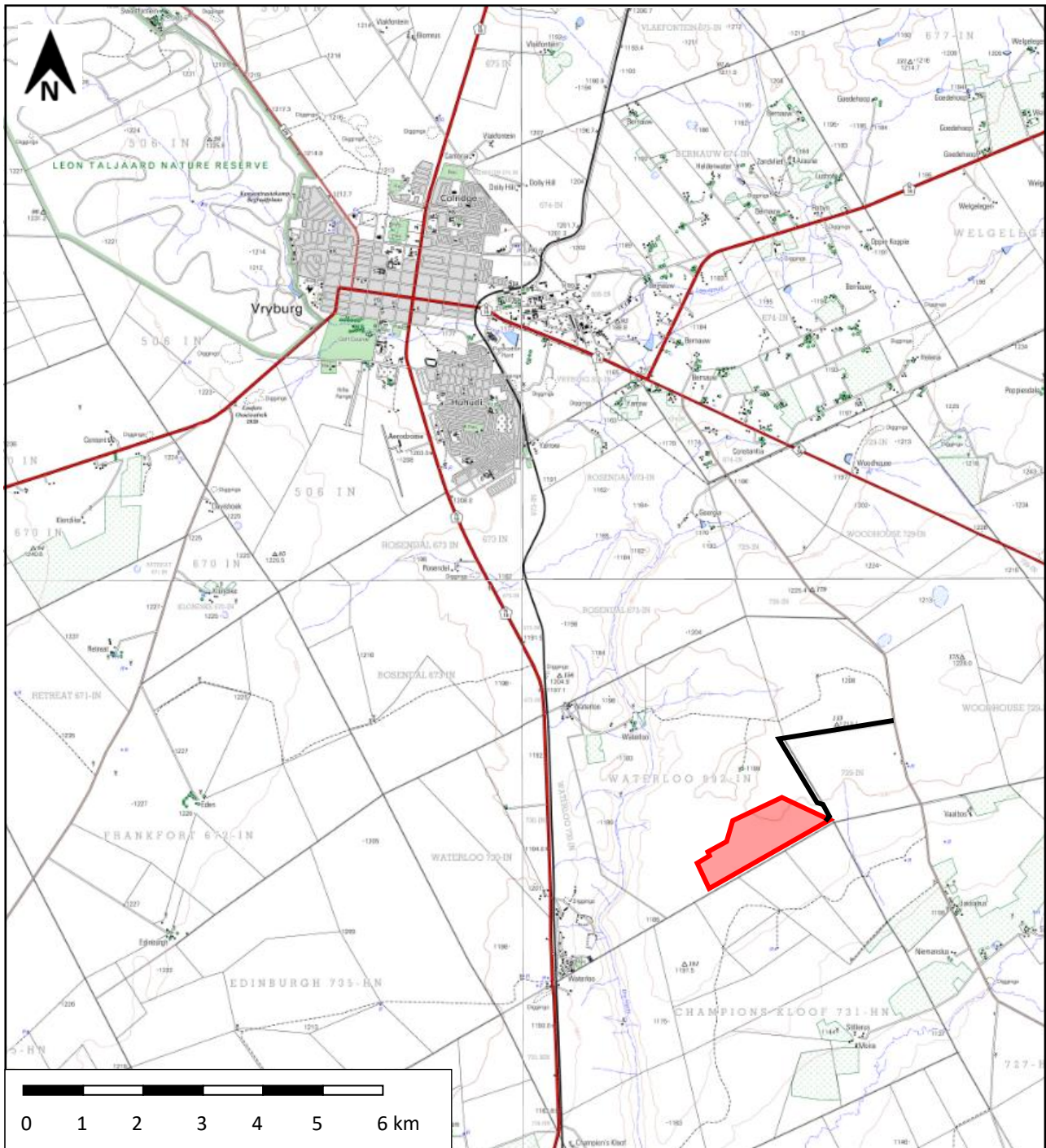
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# 1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by juwi Solar ZA Construction 4 (Pty) Ltd to compile a heritage management plan (HMP) for the protection of stromatolites at the Waterloo Solar PV facility due to be constructed on the farm Waterloo 992-IN, some 10 km southeast of Vryburg, Northwest Province (Figure 1). The centre of the facility would be at  $S27^{\circ} 02' 20'' E24^{\circ} 47' 16''$ .



**Figure 1:** Extract from 1:50 000 topographic maps 2624DC, 2624DD, 2724BA & 2724BB showing the location of the PV facility (red shaded polygon) and its access road (black line). Source: Chief Directorate: National Geo-Spatial Information. Website: [www.ngi.gov.za](http://www.ngi.gov.za).

In order to conserve and manage already identified scientifically important stromatolite occurrences and those that might still be present below the surface on Waterloo 992, the South African Heritage Resources Agency (SAHRA) requested that a HMP be compiled to ensure the management of palaeontological heritage resources and the minimisation of further impacts.

### **1.1. Project description**

Environmental authorisation was granted for the construction of a 75MW PV solar facility and supporting infrastructure on the farm Waterloo 992. The facility will include arrays of solar panels, supporting structures, electrical cables, access roads and operation and management facilities (offices, storage, etc).

### **1.2. Scope, purpose and aims of the heritage management plan**

#### **1.2.1. Scope**

ASHA Consulting was appointed to develop an HMP<sup>1</sup> for the conservation and management of palaeontological heritage resources on the farm Waterloo 992. The construction and operation of the 75MW photovoltaic solar plant and associated infrastructure will have an impact on the palaeontological heritage resources found within the project area. It is therefore important that the HMP includes management actions that will minimise and/or avoid negative impacts to these resources.

Note that although SAHRA requested that the HMP also cover stromatolite outcrops on neighbouring properties, this HMP is focused on Waterloo 992 where the proposed facility is to be constructed because the land owner and developer at Waterloo have no jurisdiction over other private land. Its recommendations could be carried over to neighbouring developments if these proceed, although they would need to be contextualised within site-specific HMPs that would cover the specifics of each site and development as relevant. For the time being, the stromatolites identified on neighbouring properties are not subject to any development-related impacts and natural degradation is not a significant threat.

#### **1.2.2. Objectives**

- Provide a framework for ensuring a balance between legislative requirements, sustainable socio-economic development and conservation of non-renewable heritage resources in the project area;
- Provide for the long term protection of the palaeontological heritage record of the area through its management, maintenance and conservation;
- Provide for long term monitoring and reporting;
- Compile a tool that allows the land owner, heritage authorities and project managers to make sound decisions about the conserved fossil heritage;
- Identify the heritage values and cultural significance of the heritage resource; and
- Develop conservation policies to be applied to protect the significance in the face of impact and change, and a strategy through which these policies will be implemented.

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<sup>1</sup> The Heritage Management Plan is a Conservation Management Plan (SAHRA 2014) which incorporates recommendations from the Development Heritage Management Plan Guidelines for Archaeological, Palaeontological and Meteorites Heritage Resources (SAHRA 2017).



### 1.2.3. Outcomes

- Clear guidelines on cost effective maintenance and management of fossil heritage resources in the project area;
- Enhanced long-term conservation of the palaeontological record on Waterloo 992, specifically the large domal stromatolites identified for specific protection;
- Foster a balanced approach between sustainable development and preventative conservation; and
- Increase awareness of the palaeontological and heritage on Waterloo 992 and1 in the surrounding area.

### 1.2.4. Guiding principles of the Heritage Management Plan

- *Minimum intervention:* Any action that could alter the heritage resource should be guided by the concept of achieving the required result through the least disturbance of the heritage resource. An intervention may only be undertaken once a permit to do so has been granted by the relevant heritage authority;
- *Reversibility:* Whatever conservation measures are applied should be reversible. A budget for maintenance and monitoring must be in place. The HMP must make clear who is responsible for what aspects of implementation and monitoring, and how this is documented;
- *An enabling environment:* The HMP should assist the developer by enabling development without unduly affecting the cultural significance of the heritage resource; and
- *Simplicity:* The HMP should have clear, simple requirements that are more likely to be followed through.

## 1.4. The authors

Ms. Cecilene Muller has an MA (UCT, 2002) in Archaeology and a B.Soc.Sci. (Hons) (UCT, 2009) in Social Development and has been active in the Heritage Management sector since 2004. She has worked as a Researcher and Education Coordinator for the Clanwilliam Living Landscape Project focusing on Rock Art and facilitating greater awareness to all stakeholders in the area. From 2004 to 2014 she worked at the South African Heritage Resources Agency first as a Data Processor in the APM Unit digitising Archaeological records, than as an Assistant Heritage Officer responsible for the issue of permits and dealing with illicit trafficking. Towards the end of 2006 she become Manager (grading and declaration) for national heritage sites (resources). She was also a participant and facilitator on the Africa 2009 programme for immovable heritage in Africa (heritage management planning and plans). Between 2015 and 2016 she was a South African Museums Association (SAMA) Council member and Regional Chairperson for the Western Cape of SAMA. She is currently a member of Heritage Western Cape's Archaeology, Palaeontology and Meteorites Committee and Impact Assessment Committee.

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting Heritage Impact Assessments and archaeological specialist studies in South Africa (primarily in the Western Cape and Northern Cape provinces) since 2004 (please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage

practitioner with the Association of Professional Heritage Practitioners (APHP; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

### **1.5. Declaration of independence**

ASHA Consulting (Pty) Ltd and its consultants have no financial or other interest in the proposed development and will derive no benefits other than fair remuneration for consulting services provided.

## **2. HERITAGE LEGISLATION**

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources. These include palaeontological materials which are protected under Section 35 and which are defined in Section 2 as “any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace”.

## **3. METHODS**

### **3.1. Literature survey and information sources**

The literature consulted included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:50 000 map was sourced from the Chief Directorate: National Geo-Spatial Information.

### **3.2. Fieldwork**

In 2013 Palaeontologist J. Almond focused on the Vryburg and Boomplaas Formations on the farm Waterloo 922. To Almond’s (2013) knowledge, a detailed description of the Vryburg stromatolite occurrences had not yet been published. Exposure of the Boomplaas Formation was found to be very poor in the flat-lying southern portion of Waterloo 992 due to the presence of gravel, soil and vegetation.

The main focus of the Phase 2 palaeontological mitigation was:

- To record (via photographs, GPS data, brief description) stromatolites exposed at the surface within the solar facility development footprint; and
- To collect a representative sample of the range of well-preserved stromatolitic structures from the Boomplaas Formation. Fieldwork took place over two days (11-12 May 2017) with visibility on the ground only moderately good due to tall grass cover, scattered shrubs and small trees (Ghaap Plateau Vaalbosveld).

A number of blocks (c. 30) of silicified stromatolitic rock were collected from the surface. Most specimens were collected from the area earmarked for protection under this HMP. Large (1-2 m diameter) stromatolitic domes at this site have largely been truncated by erosion and are usually poorly exposed (Almond 2013) making it impracticable to collect entire specimens. Collection methods employed included collection of loose material from the surface (the majority of specimens) as well as prising-out of modest-sized blocks using crowbars, hammer and chisels (only a few specimens). In practice, most of the silicified surface material proved to be extremely well-cemented to the underlying bedrocks and it was therefore not feasible to prise loose or hammer off sample blocks without destroying the fossils themselves.

A brief visit to the main outcrop of stromatolites was made by the second author of this report on 27 July 2018 to gain familiarity with the study area and to photograph a sample of stromatolites for this report (Appendix 3). Both this visit and Almond's fieldwork as described in his reports were used to inform this HMP.

### **3.3. Grading**

Section 7(1) of the National Heritage Resources Act (NHRA; No. 25 of 1999) provides for the grading of heritage resources into those of National (Grade I), Provincial (Grade II) and Local (Grade III) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade I and II resources are intended to be managed by the national and provincial heritage resources authorities respectively, while Grade III resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended under S.7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system<sup>2</sup> for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' (GP) and rated as GP A (high/medium significance, requires mitigation), GP B (medium significance, requires recording) or GP C (low significance, requires no further action). Section 7 of NHRA is further substantiated by Regulation 43 (Grading) published in Government Gazette No. 6820.

### **3.4. Consultation**

#### **3.4.1. Informal consultation**

Dr John Almond (project palaeontologist) and Dr Ragna Redelstorff (SAHRA palaeontologist) were consulted at various points during compilation of this HMP.

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<sup>2</sup> The system is intended for use on archaeological and palaeontological sites only.

### 3.4.2. Formal Consultation

Due to the lack of complexity of the heritage resources involved, stakeholder meetings have not been held during the process of compilation of this HMP. Dr John Almond, who has conducted the previous phases of palaeontological work on the site, was, however, consulted for advice as noted above. This report has been submitted to the identified stakeholders for a 30 day commenting period prior to finalisation. Apart from comments received from SAHRA (dated 20 November 2018) no other stakeholders provided feedback. Key stakeholders are the land owner, the developers, SAHRA as the responsible heritage resources authority, and the commercial and academic palaeontological community.

### 3.5. Assumptions and limitations

Pending the discovery and recording of further and better preserved fossils, the absence of fossils in any particular area should not be taken to imply that there are no stromatolites present; they may be buried beneath the surface. This report is prepared based on both the known surface occurrence of stromatolites and the assumption that further examples could be uncovered during development.

The application of a no-go buffer zone is limited by the amount of space between the core stromatolite area, the authorised development footprint and the boundary of the farm. The access road will transgress the buffer area and the development footprint will very slightly impact on the core area identified for protection. The HMP thus works with these limitations to devise and present the best possible outcome in the circumstances.

## 4. THE SITE

### 4.1. Context

Naledi Local Municipality is a Category B Municipality with a total estimated population of 68 803 and has an estimated total of 20 692 households according to the Community Survey of 2016 by Statistics South Africa (NLM 2017; IDP 2017-2022). The Naledi Local Municipality is situated in the Dr Ruth S Mompati District of South Africa's North West Province. NLM covers an area of approximately 7264 square kilometres, while Vryburg is one of ten wards in the municipality. In Section E (high level spatial development framework) of the Integrated Development Plan the focus is on special projects relating to water resources maintaining existing infrastructure while also developing it. Emphasis is on farming especially game and cattle farming in the area, while the aim of NLM is to create a green area through solar energy. The site lies within a Renewable Energy Development Zone (REDZ).

### 4.2. Description

Coordinates: S27° 02' 20" E24° 47' 16" (centre of PV facility footprint)

Property: Farm Waterloo 992, Vryburg, Naledi Local Municipality, North West Province

Location:	The site is located 10 km southeast of Vryburg, Northwest Province. The study site is situated on flat lying terrain in the south-eastern part of the farm, between 1.0 and 3.5 km east of the Droë Harts River and between 2.2 and 4.6 km east of the N18 tar road from Vryburg to Kimberley.
Land Description:	Flat-lying terrain of the Ghaap Plateau region with reddish-brown sandy soils containing abundant gravel clasts, principally cherty material. The climate is semi-arid and the dense vegetation cover of grassy thornveld is mapped as Ghaap Plateau Vaalbosveld.
Current use:	Cattle grazing
Owner:	Chris van Zyl Trust

#### **4.3. Present condition and integrity of the stromatolites**

The site is undeveloped and vegetated by grass and shrubs. The fossil stromatolites are visible on the surface but are partly covered by sand and gravel supporting the likelihood that further examples are buried both at the sensitive area identified for conservation and elsewhere on the development site. The stromatolites have been extensively described by Almond (2013, 2017).

There are few natural threats to the fossils since the present land use involves livestock grazing. Appendix 3 provides a visual impression of the site and the stromatolites in question. The stromatolites are naturally degrading but, being lithified, this process is very slow, well beyond the expected lifetime of the development and the applicability of the HMP. It is likely that better preserved stromatolites will be present beneath the surface.

## **5. PALAEOLOGICAL BACKGROUND AND SIGNIFICANCE OF THE WATERLOO STROMATOLITES**

### **5.1. What are stromatolites?**

Exploring the controversy related to the definition of stromatolites over the years and the lack of a generally accepted definition, Riding *et al.* (2011: 29) note the widespread acceptance of stromatolites as “layered, early lithified, authigenic microbial structures – often domical or columnar in form – that developed at the sediment water interface in freshwater, marine and evaporitic environments.” Through further investigation of published research they proposed a working definition of stromatolites as “macroscopically layered authigenic microbial sediments with or without interlayered abiogenic precipitates” (Riding *et al.* (2011: 31).

## 5.2. Stromatolites on site

Palaeontological studies for this project have concentrated on the south-dipping Vryburg Formation, which is well exposed along the Droë Harts River Valley, and the poorly exposed Boomplaas Formation in the flat-lying southern part of Waterloo 992. Key findings include<sup>3</sup>:

- A range of stromatolite growth types is represented, from small buttons of less than 5 cm diameter to larger cauliflower-like heads and large domes of up to 2 m or more in diameter;
- Bedrock exposure is very poor and many of the stromatolites have been planed down by erosion;
- While plan views of stromatolites were common, vertical sections were generally unavailable for study;
- Due to high levels of gravelly soil cover and dense vegetation (including summer grasses) within the development area it was not possible to fully map the occurrence of stromatolites; and
- The 2.6 billion year old Boomplaas Formation stromatolites represent some of the oldest examples of these microbially generated fossils in South Africa. They have yet to be comprehensively described and their stratigraphic and geographical distributions also remain poorly understood.

In addition to the extensive photographic record provided by Almond (2013, 2017), Appendix 2 of the present report presents a series of photographs to familiarise the reader with the stromatolites under consideration.

## 5.3. Statement of significance

Palaeontological research focusing on stromatolite assemblages in Southern Africa is well documented and records assemblages as far back as the 2.9 billion year old Pongola Supergroup. These microbial structures are important to research on early life and the Waterloo stromatolites may yet have a part to play in this research. Better preserved stromatolites may be discovered during development. An area featuring well-exposed stromatolites and which is considered to be of high palaeontological research and conservation significance has been identified on Waterloo 992 (Almond 2017) and is the focus of this HMP.

These stromatolite exposures provide a valuable window into shallow marine ecosystems and possibly climate in the Late Archaean period on the Kaapvaal Craton (ancient continental block). *In situ* stromatolites from the approximately 2.6 billion year old Boomplaas Formation (*Ghaap Group, Transvaal Group*) represent some of the oldest scientifically-useful examples of these microbially generated fossils. The Boomplaas Formation occurrences are among the oldest well-preserved and diverse stromatolite assemblages known from the South African palaeontological record. Within the area identified for conservation on Waterloo 992 there are numerous examples of large (1-2 m diameter) domal stromatolites exposed at the surface. They are too big to collect whole and have yet to be reported from other stromatolite-rich sites in the region. Although they

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<sup>3</sup> Note that an extensive detailed review has been compiled by Almond (2017: 9-12) and we provide only a brief summary.

may still be found to occur more widely within the Boomplaas Formation outcrop area, their current rarity elevates their conservation significance.

In terms of Section 2(vi) of the NHRA, “cultural significance” means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

The stromatolites have very high cultural significance for their scientific value (Almond 2017).

#### **5.4. Provisional grading**

Grading provides an indication of the importance of a heritage resource and the extent over which it should be regarded as important. It is suggested that a provisional Grade I be assigned to the regional outcropping area of stromatolites on Waterloo 992 and neighbouring farms. This grading is assigned based on:

- Their very high cultural significance in terms of scientific research potential;
- The fact that research questions related to early life on earth are of international concern;
- The presence of large stromatolites which are generally rare in the area;
- The current lack of detailed studies that include subsurface observations; and
- The fact that the regional outcropping area is under threat from solar energy development and requires careful management.

## **6. SWOT ANALYSIS**

This analysis explores issues related to the conservation, protection and management of the stromatolites on Waterloo 992, bearing in mind the resources documented on neighbouring properties. The SWOT analysis identifies issues requiring attention according to the strengths, weaknesses, opportunities and threats facing fossil heritage resources (specifically stromatolites) on Waterloo 992 (Table 1).

The SWOT analysis indicates that exciting palaeontological research opportunities exist in the area, underscoring the value of protecting the stromatolites and capturing data during the development process. The need for continued funding to cover monitoring is a potential concern but much of the monitoring can be integrated with the daily functioning of the facility. More importantly a need exists to create greater awareness regarding the palaeontological heritage of the area.

**Table 1:** A SWOT analysis pertaining to the conservation and management of palaeontological heritage resources on the farm Waterloo 992.

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> <li>• Secure environment in which to protect fossils due to development (requires security) and land ownership (Chris van Zyl Trust)</li> <li>• Stromatolites are durable and not easily damaged</li> <li>• Stromatolites are not restricted to the development area</li> <li>• Site easily accessible for research</li> <li>• Strong legislative context (permitting process, NHRA and Regulations)</li> </ul>	<ul style="list-style-type: none"> <li>• Fossils can easily be missed by the untrained eye</li> <li>• Fossils can be buried and their actual distribution on site is not known</li> <li>• Buried fossils can be accidentally damaged during excavation</li> <li>• Implementation of the HMP requires ongoing financial input</li> <li>• No integrated heritage site management system is in place in the local municipality (NLM)</li> </ul>
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> <li>• Better preserved stromatolites could be present beneath the surface</li> <li>• Development will offer the opportunity for subsurface observations from fresh bedrock exposures, especially of vertical sections</li> <li>• Monitoring will capture observations not available from the surface and contribute to scientific research</li> <li>• Future palaeontological research opportunities will exist and be preserved</li> <li>• Educating employees and contractors could lead to more fossils being identified</li> </ul>	<ul style="list-style-type: none"> <li>• Destruction of fossils during construction and/or maintenance activities</li> <li>• Unintentional damage and destruction of fossils, especially from vehicles</li> <li>• Unauthorised movement of workers and/or construction vehicles</li> <li>• Damage to the fossils by uninformed staff</li> <li>• Uncertainties over the overall impact to fossils of the proposed solar plant development</li> <li>• Broader lack of awareness of fossils and their significance</li> </ul>

## 7. HERITAGE MANAGEMENT TO DATE

### 7.1. Phase 1 recommendations

Silicified stromatolites (fossil microbial mounds) were recorded from Precambrian rocks of the Boomplaas Formation (Ghaap Group) within the study area for the solar energy facility on Farm Waterloo 992. The Phase 1 palaeontological assessment by Almond (2013) recommended mitigation in the form of surveying, recording, description and judicious sampling of well-preserved fossil occurrences within the development footprint by a professional palaeontologist. Although it was initially proposed to undertake this work after initial vegetation clearance and before the ground was levelled for construction, it was later determined that vegetation clearance was likely to damage surface-exposed stromatolite material that would be the primary target for sampling and that it would be difficult and time-consuming to integrate the palaeontological mitigation with vegetation clearance and/or construction work. Mitigation work has subsequently been carried out prior to the commencement of any development activities on site.

### 7.2. Phase 2 recommendations

After the Phase 2 mitigation had been conducted, it was recommended that an area containing many large (1-2 m diameter) stromatolites should be cordoned off and protected during development due to their local rarity and the difficulty (impossibility) of adequately sampling them. In conjunction with conservation of the stromatolite outcrops proposed for protection on neighbouring properties (Champions Kloof 731 and Hartsboom 73; See Almond 2016a, 2016b,



Groenewald 2016), and assuming that other mitigation requirements on those properties were met should developments proposed there proceed, this action was considered appropriate to preserve a representative, scientifically-useful sample of the various stromatolite types known to be present in the Boomplaas Formation in the Vryburg region.

The final specialist recommendations and conditions provided by SAHRA in their comment dated 10 January 2018 are paraphrased in Table 2. These were provided in response to the palaeontological mitigation by Almond (2017). This comment provides input pertaining to what heritage resources should be conserved and managed through the HMP.

**Table 2:** Paraphrased Final Comment provided by SAHRA in terms of Section 38(4) and 38(8) of the NHRA, dated 10<sup>th</sup> January 2018.

RECOMMENDATIONS	CONDITIONS
<ol style="list-style-type: none"> <li>1. The portion of the stromatolite-rich area outside the eastern edge of the solar facility project area must be fenced (rather than security tape) for future conservation;</li> <li>2. The access road should follow either the suggested mitigated Alternative 1 route (to exclude the sensitive stromatolite-rich area) or an alternative road option must be selected;</li> <li>3. A representative, scientifically-useful sample of the various stromatolite types known to be present in the Boomplaas Formation in the Vryburg region would be conserved within the following areas once the solar facility is constructed: (a) the area just outside and to the east of the main solar facility project area on Waterloo 992 and (b) protected areas proposed on neighbouring farms Champions Kloof 731 and Hartsboom 734 (See Almond 2016a, 2016b, Groenewald 2016 and Fig. 2 herein);</li> <li>4. Recommendations must be included in the Environmental Management Programme (EMPr) for the proposed solar energy facility on Farm Waterloo 992; and</li> <li>5. Since fossils will undoubtedly be destroyed, the developer will need to apply on the basis of this report for a Fossil Destruction Permit from the South African Heritage Resources Agency.</li> </ol>	<ol style="list-style-type: none"> <li>1. Areas mentioned in recommendations 1-3 must be avoided with a 30 m no-go buffer. These areas must be fenced off and a Heritage Management Plan (HMP) must be developed for their long-term <i>in situ</i> conservation. The HMP must be submitted to SAHRA for comment.</li> <li>2. A permit for destruction of fossils must be applied for in terms of Section 35 of the National Heritage Resources Act, Act 25 of 1999 (NHRA) and Chapter II and IV of the 2000 NHRA Regulations (No 548 of 2000); and</li> <li>3. A qualified palaeontologist must be appointed to undertake a watching brief during the construction phase. A Watching Brief Report must be submitted to SAHRA for comment upon completion of the construction phase.</li> </ol>

## 8. MANAGEMENT ACTIONS AND TIMEFRAMES

### 8.1. Management Committee

A management committee must be established as soon as this HMP is approved and its membership and contact details communicated to SAHRA. The committee will oversee the management of the protected area and control access. This committee should include, as a minimum, the landowner, a representative of the developer/owner and a senior staff member at the facility. It is not required to include a palaeontologist but the committee should request the advice of a palaeontologist whenever this is deemed necessary. Contact details of palaeontologists are included in the stakeholder database (Appendix 5). The management committee will be

responsible for ensuring that the sensitive area remains adequately protected and will be required to submit reports to SAHRA. These reports should include mention of the condition of the stromatolites, the enclosed area in general, and its protective fence. Photographs should be included as required.

## **8.2. Budget**

Budget for the implementation of the management plan is largely expected to be required during the construction phase. Once the project is operational the majority of tasks (monitoring and reporting) would be incorporated within the daily jobs of appointed staff (e.g. security and facility manager) and would not require dedicated budget.

## **8.3. Fencing**

The developer must install a fence enclosing the high concentration of large domal stromatolites that lies outside and to the east of the main solar facility development area. The current extent of the stromatolite scatter must be recognised as the core area and, where possible, a no-go buffer of 30 m must be included within the fenced area. Where not possible, the fence should be placed as close to the access road as is feasible, bearing in mind the heavy vehicles that will make use of the road. The primary function of the fence will be to identify the site visually and prevent vehicles from driving over it. The location of this fence should be as mapped in Appendix 4.

Clear signage indicating the no-go zone should be placed on the outside of the fence. Signs should be placed every 50 m along the fence. The fence can be a farm-style fence in order to minimise ground disturbance but must be sturdy. The fence must not impact the flora and fauna of the area (i.e. must not prevent small animal movement through the area) or pose additional threats to the environment, but should keep livestock out of the fenced area. Straining posts that require excavation should be placed in areas where excavation for their footing does not impact on bedrock. A gate should be provided to facilitate access for site inspections. The gate should be locked and the key held by the facility manager.

Note that some of the core area extends within the development footprint. In this area the core can be taken as the edge of the development footprint. If any facility security fence needs to run outside of the development footprint as shown in Appendix 4, then it may not pass through the core or buffer area and should run around the buffer. In such an instance the farm-style fence would be replaced by the security fence when the latter is erected. A lockable gate should still be included.

### **8.3.1. Minimum requirements for inspections and maintenance**

- During construction (and decommissioning if this happens) the fence must be inspected by the Environmental Control Officer (ECO) on a weekly basis. Such inspections should be logged with comments on the integrity of the fence and enclosed area being noted as required;
- During operation the fence must be regularly patrolled by project operations or security staff (at least once a month);
- No machinery or vehicles will be allowed within the fenced/enclosed area;

- A log book indicating the inspection dates should be held at the facility and completed after each inspection with an indication of who carried out the inspection, the date and any remarks regarding the condition of the fence and signage;
- Any repairs that become necessary must be effected as soon as possible and recorded in the log book; and
- Because grazing will not be allowed within the stromatolite protection zone, regular grass and bush cutting should occur to mitigate wild fires. Litter should also be collected by hand.

#### **8.4. Curation of fossil material**

Stromatolitic material collected from Farm Waterloo 992 and relevant collection data is curated in the Precambrian fossil collections at the offices of the Council for Geoscience, Bellville. This collection was under a permit dated 4<sup>th</sup> May 2017 and issued under SAHRA Case 10938. Any further material collected for whatever reason, whether in mitigation of activities connected with the facility or as part of academic research, must be added to this same collection and also housed at the Council for Geoscience in Bellville. Fragmentation of the collection through storage in multiple facilities diminished research value.

#### **8.5. Monitoring**

##### **8.5.1. Palaeontological monitoring during construction work**

SAHRA has requested that palaeontological monitoring of the construction work should take place. The frequency of such monitoring visits over the bulk of the development area will be determined by the appointed palaeontologist and is not subject to the conditions of this HMP. It is essential, however, that full-time monitoring of any below ground construction work (i.e. excavation of trenches for foundations and services, casting of foundations and backfilling) within 30 m of the core area be carried out by a professional palaeontologist. Because this area is sensitive, it is imperative that any possible subsurface observations in connection with the large domal stromatolites should be professionally recorded and the records curated with the sampled fossils. This monitoring includes construction of the access road past this area (unless the road will be made by importing gravel and laying it over the present ground surface which would be preferred) as well as all works within the development footprint where it falls within 30 m of the core area. The developer has indicated that an effort will be made to keep subsurface disturbance as far away as possible from the core area and to an absolute minimum within the 30 m buffer area. The areas for full-time construction monitoring are shaded in green in Appendix 4.

##### **8.5.2. Environmental monitoring of the site in general**

During the construction period (and decommissioning if this happens) the ECO or a designated representative on site should inspect the area on a weekly basis as noted above. This inspection should take note of the fence and gate condition as well as whether there are any signs of people having accessed the enclosed fossil site. All inspections should be recorded in the log book. Operational phase inspections can be carried out at monthly intervals.

##### **8.5.3. Chance find procedure and staff training**

A fossil chance finds procedure should be drawn up in consultation with the appointed monitoring palaeontologist. The purpose of this procedure is to facilitate the recording and/or recovery of any stromatolites or other fossil materials at times when it is not possible to get the palaeontologist on site immediately. The palaeontologist would advise on what should be recorded and/or protected and how this should be effected. At the discretion of the palaeontologist, this procedure may also need to include training of ground staff to recognise stromatolites and encourage their reporting.

Monitoring and reporting of chance finds adds a positive impact to the development because the opportunity to understand the stromatolite occurrence is enhanced through the capture of more, and especially subsurface, data.

#### 8.5.4. Minor works during the operation phase

Should the need arise for any minor works that require excavation during the operation phase of the project then these should be subject to the chance finds procedure. Should any work that involves (1) an area of greater than 100 m<sup>2</sup> or (2) any area within 30 m of the core area then the input of a palaeontologist should be sought to determine whether any professional monitoring may be required.

### 8.6. Reporting

Reporting in terms of this HMP should be undertaken as detailed in Table 3. Reporting is required to ensure compliance with the HMP and an evaluation of its effectiveness. Reports can take the form of brief letters itemising actions taken under the HMP since the last report (e.g. fence inspections, fence repairs, fossil discoveries). They should be submitted to SAHRA and must be uploaded to the project case on SAHRIS. If any issues arise then these would need to be reported immediately so that they can be resolved. Brief discussion with a palaeontologist prior to submission of the report to SAHRA could hasten the process of resolution.

**Table 3: Reporting frequency and responsibility under the HMP.**

<b>Project Phase</b>	<b>If no issues arise</b>	<b>If issues arise</b>
Construction	Monthly reporting to note continued integrity of the fence and fossil site. <b>Responsibility:</b> ECO	Immediate reporting including a description of the issue, what impact resulted, and a plan of action for resolution of the issue and mitigation of the impact. Photographs should be included. <b>Responsibility:</b> ECO and/or palaeontologist as relevant
Construction	Monthly reporting to note progress with implementation of the HMP. <b>Responsibility:</b> Management Committee	
Operation	Annual reporting to note continued integrity of the fence and fossil site and to note progress with implementation of the HMP. <b>Responsibility:</b> Management Committee	Immediate reporting including a description of the issue, what impact resulted, and a plan of action for resolution of the issue and mitigation of the impact. Photographs should be included. <b>Responsibility:</b> Management Committee and/or palaeontologist as relevant

Decommissioning	Monthly reporting to note continued integrity of the fence and fossil site. <b>Responsibility:</b> ECO	Immediate reporting including a description of the issue, what impact resulted, and a plan of action for resolution of the issue and mitigation of the impact. <b>Responsibility:</b> ECO and/or palaeontologist as relevant
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In addition to the above requirements, and in the event that any on-site specialist intervention becomes necessary, more detailed reports would be submitted by the project palaeontologist in terms of the standard permitting procedure under the NHRA.

Reporting could include the following information as appropriate:

1. Dates of fence inspections and names of inspectors as recorded in the log book since the last report;
2. Condition of fence as recorded in the log book (e.g. fully intact, one wire broken, one pole damaged, straining post sagging, gate damaged, gate found unlocked, etc);
3. Condition of enclosed area with stromatolites as recorded in the log book (e.g. surface unchanged, vehicle tyre tracks present, evidence of access by cattle, etc);
4. Actions to be taken and timeframe: (e.g. none, wire to be replaced, straining post anchor to be replaced, gate hinge to be fixed, etc);
5. Photographs in support of any observations of damage/deterioration; and
6. If necessary, details of any correspondence with a palaeontologist regarding the resolution of any degradation of stromatolites identified in point 3 above.

### 8.7. Decommissioning of the facility

The provisions of this HMP should continue to apply throughout the lifetime of the facility. However, when the facility is decommissioned it may be feasible to remove all fencing and allow the site to return to its present condition. It would be imperative, however, that the fence around the protected area be removed once all other decommissioning and rehabilitation activities on site have been completed. A decision on whether the fence may be permanently removed can only be taken once decommissioning has been proposed and should be made in consultation with SAHRA and a palaeontologist. Factors such as the advance of scientific research and the possible discovery and protection of other stromatolite outcrops would need to be considered as relevant.

### 8.8. Review and update of the Heritage Management Plan

The HMP must be reviewed and updated at least every five years. This is to ensure that it remains relevant and effective. It may be necessary to include new actions based on new research or to protect the site from a newly identified threat. Such an update may be requested by SAHRA at any point if, during the course of monitoring and reporting, it becomes apparent that the HMP is not effective enough or if a new threat requires immediate intervention. Depending on need, a site visit may be required as part of the review and update process, but it may well be acceptable to make use of photographs supplied by the developer. This would be mainly to determine if there has been any physical degradation of the fossil stromatolites caused by activities on site.

## 8.9. Heritage Management Framework

### 8.9.1. Development

Heritage Management in relation to new development in the Waterloo 992 project area will be governed by the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) together with recommendations from SAHRA. Any new development would need to follow the regulated impact assessment process in terms of S.38(1) or S.38(8) of the NHRA as appropriate. If an action that may affect the stromatolites is proposed and that does not trigger S.38 then a permit application in terms of S.35 should be submitted to SAHRA for approval.

### 8.9.2. Research and visitors

Academic research on site should be encouraged as this will contribute to and enhance the cultural significance of the fossil stromatolites. Research will require the permission of the land owner and management committee and any intrusive actions or sampling should be conducted under a permit issued by SAHRA in terms of S.35 of the NHRA. It is highly unlikely that the site will be open to the general public or non-academic visitors in the near future<sup>4</sup> but should this ever become desirable then a visitor management section would need to be added to this HMP that deals with the proposal as necessary.

## 9. CONCLUSIONS

Recommendations have been provided and complied with during the impact assessment process for the Waterloo Solar Energy Facility. This has already served to reduce and manage impacts to fossil stromatolites. The HMP is intended to manage the stromatolites and any potential threats to them for the lifetime of the project. Through a simple management, monitoring and reporting process it is envisaged that the cultural significance of the stromatolites will be retained and even enhanced if new information comes to light and is professionally captured during development activities.

## 10. REFERENCES

- Almond, J.E. 2013. Proposed PV Solar Facility on a portion of the farm Waterloo 992 near Vryburg, Naledi Local Municipality, North-West Province. Palaeontological heritage assessment: combined desktop & field-based study. Natura Viva cc: Cape Town.
- Almond, J.E. 2016a. Proposed Gamma Solar Power Plant on the Remaining Extent of Portion 4 (Bos Kop), Farm Champions Kloof 731 near Vryburg, Naledi Local Municipality, North-West Province. Palaeontological heritage assessment: combined desktop & field-based study. Natura Viva cc: Cape Town.

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<sup>4</sup> The site is likely not of great general interest and other stromatolite outcrops do occur in the surrounding area.

- Almond, J.E. 2016b. Proposed Khubu Solar Power Plant on Portion 5 (Shadow Eve) (Portion of Portion 4), Farm Champions Kloof 731 near Vryburg, Naledi Local Municipality, North-West Province. Palaeontological heritage assessment: combined desktop & field-based study. Natura Viva cc: Cape Town.
- Almond, J.E. 2017. Recording & surface sampling of Precambrian stromatolites from the Boomplaas Formation (Ghaap Group) on a Portion of the Farm Waterloo 992 near Vryburg, Naledi Local municipality, Northwest Province. Palaeontological heritage: phase 2 mitigation report. Natura Viva cc: Cape Town.
- Groenewald, G. 2016. Proposed construction of the Sendawo Solar Photovoltaic (PV) Energy Facility near Vryburg, Northwest Province. Palaeontological Assessment Report. Pretoria: PGS Heritage.
- Naledi Local Municipality. 2017. Final Integrated Development Plan. "Fourth Generation" Integrated Development Plan 2017-2022. Vryburg: Naled Local Municipality.
- Riding, R. 2011. The Nature of Stromatolites: 3,500 Million Years of History and a Century of Research. *Lecture Notes in Earth Sciences* 131: 29-74. Springer, Berlin, Heidelberg.
- SAHRA. 2007. Minimum Standards: archaeological and palaeontological components of impact assessment reports. Document produced by the South African Heritage Resources Agency, May 2007.
- SAHRA. 2014. Guidelines for Conservation Management Plans (Revised). Document produced by the South African Heritage Resources Agency, 2014.
- SAHRA. 2017. Development Heritage Management Plan Guidelines for Archaeological, Palaeontological and Meteorites Heritage Resources. Document produced by the South African Heritage Resources Agency, 2017.

# APPENDIX 1 – Curriculum Vitae of Jayson David John Orton



*Curriculum Vitae*

**Jayson David John Orton**

ARCHAEOLOGIST AND HERITAGE CONSULTANT

## Contact Details and personal information:

**Address:** 40 Brassie Street, Lakeside, 7945  
**Telephone:** (021) 789 0327  
**Cell Phone:** 083 272 3225  
**Email:** jayson@asha-consulting.co.za

**Birth date and place:** 22 June 1976, Cape Town, South Africa  
**Citizenship:** South African  
**ID no:** 760622 522 4085  
**Driver's License:** Code 08  
**Marital Status:** Married to Carol Orton  
**Languages spoken:** English and Afrikaans

## Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science) 1997	
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

\*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

## Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

## Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233

CRM Section member with the following accreditation:

- Principal Investigator: Coastal shell middens (awarded 2007)  
Stone Age archaeology (awarded 2007)  
Grave relocation (awarded 2014)
- Field Director: Rock art (awarded 2007)  
Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

## Memberships and affiliations:

South African Archaeological Society Council member	2004 – 2016
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
UCT Department of Archaeology Research Associate	2013 –



Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –
Kalk Bay Historical Association	2016 –
Association of Professional Heritage Practitioners member	2016 –

### **Fieldwork and project experience:**

Extensive fieldwork and experience as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

#### Feasibility studies:

- Heritage feasibility studies examining all aspects of heritage from the desktop

#### Phase 1 surveys and impact assessments:

- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 archaeological test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

#### Phase 2 mitigation and research excavations:

- ESA open sites
  - Duinefontein, Gouda, Namaqualand
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

### **Awards:**

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

# APPENDIX 2: – Curriculum Vitae of Cecilene L. B. Muller

CURRICULUM VITAE  
CECILENE LI-ZAAN BRAAF MULLER

**MOBILE:** (+27) 722528950 **EMAIL:** loggomuller@gmail.com/lizaanbraafcm@yahoo.co.uk

**Linkedin URL:** <https://za.linkedin.com/in/cecilene-lizaan-braaf-muller-261a3348>

## PERSONAL INFORMATION

**Date of Birth** : 30 October 1972 **I.D. No** : 7210300214085  
**Nationality** : South African **Driver's License:** Code 08  
**Languages** : Afrikaans (Excellent), English (Excellent), French (Basic)  
and IsiXhosa (Basic)

## WORK EXPERIENCE

### CLANWILLIAM LIVING LANDSCAPE PROJECT: ARCHAEOLOGY DEPT. (UCT).

**Position:** Researcher and Education Coordinator (Jan. 2002-Dec. 2003).

### SOUTH AFRICAN HERITAGE RESOURCES AGENCY (SAHRA)

- Position:** Data Processor and Digitizer (Mar. 2004-Jun. 2005)-APM Unit
- Position:** Assistant Heritage Objects Officer (Jul. 2005-Oct.2006)-HO Unit
- Position:** Grading and Declarations Manager (Nov. 2006-Jan. 2014)-G&D Unit
- Position:** Project Manager: External Funding (Nov 2012-Nov 2013)

### AFRICA 2009 ( ICCROM, NORAD, SIDA )

**Position1:** Facilitator for Africa 2009 course.

**Position2:** Guest Editor (2008)

### FIFA: CAPE TOWN STADIUM, 2010

**Position:** Volunteer Manager (Jun.-Jul.2010)-

### SOUTH AFRICAN MUSEUMS ASSOCIATION-WESTERN CAPE REGION

**Position:** Chairperson (Volunteer Jan. 2016-Feb. 2017)

### HERITAGE WESTERN CAPE

**Position:** Committee member (Dec. 2016-Current).

<sup>A</sup>Archaeology, Palaeontology and Meteorites Committee and <sup>B</sup>Impact Assessment Committee.

## EDUCATION

Phoenix Senior Secondary- Manenberg

Jan. 1987-Jan. 1991

### University of Cape Town

DEGREE	SUBJECT/S	YEARS
Honours in Social Policy and Management (BSOCSC).	Development Studies, Social Research, Management and Program Planning	2008-2009
Master of Arts (Archaeology)	Research Dissertation: Doing a carbon and nitrogen isotope analysis of cultural and skeletal material from Nelson Bay Cave and Matjies River Rock Shelter.	1999-2002
BA of Arts ( Honours)	Dissertation: " <i>Sutherlandia: An ethnobotany and pharmacological study in Clanwilliam</i> ".	1998
Bachelor of Social Science (BSOCSC)	Social Work and Industrial Sociology Community Profiling: Manenberg, Community, Group Work, Carehaven, Centre for Battered women in Bridgetown. Medical Social Work: Ophthalmology Unit, Groote Schuur Hospital,	1993-1996

	Community Work-Child Welfare-Hout Bay. Anti-gangsterism project. 1993: The Dean's Merit award-St. Ledger Prize for best student	
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## SKILLS

\*Research, \*Mapping and Surveying \*Data Analysis, \*Project Management, \*Monitoring and Evaluation (Review), \*Reporting, \*Presentations (Conference Papers), \*Site Inspection, \*Management, \*Consultation, \*Client/Stakeholder Engagement, \*Facilitation, \*Conference Management, \*Design. **Computer Skills:** GIS-MapInfo, GPS (Garmin III) and ArcGIS 9 (2008-GIMS), Microsoft Office (Full Suite:), Statistical – Statistica, Internet – Web Design (Starter and Intermediate module), E-mail – Outlook , Netscape, Gmail, GroupWise and Zimbra, Social Media Platforms (Whatsapp, Facebook etc.) Dropbox and Wordpress.

## RELEVANT COURSES

YEAR	COURSE	INSTITUTION
2005	Project Management	UCT
2005	Africa 2009, 7 <sup>th</sup> Regional course, conservation and management of immovable cultural heritage.	ICCROM; Mombasa Kenya
2007	Executive Guide to Project Management	UCT
2007	Training Workshop for South African Rock Art Documentation Rock Art Institute	WITS
2011	Managing Indoor Climate Risks' workshop in Olinda, Brazil (Archives, Museums and Heritage Sites	Olinda, (Archives, Museums and Heritage Sites ) Rijksdienst voor het Cultureel Erfgoed Nederland
2015	Basics for Financial Management	Getsmarter/UCT
2017	Becoming a changemaker: Introduction to Social Innovation	Coursera/UCT-Bertha Institute

## CONFERENCES ORGANISED

- **2013:** The South African Heritage Resources Agency (SAHRA) Conference on Sacred Sites. Mapungubwe National and World Heritage Site. Mapungubwe.
- **2016:** Cultural Heritage Landscape and Museums Symposium. SAMA Western Cape. University Museum Stellenbosch.

## ACADEMIC PUBLICATION

- **2014:** Integrated management planning: Sustainable Development of heritage resources. International Conference on, "Living with World Heritage in Africa'. Johannesburg 2012. African World Heritage Fund.

## Membership/s

South African Museums Association (SAMA: 2006-current-Member WC65) - Regional Committee Chairperson (Jan. 2016-Feb. 2017), Association of Southern African professional Archaeologists (ASAPA: 2005-current-Member 220).

## APPENDIX 3 – Stromatolite photographs

Photographs taken by the second author to record the condition of the site on 27<sup>th</sup> July 2018.



**Figure A2.1:** View of the area in which the sensitive large stromatolites occur with the silicified rim of a large stromatolite visible in the foreground at right.



**Figure A2.2:** A horizontally-truncated and partially silicified large stromatolitic dome (scale bar = 0.5 m).



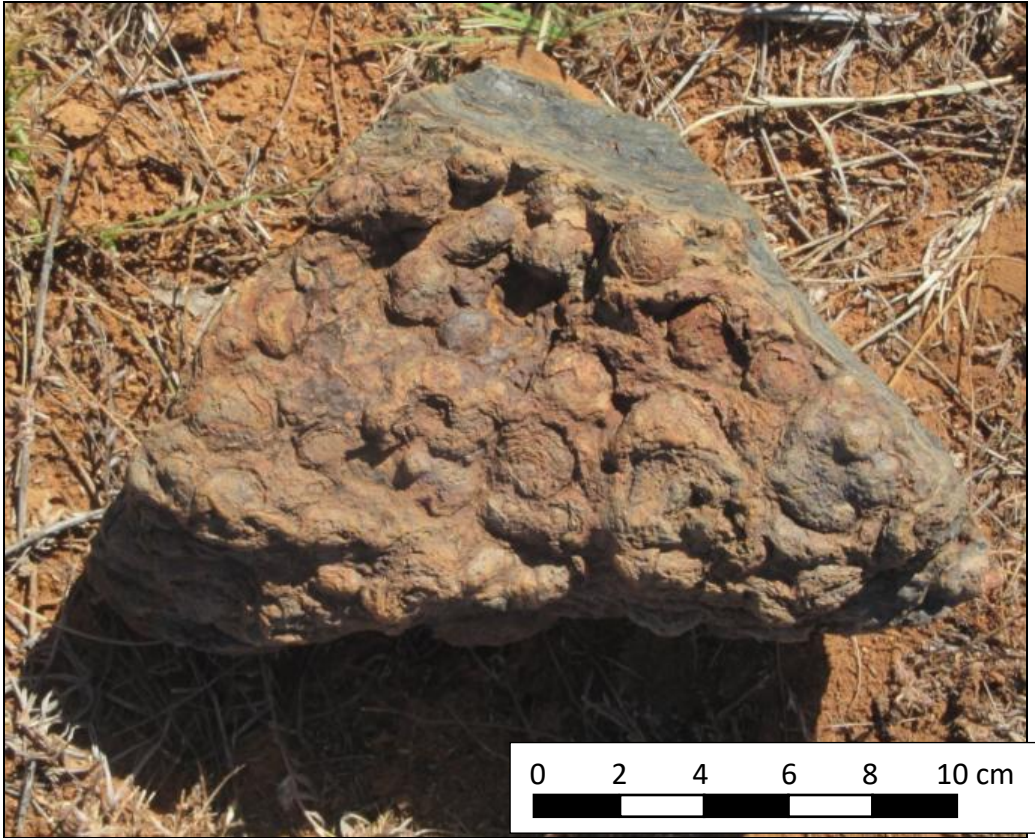
**Figure A2.3:** A horizontally-truncated and partially silicified large stromatolitic dome with the core zone weathered away (scale bar = 0.5 m).



**Figure A2.4:** A horizontally-truncated large stromatolitic dome showing weathering of the silicified peripheral zone and total loss of the core zone (scale bar = 0.5 m).



**Figure A2.5:** A horizontally-truncated partially silicified large stromatolitic dome with a partially weathered periphery and completely weathered core zone (scale bar = 0.5 m).



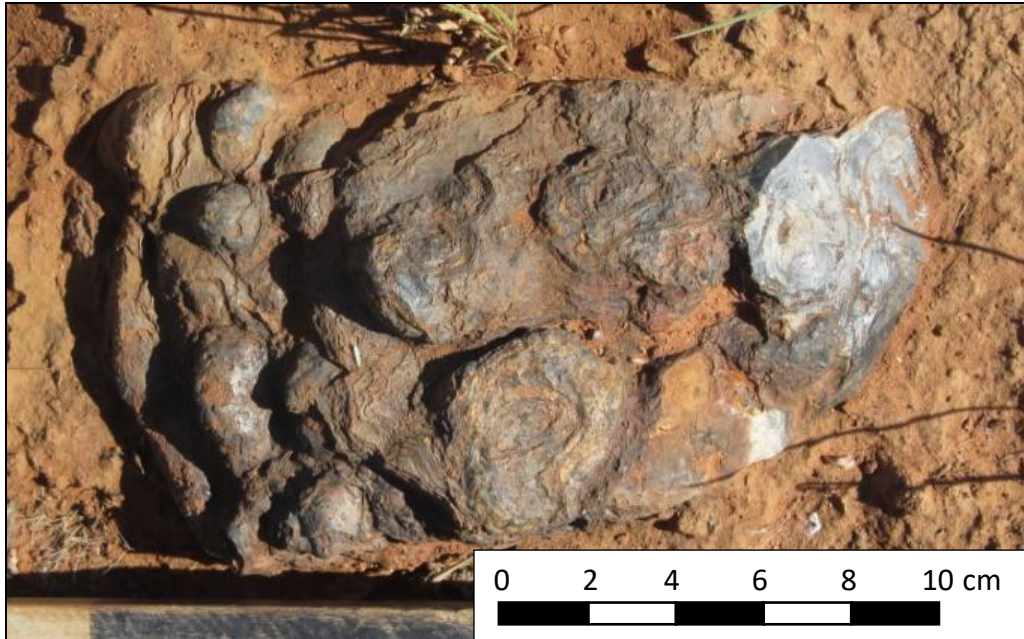
**Figure A2.6:** Horizon of tightly-packed small stromatolitic buttons.



**Figure A2.7:** Domal surface covered with small stromatolitic buttons (scale bar = 0.5 m).



**Figure A2.8:** Transverse section through irregular small stromatolites.



**Figure A2.9:** Irregular-shaped small stromatolites.



**Figure A2.10:** Cross-section through a small stromatolitic button (left) and the outer side of its dome (right) (scale bar in mm & cm).



## APPENDIX 4 – Stromatolite Protection Zone



*Satellite image of eastern corner of the study area showing the sensitive stromatolite area.*

**Key:**

- Blue lines:** *Northeast and southeast edges of development footprint.*
- Yellow line:** *Approved access road.*
- Red polygon:** *Core of sensitive stromatolite area enclosing the waypoints presented by Almond (2017: Appendix 1)*
- Orange shaded polygon:** *Buffer area around core area. This is the minimum area to be fenced.*
- Green shaded polygons:** *Areas that require full time professional palaeontological monitoring.*

## APPENDIX 5 – Stakeholder database

Organisation	Role	Contact person	Postal address	E-mail address	Tel./fax.
Chris van Zyl Trust	Land owner	Dr. Chris van Zyl	P.O. Box 1801 Vryburg 8600	Waterloo1@telkomsa.net vanzylcg@gmail.com	082 779 3974 (m) 079 196 5302 (m)
African Clean Energy Developments(Pty) Ltd (ACED)	Representing Old Mutual (facility owner)	Ms Stephnie Kot	P.O. Box 23101 Claremont 7735	stephnie.kot@aced.co.za	021670 1423 (t) 083 318 3982 (m)
juwi Renewable Energies (Pty) Ltd	Engineering, Procurement and Construction	Ms Nazley Towfie Mr Andre Steffen Mr Coen Fourie	24th Floor Metropolitan Centre, 7 Walter Sisulu Avenue, Foreshore, Cape Town, 8001	nazley.towfie@juwi.co.za andre.steffen@juwi.co.za coen.fourie@juwi.co.za	021 831 6131 (t) 021 831 6199 (f)
Council for Geoscience, Bellville	Curator of the collected samples	Ms Claire Browning	P.O. Box 572 Bellville 7535	Info@geoscience.org.za	021 943 6700 (t) 021 946 4190 (f)
SAHRA	Responsible Heritage resources Authority	Dr Ragna Redelstorff Ms Natasha Higgitt Mr Philip Hine	P.O. Box 4637 Cape Town 8000	rredelstorff@sahra.org.za nhiggitt@sahra.org.za phine@sahra.org.za	021 462 4502 (t) 021 462 4509 (f)
North West Provincial Heritage Authority	Provincial Heritage Resources Authority	Mr. Mosiane	Private Bag X90 Mmabatho 2735	mosianem@nwpg.gov.za	018 388 2826 (t) 086 621 1240 (f)
Naledi Local Municipality	Municipal Manager	Mr Modisenyane Segapo	P.O. Box 35 Vryburg 8600	info@naledi.local.gov.za	053 928 2200 (t) 053 927 3482 (t)
Natura Viva cc	Project palaeontologist	Dr. John Almond	P.O. Box 12410 Mill Street, Cape Town 8010	naturaviva@universe.co.za	021 462 3622 (t) 071 947 0577 (m)
n/a	Palaeontologist	Dr Gideon Groenewald	PO Box 360 Clarens 9707	gideonhgroenewald@gmail.com gideon@bhm.dorea.co.za	058 256 1314 (t) 078 713 6377 (m)
National Museum, Bloemfontein	Palaeontologist	Dr Lloyd Rossouw	National Museum PO Box 266 Bloemfontein 9300	lloyd@nasmus.co.za	051 447 9609 (t)

National Museum, Bloemfontein	Palaeontologist	Dr Jennifer Botha-Brink	National Museum PO Box 266 Bloemfontein 9300	jbotha@nasmus.co.za	051 447 9609 (t)
National Museum, Bloemfontein	Palaeontologist	Ms Elize Butler	National Museum PO Box 266 Bloemfontein 9300	elize.butler@nasmus.co.za	051 447 9609 (t)
University of the Witwatersrand	Palaeontologist	Dr Bruce Rubidge	1 Jan Smuts Avenue Braamfontein 2000	Bruce.Rubidge@wits.ac.za	011 717 6685 (t)
Albany Museum	Palaeontologist	Dr Billy de Klerk	40 Somerset Street Grahamstown 6139	B.Deklerk@ru.ac.za	046 622 2312 (t)
Iziko South African Museum	Palaeontologist	Dr Roger Smith	P.O. Box 61 Cape Town 8000	rsmith@iziko.org.za	021 481 3879 (t) 082 723 2804 (m)
n/a	Palaeontologist	Mr John Pether	P.O. Box 48318 Kommetjie 7976	jpether@iafrica.com	021 783 3023 (t) 083 744 6295 (m)

## APPENDIX 6 – List of actions and timeframes for the implementation of the HMP

Action	Timeframe	Responsibility	Dedicated Budget Required	Deliverable / Objective
Establish a Management Committee including at least the landowner, a representative of the developer / owner and a senior staff member at the facility	Pre-construction	Developer	No	<ul style="list-style-type: none"> <li>Letter to SAHRA providing membership details of committee</li> </ul>
Create budget availability for any actions requiring funding.	Pre-construction	Developer	No	<ul style="list-style-type: none"> <li>Budget set aside and available when required</li> </ul>
Establish a Buffer of 30 m around the core area – to be surveyed and pegged on site	Pre-construction	Management Committee / ECO	Yes	<ul style="list-style-type: none"> <li>Buffer zone pegged on site</li> </ul>
Order weather proof no entry signs	Pre-construction	Management Committee	Yes	<ul style="list-style-type: none"> <li>Signs procured</li> </ul>
Erect a fence and install no entry signs	Pre-construction	Management Committee / ECO	Yes	<ul style="list-style-type: none"> <li>Fence established</li> <li>Signs installed</li> </ul>
Appoint a monitoring palaeontologist	Pre-construction	Developer	No	<ul style="list-style-type: none"> <li>Palaeontologist on standby for construction period</li> </ul>
Create a chance find procedure	Pre-construction	Monitoring palaeontologist	Yes	<ul style="list-style-type: none"> <li>Chance find procedure ready for use</li> </ul>
Procure and provide a log book for the recording of fence inspections and repairs and any visits to the conserved area	Pre-construction	Management Committee	Yes	<ul style="list-style-type: none"> <li>Log book ready for use</li> </ul>
Staff training/induction for fossil recognition	At start of Construction	Monitoring palaeontologist	Yes	<ul style="list-style-type: none"> <li>Project staff familiar with stromatolite appearance and reporting procedure</li> </ul>
Carry out monitoring	As required	Monitoring palaeontologist	Yes	<ul style="list-style-type: none"> <li>Palaeontologist present when required</li> <li>Fossils recorded</li> <li>Monitoring report submitted to SAHRA</li> </ul>
Construction Phase - Monitor fence and site	Entire construction period	ECO	No	<ul style="list-style-type: none"> <li>Weekly record in log book</li> <li>Monthly reports to SAHRA</li> </ul>
Maintain the fence	As required	Management Committee	Yes	<ul style="list-style-type: none"> <li>Repairs effected timeously</li> </ul>
Manage access to fenced fossil site for monitoring or research	As required	Management Committee	No	<ul style="list-style-type: none"> <li>Access to responsible persons granted as required</li> </ul>
Construction Phase - Monitor works in buffer zone	Full time	Monitoring palaeontologist	Yes	<ul style="list-style-type: none"> <li>Monitoring report submitted to SAHRA</li> </ul>
Construction Phase - Monitor works elsewhere	As required	Monitoring palaeontologist	Yes	<ul style="list-style-type: none"> <li>Monitoring report submitted to SAHRA</li> </ul>

Operation Phase – Monitor fence and site	Entire operation period	Appointed staff member	No	<ul style="list-style-type: none"> <li>• Monthly record in log book</li> <li>• Annual reports to SAHRA</li> </ul>
Operation Phase – Review and update HMP	5 yearly or less as required	Heritage consultant	Yes	<ul style="list-style-type: none"> <li>• Updated HMP that remains relevant and effective</li> </ul>
Decommissioning Phase – Monitor fence and site	Entire decommissioning period	ECO	No	<ul style="list-style-type: none"> <li>• Weekly record in log book</li> <li>• Monthly reports to SAHRA</li> </ul>
Decommissioning Phase – Site rehabilitation and removal of fence (if deemed appropriate at the time)	At end of decommissioning	Management Committee / ECO	Yes	<ul style="list-style-type: none"> <li>• The site is returned to agricultural (grazing) use</li> <li>• The stromatolites remain in the same condition as before construction</li> </ul>

## APPENDIX 7 – Layout plan response to HMP

After compilation of this HMP the developer sought to redesign the infrastructure in close proximity to the stromatolite protection zone and within the constraints of the environmental authorisation. The plan shown below is the result. The security fence of the facility (green line) will now run along the south-western boundary of the core protection area rather than bisecting it and the access road has been shifted south to further reduce potential subsurface impacts on stromatolites. This plan is fully supported by the present authors as it assists with the implementation of the required conservation measures. The only infrastructure that would be present within the stromatolite protection zone is the existing power line (brown dashed line).

