

## SPORTFIELD IRRIGATION PIPELINES IN CALVINIA, HANTAM MUNICIPALITY, NAMAQUA DISTRICT, NOTHERN CAPE PROVINCE

John E. Almond PhD (Cantab.)  
*Natura Viva* cc, PO Box 12410 Mill Street,  
Cape Town 8010, RSA  
naturaviva@universe.co.za

August 2019

### EXECUTIVE SUMMARY

The overall palaeontological impact significance of the proposed sports field irrigation project at Calvinia, Hantam Municipality, Northern Cape, is considered to be LOW because (1) the Tierberg Formation (Permian Ecca Group) basinal mudrocks underlying the project footprint are generally of low palaeontological sensitivity, and are likely to be weathered near-surface; (2) deep, voluminous excavations into fresh bedrock are not envisaged; (3) the project footprint is small and for the most part is already highly disturbed (urban context, road reserves *etc*), and (4) small water courses traversed by the pipeline routes are not associated with substantial deposits of consolidated, potentially fossiliferous older alluvium.

**It is therefore recommended that, pending the exposure of significant new fossils during development, exemption from further specialist palaeontological studies and mitigation be granted for this development.**

There are no objections on palaeontological heritage grounds to authorisation of the proposed municipal irrigation project. Should any substantial fossil remains (*e.g.* vertebrate bones and teeth, shells, calcretised burrows) be encountered during excavation, however, these should be reported to SAHRA for possible mitigation by a professional palaeontologist. A tabulated Chance Fossil Finds protocol is appended to this report. These mitigation recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed development.

### 1. PROJECT OUTLINE

Hantam Municipality, Northern Cape, is proposing to use treated sewage effluent from the Calvinia Waste Water Treatment Works (WWTW) to irrigate two sports fields in town, the Hantam Park Show Grounds and De Kraal Sport Grounds. An existing pipeline is already in place from the Calvinia WWTW to the existing pump station. Proposed new infrastructure comprises the following (Fig. 1):

- A WWTW Irrigation Pump station at the WWTW;
- Two 120 kL reservoirs on the sport fields, each with a booster pump;
- Sports field irrigation pipelines;
- Security fencing;
- Irrigation rising main pipelines from the existing pump station to the Hantam Park Showgrounds & De Kraal Sport Grounds. The pipelines will be constructed within road reserves (*e.g.* R355) and on municipal land, so no natural vegetation will be lost. The pipeline to Hantam Park Showgrounds will cross the R355 as well as transversing one a stormwater culvert and a modified drainage line (Fig. 2).
- A 400 m, 11 kV Medium Volt (MV) powerline will be constructed for 2 Phase 400 v power supply to the WWTW Irrigation pump station *plus* Low Volt (LV) power supply lines to the sport field irrigation pump stations.

A desktop palaeontological heritage comment for the development has been requested by ACRM, Rondebosch (Jonathan Kaplan. 5 Stuart Road, Rondebosch, 7700. Phone / Fax: 021 685 7589. Cell: 082 321 0172. E-mail: acrm@wcaccess.co.za).



**Figure 1: Google Earth© satellite image showing the footprint of the proposed sports field irrigation project on the western outskirts of Calvinia, Hantam Municipality, Northern Cape (Figure abstracted from the draft EMPr compiled by Enviroafrica, Helderberg, June 2019).**



**Figure 2: The proposed pipeline route to Hantam Park Showgrounds crosses a modified drainage line just south of the R355 (Point J in Figure 1). The drainage line has been transformed into a stormwater trench. The pipeline footprint will remain less than 10 m<sup>3</sup> and less than 100m<sup>2</sup> within the drainage line (Figure and data abstracted from the draft EMPr compiled by Enviroafrica, Helderberg, June 2019).**

## 2. GEOLOGICAL CONTEXT

The geology of the Calvinia area is outlined on 1: 250 000 sheet 3118 Calvinia (Council for Geoscience, Pretoria) (De Beer *et al.* 2002) (Fig. 3). The sports field irrigation scheme footprint is underlain by basinal mudrocks of the Middle Permian **Tierberg Formation** (Ecca Group, Karoo Supergroup) that are locally mantled by thin colluvial and alluvial gravels, such as along minor water courses (Fig. 2). In the Hantamsberge to the north of town, as well as the small *koppie* to the NW of the WWTA, the Ecca bedrocks are extensively intruded by major Early Jurassic sills of the Karoo Dolerite Suite.

The Tierberg Formation is a thick, recessive-weathering, mudrock-dominated succession consisting predominantly of dark, often brown to grey, well-laminated, carbonaceous shales with subordinate thin, fine-grained sandstones (Viljoen 2005, Johnson *et al.*, 2006). The Tierberg shales are Early to Middle Permian in age and were deposited in a range of offshore, quiet water environments below wave base. These include basin plain, distal turbidite fan and distal prodelta in ascending order (Viljoen 2005, Almond *in* Macey *et al.* 2011). Thin coarsening-upwards cycles occur towards the top of the formation with local evidence of soft-sediment deformation, ripples and common calcareous concretions. Thin water-lain tuffs (volcanic ash layers) are also known. A restricted, brackish water environment is reconstructed for the Ecca Basin at this time. Close to the contact with Karoo dolerite intrusions the Tierberg mudrocks are often baked to a dark grey hornfels with a reddish-brown crust (Prinsloo 1989).

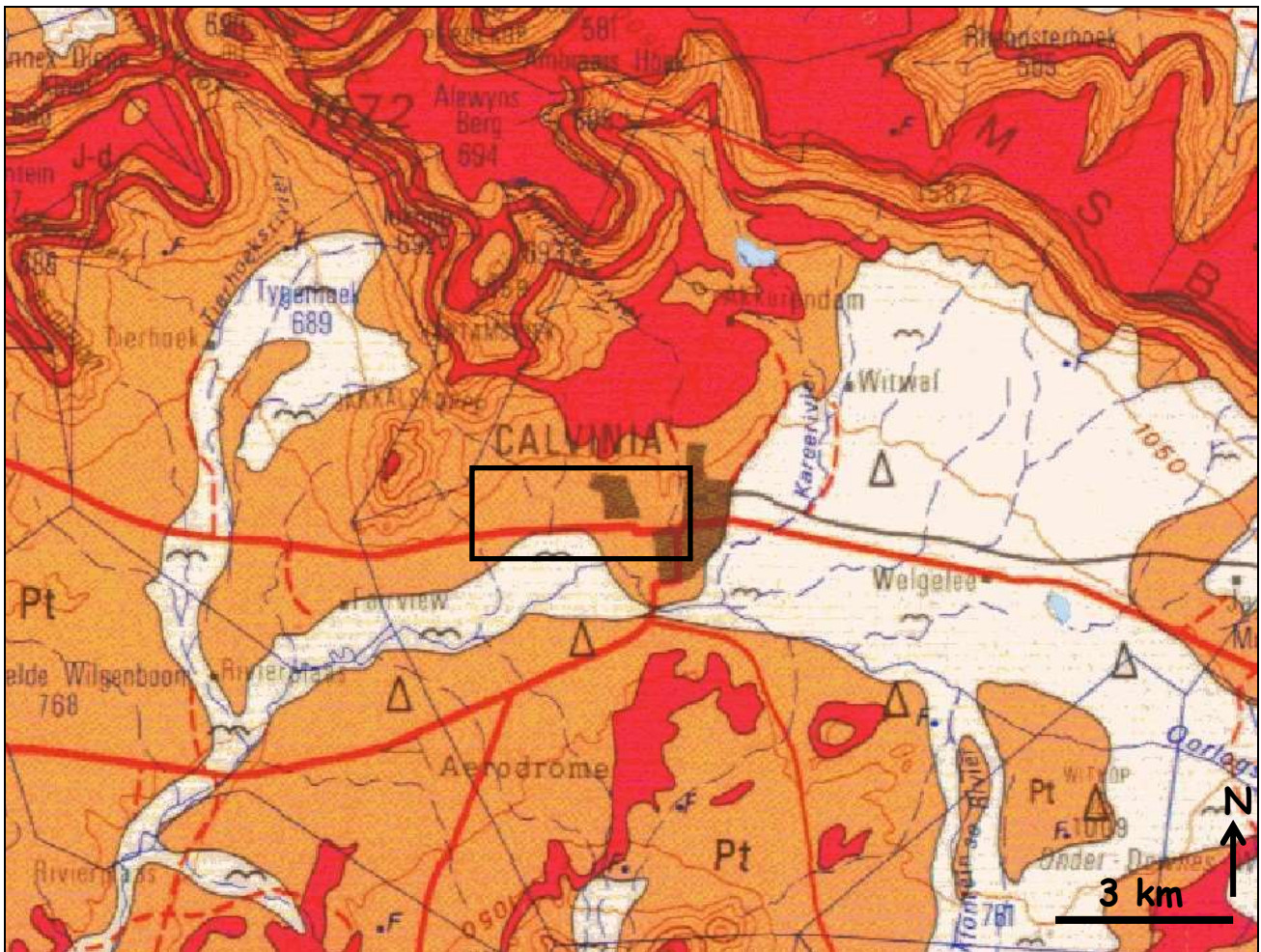


Figure 3. Extract from 1: 250 000 geology Sheet 3118 Calvinia (Council for Geoscience, Pretoria) showing the approximate location of the irrigation scheme on the western outskirts of Calvinia (black rectangle). The project area is underlain by basinal mudrocks of the Middle Permian Tierberg Formation (Ecca Group, Karoo Supergroup) (Pt, orange) that are extensively intruded by Early Jurassic dolerites of the Karoo Dolerite Suite in the Calvinia region (Jd, red).

### 3. PALAEOLOGICAL HERITAGE

The fossil record of the Tierberg Formation in the Calvinia sector of Main Karoo Basin has been reviewed in detail by Almond *in* Macey *et al.* (2011). Rare body fossil records include disarticulated microvertebrates (*e.g.* fish teeth and scales) from calcareous concretions and allochthonous plant remains (leaves, petrified wood). The latter become more abundant in the upper, more proximal (prodeltaic) facies of the Tierberg succession (*e.g.* Wickens 1984). Prinsloo (1989) records numerous plant impressions and unspecified “fragmentary vertebrate fossils” within fine-grained sandstones in the Britstown sheet area; the latter may in fact be misidentified concretionary material. Dark carbonaceous Ecca mudrocks are likely to contain palynomorphs (*e.g.* pollens, spores, acritarchs). The commonest fossils by far in the Tierberg Formation are sparse to locally concentrated assemblages of trace fossils that are often found in association with thin event beds (*e.g.* distal turbidites, prodeltaic sandstones) within more heterolithic successions. A modest range of ten or so different ichnogenera have been recorded from the Tierberg Formation (See Almond *in* Macey *et al.* (2011)). Among these distinctive broad (3-4 cm), strap-shaped, horizontal burrows with blunt ends and a more-or-less pronounced transverse ribbing occur widely within the Tierberg mudrocks. They have been described as “fucoid structures” by earlier workers by analogy with seaweeds, and erroneously assigned to the ichnogenera *Plagiogmus* by Anderson (1974) and *Lophoctenium* by Wickens (1980, 1984). Examples up to one metre long were found in Tierberg mudrocks near Calvinia in 1803 by H. Lichtenstein, who described them as “eel fish”. These are among the first historical records of fossils in South Africa (MacRae 1999). These as yet unnamed burrows are infilled with organized arrays of faecal pellets. Microbial mat textures, such as *Kinneyia*, also occur in these offshore mudrocks but, like the delicate grazing traces with which they are often associated, are generally under-recorded.

The palaeosensitivity of the Tierberg Formation may be locally high (*e.g.* plant- and trace fossil-rich horizons) but is generally low. Many of the fossil remains here are of widely-occurring forms within the extensive outcrop area of the formation. Satellite images suggest that good exposures of fresh Tierberg mudrocks are not present within the project footprint. The thin, unconsolidated alluvial deposits associated with small water courses within the project footprint (Fig. 2) are unlikely to be fossiliferous.

### 4. CONCLUSIONS & RECOMMENDATIONS

The overall palaeontological impact significance of the proposed sports field irrigation project at Calvinia is considered to be VERY LOW because:

- The Tierberg Formation mudrocks underlying the project footprint are generally of low palaeontological sensitivity, and are likely to be weathered near-surface; deep, voluminous excavations into fresh bedrock are not envisaged.
- The project footprint is small and for the most part is already highly disturbed (urban context, road reserves *etc.*).
- Small water courses traversed by the pipeline routes are not associated with substantial deposits of consolidated, potentially fossiliferous older alluvium.

**It is therefore recommended that, pending the exposure of significant new fossils during development, exemption from further specialist palaeontological studies and mitigation be granted for this development.**

There are no objections on palaeontological heritage grounds to authorisation of the proposed development. Should any substantial fossil remains (*e.g.* vertebrate bones and teeth, petrified wood) be encountered during excavation, however, these should be reported to SAHRA. A tabulated Chance Fossil Finds protocol is appended to this report.

These mitigation recommendations should be incorporated into the Environmental Management Programme (EMPr) for the proposed development.

Please note that:

- All South African fossil heritage is protected by law (South African Heritage Resources Act, 1999) and fossils cannot be collected, damaged or disturbed without a permit from SAHRA;
- The palaeontologist concerned with potential mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (e.g. museum or university collection);
- All palaeontological specialist work should conform to international best practice for palaeontological fieldwork and the study (e.g. data recording fossil collection and curation, final report) should adhere as far as possible to the minimum standards for Phase 2 palaeontological studies developed by HWC (2016) and SAHRA (2013).

## 5. KEY REFERENCES

ALMOND, J.E. 2018. Proposed telecommunications mast on Erf 1644, Calvinia, Namaqua District, Northern Cape. Palaeontological specialist study: letter of exemption, 8 pp. Natura Viva cc, Cape Town.

ANDERSON, A.M. 1974. Arthropod trackways and other trace fossils from the Early Permian lower Karoo Beds of South Africa. Unpublished PhD thesis, University of Witwatersrand, Johannesburg, 172 pp.

CTS HERITAGE 2018. Proposed 25m high telecommunications mast on Erf 1644, Calvinia sportsground, Dorp Street, Calvinia, Northern Cape. Heritage Screener report, 13 pp. CTS Heritage, Cape Town.

DE BEER, C.H., GRESSE, P.G., THERON, J.N. & ALMOND, J.E. 2002. The geology of the Calvinia area. Explanation to 1: 250 000 geology sheet 3118 Calvinia. 92 pp. Council for Geoscience, Pretoria.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., De V. WICKENS, H., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Marshalltown.

MACEY, P.H., SIEGFRIED, H.P., MINNAAR, H., ALMOND, J. & BOTHA, P.M.W. 2011. The geology of the Loeriesfontein area. Explanation to 1: 250 000 geology sheet 3018, 139 pp. Council for Geoscience, Pretoria.

MACRAE, C. 1999. Life etched in stone. Fossils of South Africa, 305 pp. The Geological Society of South Africa, Johannesburg.

PRINSLOO, M.C. 1989. Die geologie van die gebied Britstown. Explanation to 1: 250 000 geology Sheet 3022 Britstown, 40 pp. Council for Geoscience, Pretoria.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

VILJOEN, J.H.A. 2005. Tierberg Formation. SA Committee for Stratigraphy, Catalogue of South African Lithostratigraphic Units 8: 37-40.

WICKENS, H. DE V. 1980. Verslag oor kartering in die Calvinia gebied. Unpublished report, Council for Geoscience, Pretoria, 19 pp.

WICKENS, H. DE V. 1984. Die stratigraphie en sedimentologie van die Group Eccas van Sutherland. Unpublished MSc thesis, University of Port Elizabeth, viii + 86 pp.

WICKENS, H. DE V. 1992. Submarine fans of the Permian Eccas Group in the SW Karoo Basin, their origin and reflection on the tectonic evolution of the basin and its source areas. In: De Wit, M.J. & Ransome, I.G.D. (Eds.) Inversion tectonics of the Cape Fold Belt, Karoo and Cretaceous Basins of southern Africa, pp. 117-126. Balkema, Rotterdam.

WICKENS, H. DE V. 1994. Submarine fans of the Eccas Group. Unpublished PhD thesis, University of Port Elizabeth. 350 pp.

WICKENS, H. DE V. 1996. Die stratigraphie en sedimentologie van die Eccas Groep van Sutherland. Council for Geosciences, Pretoria Bulletin 107, 49pp.

## **QUALIFICATIONS & EXPERIENCE OF THE AUTHOR**

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Gauteng, KwaZulu-Natal, Mpumalanga, Northwest and Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has been a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and AHP (Association of Professional Heritage Practitioners – Western Cape).

## **Declaration of Independence**

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.



**Dr John E. Almond**  
**Palaeontologist**  
***Natura Viva* cc**

<b>CHANCE FOSSIL FINDS PROCEDURE: Proposed sports field irrigation project, Calvinia, Hantam Municipality</b>	
<b>Province &amp; region:</b>	<b>NORTHERN CAPE, Namaqua District</b>
<b>Responsible Heritage Resources Authority</b>	SAHRA (Contact details: P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502)
<b>Rock unit(s)</b>	Tierberg Formation (Ecca Group, Karoo Supergroup)
<b>Potential fossils</b>	Trace fossils, plant fossils including petrified wood, rare microvertebrate remains (e.g. fish bones, teeth)
<b>ECO protocol</b>	1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately ( <i>N.B.</i> safety first!), safeguard site with security tape / fence / sand bags if necessary.
	2. Record key data while fossil remains are still <i>in situ</i> : <ul style="list-style-type: none"> <li>• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo</li> <li>• Context – describe position of fossils within stratigraphy (rock layering), depth below surface</li> <li>• Photograph fossil(s) <i>in situ</i> with scale, from different angles, including images showing context (e.g. rock layering)</li> </ul>
	3. If feasible to leave fossils <i>in situ</i> : <ul style="list-style-type: none"> <li>• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation</li> <li>• Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Authority for work to resume</li> </ul>
	3. If <i>not</i> feasible to leave fossils <i>in situ</i> (emergency procedure only): <ul style="list-style-type: none"> <li>• <i>Carefully</i> remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)</li> <li>• Photograph fossils against a plain, level background, with scale</li> <li>• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags</li> <li>• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist</li> <li>• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation</li> </ul>
	4. If required by Heritage Resources Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.
5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Authority	
<b>Specialist palaeontologist</b>	Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Authority minimum standards.

