South Australian
HERITAGE COUNCIL

SUMMARY OF STATE HERITAGE PLACE

REGISTER ENTRY

Entry in the South Australian Heritage Register in accordance with the *Heritage Places Act 1993*

NAME: Green Waterhole – Tank Cave Fossil Complex **PLACE NO.:** 26530

ADDRESS: Green Waterhole Water Reserve (L81), Allotment 550, Princes Highway, Tantanoola SA, 5280

CR/5762/955, Plan H420600, Section 550, Hundred of Hindmarsh

STATEMENT OF HERITAGE SIGNIFICANCE

The Green Waterhole - Tank Cave Fossil Complex contains the only known extensive underwater vertebrate fossil deposits in Australia. This unique freshwater depositional environment has ensured the preservation of extinct species not found anywhere else, with several additional species new to science recovered and awaiting description.

The underwater deposits have also resulted in a completeness and preservation of fossil assemblies almost unique for Australia. This provides an important opportunity to investigate the evolution of South Australian mammals and birds. The impacts of this type of site on the age and nature of the fossil remains have yet to be fully studied.

The complex represents unusual geological formations including the high collapse talus cone forming the cave entrance, the occurrence of a shallow fresh waterhole not usually found in sinkholes in the South East, and evidence of rare volcanogenic influences in the formation of the cave system.

The cave complex also demonstrates rare speleological features, including length of cave passageways, clarity of water, underwater speleothems, and being a type locality for stygofauna. The complex also holds importance for the development of cave diving in the country and is closely associated with the Cave Divers Association of Australia.

STATEMENTS OF DESIGNATION

Designated Place of Palaeontological Significance

The Green Waterhole – Tank Cave Fossil Complex is highly significant for palaeontology in three important ways.

First, it is the best example of underwater Pleistocene vertebrate deposits anywhere in Australia. Although fossils of this age are found in underwater settings throughout the Mt Gambier region, fossils in the Green Waterhole - Tank Cave Fossil Complex are incredibly numerous, very well preserved, and found in situ.

Second, the site contains fossil species found nowhere else in Australia, or else are incredibly rare. These include both bird and kangaroo species.

Third, the site offers the rare opportunity to study the taphonomy of underwater deposits. Evidence for at least one wetting and drying phase in the cave has the potential to provide important information for understanding how fossil deposits are formed and preserved in cave settings.

The significant palaeontological features contained within the complex are:

- Oligo-Miocene marine species throughout the cave walls and ceilings
- Incredibly well-preserved and diverse underwater vertebrate fossil deposits
- Type site for extinct kangaroo *Simosthenurus newtonae*
- Type site for extinct birds *Centropus colossus* and *Orthonyx hypsilophus*
- Untouched* fossil and sedimentary deposits in Green Waterhole/Tank Cave
- Presence of rare megafauna taxa such as *Propleopus*
- Underwater taphonomic processes including microbial activity, mineral dissolution and deposition, weathering, fragmentation, and disarticulation
- Diverse and rich avifaunal deposits

*Several sites within the complex are almost untouched, in particular some sedimentary beds. Sedimentary deposits are a well-known source of palaeoenvironmental information that can inform on precipitation and vegetation histories. Science recognises the intrinsic value of preserving important elements of the caves in their original (pre-human) condition. This provides a significant undisturbed record of the State's palaeoenvironment. Science also recognises that such preservation may enable future examination and enhanced interpretation using techniques not yet devised or invented for understanding our State's past environment.

Designated Place of Speleological Significance

The Green Waterhole – Tank Cave Fossil Complex is situated at the Western end of the longest underwater cave system in South Australia, widely acclaimed as one of the premier cave diving localities in Australia. The Green Waterhole – Tank Cave system has a long history in the development of the sport of cave diving in Australia.

In addition to the 10 kms of passageways that can be explored by divers, the complex preserves important speleological formations, features, and fauna that are rare or not found in other caves in the area.

The significant speleological features contained within the complex are:

- Extensive phreatic joint-controlled maze cave system with outstanding exploration potential
- Twilight and dark underwater zones accessible by divers
- Cave collapse features and boulders in Green Waterhole
- Underwater speleothem formations
- Calcite raft deposits
- Undisturbed mud cracks and significant sediment accumulations
- Marine and vertebrate fossils in the walls and on the floor, respectively
- Preservation of stromatolites around the cave entrance
- Type locality for *Koonunga crenarum* (a *syncarid* crustacean)
- Habitat for over 40 other species of stygofauna
- Scalloping and phreatic erosion above the current water table

Designated Place of Geological Significance

The broad Gambier Limestone Plain extends from the coastline to the Bordertown/Kingston area and is a raised sea floor, elevated over 1–2 million years by tectonic forces associated with the volcanic activity across the region. Fresh groundwater from rainfall percolates through the limestone from inland to the coast, dissolving cave systems particularly along major fracture lines (geological faults). Volcanoes have also erupted along two large regional faults in the Mount Gambier region. Many large deep sinkholes ('cenotes') have developed south of Mount Gambier reaching the water table and extending deep below them (50–120m).

The combined Green Waterhole-Tank Cave system is shallow by comparison (20m) with other sinkholes in the region, and is the longest underwater cave system by far in South Australia, developed by solution in a large complex grid system (see site map overlay). Initiation and enlargement of the cenotes and possibly the cave system itself has been assisted by volcanic CO2 gases rising up fault lines and acidifying the groundwater, stimulating large-scale solution of passages in the limestone (Webb et al 2010). This is a rare process in global cave development known as 'volcanogenesis' and requires the coexistence of volcanoes, extensive limestone and abundant groundwater, which occurs at this location. Ongoing research will establish if this process has been applied throughout the development of the cave system.

Green Waterhole is a *shallow* cenote, highly unusual geologically and uniquely attractive to animals and humans, being more accessible for drinking during dry periods than most other sinkholes in the region. The waterhole made water available in a pool perched above the regional water table during low sea levels. The cave complex provides an excellent opportunity to study the relationship between changing sea-levels, ground water, and environment, and their effects on the evolution and extinction of fauna in the region over a long time period.

The significant geological features contained within the complex are:

- The presence of a topographically high collapse talus cone in Green Waterhole entrance
- Exposure of the regional water table and associated freshwater semi-troglobitic aquatic life
- Untouched sedimentary deposits preserving pollen and spores over thousands of years
- Solutional/Erosional features indicative of higher and lower water levels in the past and their various effects upon cave development in the limestone mass
- Capacity for examination in detail of possible impact of rare 'volcanogenic' influences
- Excellent example of soft limestone caves and the connection between doline and dissolution passages

RELEVANT CRITERIA (under section 16 of the Heritage Places Act 1993)

(c) it may yield in formation that will contribute to an understanding of the State's history, including its natural history

The Green Waterhole – Tank Cave Fossil Complex has yielded and will continue to yield significant information contributing to an understanding of South Australia's palaeontological, speleological and geological history.

Palaeontologically, the complex is significant both for the types of fauna preserved as well as the mode by which they came to be preserved. Green Waterhole is the type site (i.e. site of origin) of two named fossil bird species and fourteen other birds. Of the birds, three are extinct and representative of the Pleistocene 'megafauna', while the rest are extant. The complex also hosts a considerable mammalian fossil fauna, comparable in diversity of 'megafauna' to some of the caves in the World Heritage Naracoorte Caves. It is the type site of one species of extinct short-faced kangaroo, and of particular note is the presence of *Propleopus oscillans*, a nationally rare 'carnivorous'/scavenging kangaroo from the Pleistocene.

The mode of preservation of the fossils in this complex is unique for Australia. The presence of many small bird fossils in the cave may be a result of the standing water, which may have attracted and helped preserve the remains of flocks of birds in an otherwise relatively arid period. The cave is also one of the very few caves in Australia that preserve fossils in an underwater setting. Being submerged allows for the preservation of the fossils in an exceptional physical state as well as level of completeness, with several extinct kangaroos represented by complete or near-complete skeletal representation and undamaged elements.

Although the majority of surface mammal fossils have already been extracted, the fossils from deposits situated in the Western-end of Tank Cave have been minimally disturbed and remain largely unexamined. There are also several significant areas within Green Waterhole that have been left untouched. Moreover, the development of new diving equipment, underwater excavation methods and technologies, and increased access to techniques for dating and environmental analysis provide additional means of developing a sophisticated and holistic understanding of the deposits. Such information will be critical for contextualising previous finds and to better understand ecosystem responses to environmental change and the conservation of biodiversity.

As a submerged Quaternary fossil deposit, the site represents an almost unique type of fossil site in Australia. Despite its importance, it has been subject to relatively little study, owing in large part to difficulty in accessing the site by non-cave divers. Many important questions concerning the site and its formation remain to be answered. This includes: the age of the site; the chronology of formation; the impact of the submerged environment on the preservation of the bone; the conflicting preservation data coming from the bird versus the mammal fossils; the true species richness of the site; and the types of habitats that were present during site formation.

Altogether, the significance of the site lies in the presence of several unique bird species, the rareness of this level of fossil completeness and preservation, and the unique depositional environment for Australian megafauna sites. Many undisturbed areas in the complex preserves in situ deposits representing an important natural history resource. The contributions of the site for understanding the evolution of South Australia's mammal and bird faunas, environmental change, and how fossil systems form and are preserved is unmatched in Australia.

Geologically and hydrologically, this lengthy cave system has the potential to reveal groundwater processes and developmental characteristics not examinable in any of the many short or deep cave systems throughout the Gambier Limestone Plain or indeed across the State of South Australia.

The site hosts numerous speleological and geological features that are either rare or non-existent in other caves of Mt Gambier, including a doline entrance with high talus cone, calcite rafts, extensive underwater passages, untouched mud cracks, and underwater speleothem formations. Its scalloped and phreatic erosional features and stromatolite deposits have been little studied but are likely to provide important information regarding changing water table levels tied to sea-level fluctuations.

The complex, as a largely submerged cave system, has also provided important habitat for stygofauna - animals that live in the phreatic zone, i.e., below the water table and which are normally only accessible via bore holes or cave diving. Green waterhole is the type locality for *Koonunga crenarum*, a species endemic to the local region.

(g) it has special association with the life or work of a person or organisation or an event of historical importance

The Green Waterhole – Tank Cave Fossil Complex has special associations with the Cave Divers Association of Australia (CDAA). This association is the not-for-profit incorporated body responsible for establishing and maintaining specialised cave diving standards for Australia, liaising with landowners and facilitating safe access to approximately 60 diveable caves and sinkholes across South Australia's Limestone Coast and the Nullarbor Plain in Western Australia, as well as a number of individual sites in other regions of Australia.

Between 1969 and 1973 there were 11 fatalities in submerged cave systems in the Limestone Coast region of South Australia. Widespread concern throughout the community regarding cave diving activities forced the government to intervene and, for a time, access to submerged cave systems in South Australia was prohibited. Following a formal inquiry and under State Government direction, the CDAA was established in September 1973 as a means to regulate cave diving activities in South Australia. Since this time, the CDAA has trained over 5,400 cave divers, hosted many International cave-diving visitors, and currently consists of 750 current members. The

Association's aims are to foster the development, advancement, promotion, mapping, education, exploration, conservation, safety and research of underwater caves and related features.

The Green Waterhole – Tank Cave system has been an integral part of the CDAA's training programs and focal point for the CDAA's research, conservation and exploration activities for several decades. Green Waterhole (known colloquially as "Fossil Cave") is one of the key sites utilised by CDAA Instructors for the CDAA's "Cave" level diver training. It is the only "Cave" level site in Australia where cave divers are able to witness aspects of such palaeontological and speleological significance, and it thereby underpins the Association's "Cave" level educational programs around conservation and site preservation and the importance of implementing minimal-impact diving techniques.

Tank Cave, which lies predominantly to the East of Green Waterhole is equally significant to the CDAA's aims. Featuring 10 kilometres of intersecting phreatic passages, it is by far the longest underwater cave system in South Australia and the second-longest in the nation, Access is restricted to "Advanced-Cave" level divers, and it is used for the final assessment dives for "Advanced-Cave" diver candidates. Ongoing exploration of Tank Cave in recent years has resulted in the discovery of several kilometres of additional cave passage, including, in 2018, the connection to Green Waterhole, and the fossil deposits at the systems Western extremity, located in the designated Green Waterhole – Tank Cave Fossil Complex.

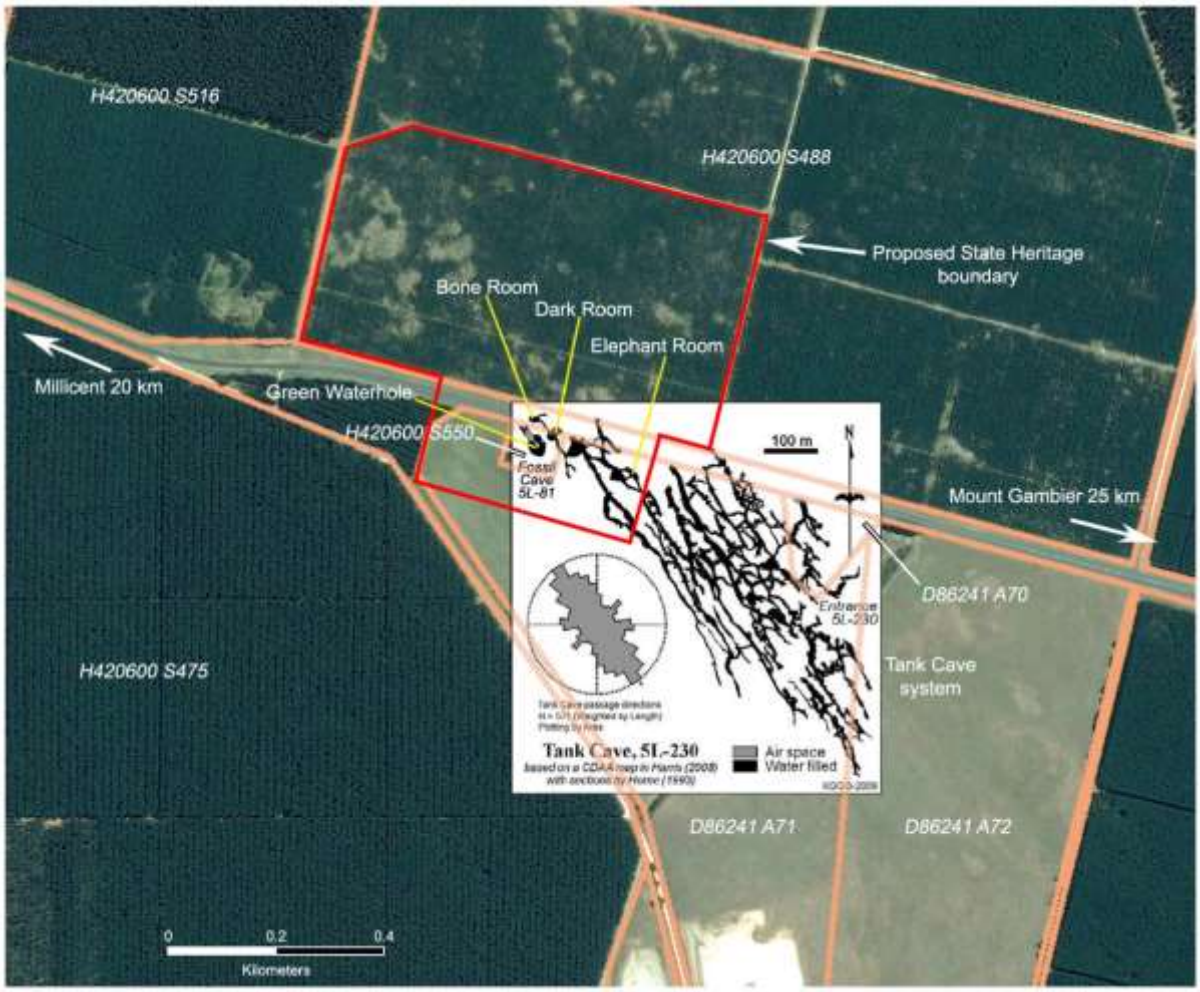
The importance of Tank Cave to the CDAA resulted in the Association purchasing the land where the primary entrance to the system is located in 2010. Access via this entrance is managed by the CDAA. The only other known natural entrance to the system is via Green Waterhole, which is currently managed by the Department for Environment and Water [DEW]. In 1998, government recognition of the CDAA's modern training programs and strict access protocols resulted in the responsible Minister reinforcing the State Government's 1973 findings, with an ongoing directive reiterating that access to these sites be limited to members of the CDAA.

While the Green Waterhole – Tank Cave system lacks some of the spectacular attributes synonymous with the region's other world-renowned sites such as Piccaninnie Ponds, the Shaft, and Kilsby Sinkhole, it is nonetheless one of Australia's most popular and frequently dived cave systems. Recognition of the subtle and sensitive nature of significant features, such as the unique speleology and outstanding fossil assemblages located in the Western end of the system have resulted in the identification of the Green Waterhole – Tank Cave Fossil Complex. The CDAA considers these potentially vulnerable areas within the Complex to be worthy of higher legislative protection, in order to secure the CDAA's role in future research, training, education and conservation initiatives.

SITE PLAN

Green Waterhole – Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Allotment 550, Princes Highway, Tantanoola SA, 5280



LEGEND

Parcel boundaries (Indicates Extent of Listing)

Outline of Elements of Significance for State Heritage Place

Extent of Listing *includes* (all within Hundred of Hindmarsh, SE South Australia):

- Whole of land parcel H420600, Section 550, (Government Water Reserve)
- North-western sector (approx 10%) of land parcel D8241, Allotment 71 (private land)
- South-western sector (approx 25%) of land parcel H420600, Section 488 (pine forest – boundary coincides with firebreaks around forest compartment)
- 0.45kms of Princes Highway separating Sections 488 and 550

Extent *excludes* the large proportion (approx 90%) of the Tank Cave complex to E and SE of boundary as this system does not contain fossils in either of its dry or underwater areas.

COMMENTARY ON THE LISTING

Description and notes with respect to a place entered in the South Australian Heritage Register in accordance with the *Heritage Places Act 1993*

Physical Description

Green Waterhole Cave (5L81, aka Fossil Cave) is located within the Gambier Limestone 25 kms west of the city of Mt Gambier. The entrance is a shallow and relatively small oval-shaped collapse doline (sinkhole), with a rounded, cemented upper edge which indicates that it is considerably older than the large sharp-edged sinkholes in the region. This age difference is likely to be significant and invites further research.

To the southeast and, to a lesser extent northwest, caverns extend underwater at a gross average incline of approximately 22° to a maximum depth of approximately 16 m. The presence of at least three phreatic (honeycombed) solution zones in the doline walls indicate substantial water level changes of several metres in the geological past, likely tied to rainfall recharge variations from past climate change phases, and with periodic impacts from global sea level changes and/or tectonic movement.

The Green Waterhole sinkhole entrance and underwater chamber contains Pleistocene animal and avian fossils within in-washed volcanic silt. The cave contains evidence of three significant past underwater fossil excavations in 1979, 1987-88 and 2006.

A surrounding buffer covers adjacent underwater chambers in the Tank Cave system which also contain similar fossils and encompasses an area of land to the north where the cave is geologically extended with further possible buried entrances where fossils have accumulated.

Elements of Significance:

Elements of heritage significance include (but are not necessarily limited to):

- Historic entrance
- Fossil beds and body fossils
- Speleothems (Stalactites, stalagmites, stromatolites and rafts)
- Undisturbed sediments (naturally deposited)
- Natural collapses and rockfall formations
- Connection between Green Waterhole and Tank Cave
- Location of grid posts marking fossil collection areas
- Cave walls, floors and roof
- Quality and clarity of water, including low silt levels (maintain 'natural' water quality of site)
- Stygofauna habitat

Elements not considered to contribute to significance of place include (but are not necessarily limited to):

- iron posts, ropes, guidelines
- modern faunal material (e.g. sheep, goats)
- non-perishable rubbish or other refuse
- fence, stairs, and benches near Green Waterhole entrance
- underwater signage
- all above-ground development on land above the cave system

History of the Place

Geological time (dates approximate)

Approximately 30–15 million years ago, an extensive limestone sea floor developed offshore of south-eastern SA after Australia separated from Antarctica. Between 15 and 10 million years ago, this limestone sea floor emerged from the sea due to regional tectonic uplift, becoming the large Gambier Limestone Plain (extending to the Bordertown/ Kingston area). The Tartwaup Fault (hingeline) developed along the Mount Gambier-Tantanoola-Millicent region.

Around 5 million years ago, extensive volcanics (termed the 'Newer Volcanics') commenced in the region. Then, between 1–2 million years ago, the Mount Burr Range volcanoes erupted along the Tartwaup Fault, adjacent to the Green Waterhole-Tank Cave complex locality.

Approximately 528 thousand years ago, the oldest dated megafauna fossils in the region began accumulating in the World Heritage Naracoorte Caves, located 100 kms north on the Gambier Limestone Plain. Nearer to Mt Gambier, the oldest dated megafauna (from 134 thousand years ago) have been found in Kilsby's Sinkhole.

The Green Waterhole – Tank Cave system is believed to have been formed around 125 thousand years ago. This was later followed by lowering of regional water table and subsequent cave collapse forming Green Waterhole Cave entrance. The earliest dated megafauna in the system dates to approximately 65 thousand years ago.

First Nations interactions (overview)

First Nations Peoples have lived in the Limestone Coast region for tens of thousands of years. Archaeological evidence places people in the northern Flinders Rangers around 49,000, so it is possible people were in the Limestone Coast region around that time. Several caves in the Mount Gambier region contain non-figurative rock art. There is also evidence of chert mining from some caves. This is the traditional land of the Boandik (Bunganditj language) People.

The Green Waterhole was probably an important water source for Boandik People, particularly as it is one of only three such dolines (sinkholes) within a 20km radius with easily accessible fresh water. It is also the most obvious of the three sinkholes, being

located at the edge of the original forest country near the foot of 'The Bluff' – a large nearby volcano in the Mount Burr Range. A number of bone and stone tools have been recovered from the Green Waterhole cave during scientific excavations.

Colonial settlement and early survey

Boandik People probably showed the Green Waterhole to the early European explorers/settlers who began arriving in the region from 1836. The waterhole was strategically located halfway between the developing settlements of Mount Gambier and Millicent alongside the most direct route between them, also following the foothills of the Mount Burr range. Having such easily accessible fresh water made it an important stock and domestic watering stop along the journey.

An early survey map dated 1859 identifies a waterhole at that location. Although not named Green Waterhole at that time, it was clearly surveyed as a Government Water Reserve, similar to other easily accessible water points across the State; whether caves or otherwise. The site was used as a stock watering reserve as part of the travelling stock route system. These stock routes probably originated from traditional pathways used by First Nations People.

In addition to the natural formation of the waterhole, early settlers dug a one-metre diameter well that penetrated the roof of the south-eastern water chamber to make bucketing easier and more efficient. This is presumed to have been created prior to the survey of the waterhole.

Green Waterhole remains as a Water Reserve under Crown Lands at the present time but under the proxy management of SA National Parks

Scientific investigation and collecting

The first fossils were recovered from the cave in 1964, followed by several expeditions mounted by divers in the 1960s and 1970s to recover mammal fossil skulls belonging to extinct 'megafauna' kangaroos. Starting in 1979, divers and researchers began systematic excavations at the site using a grid system of pickets set up in the south-eastern portion of the cave. A considerable amount of fossil material was recovered from these excavations, with divers collecting visible surface bones first, followed by reaching into the unconsolidated sediment and feeling for further finds.

As a result of excavations at the site, 1,258 specimens are currently registered at the South Australian Museum representing 38 genera and containing over 35 species. Avifauna makes up the majority of the collection with 958 registered specimens, comprising 26 genera and around 20 species. This is followed by 187 registered macropodoids containing 4 genera and 6 species. Of the order Rodentia, 57 specimens are registered with the remaining fauna representing members of the order Dasyuromorphia, Peramelemorphia, Anura, Chiroptera, the family Phalangeridae, Palorchestidae and the class Reptilia.

A detailed history of the expeditions and fossil collection that has taken place at Green Waterhole cave from 1964-2021 is provided in the 2021 Heritage Assessment Report for this place.

Aquatic fauna in Green Waterhole-Tank Cave

Stygofauna, is the term for animals inhabiting groundwater environments, such as in bore holes and caves or sinkholes. Australia is recognised as a regional centre of stygofaunal diversity with 238 taxa recognised in eastern areas with the crustaceans (amphipods, syncarids) and hydrobiid gastropods the dominant and most widespread groups (see Thurgate et al. 2001) . These authors report that the Naracoorte Coastal Plain (Naracoorte to the Mount Gambier area) has more than 40 taxa, mostly epigean species in springs and cenotes with the following taxa having more than five species Ceinidae, Paramelitidae, Koonungidae, Hydrobiidae, Planorbidae.

The amphipod *Uronyctus longicaudus* (Neoniphargidae) has a very localised distribution in hypogean (underground) habitats in the Mt Gambier area (Stock & Iliffe 1990). At least four genera from three families of molluscs occur in groundwaters of the Naracoorte Coastal Plain Region but none are obligate stygobiontic species (Thurgate et al. 2001). Therefore, it is very likely that multiple stygobiontic species occur in the Green Waterhole – Tank Cave complex.

Two notable species are the syncarid crustaceans in the genus *Koonunga,* of the Family Koonungidae, Order Anaspidacea. Green Waterhole Cave is the type locality for *Koonunga crenarum* Zeidler, 1985 which was described following discovery of the species by Peter Horne on 8 March 1981 (Zeidler 1983, 1985). The types (holotypes and paratype specimens) are in the SA Museum. *Koonunga crenarum* is most commonly found in the large water filled collapsed caves which are exposed to daylight and are relatively large (10-20 mm long), partially pigmented and lack eyes (Leijs et al. 2015). This species is only found in the Tantanoola – Mt Gambier region where it has been recorded from numerous caves and sinkholes (Zeidler 1985; Leijs et al. 2015).

A second smaller (~ 7 mm) species of syncarid, *Koonunga hornei*, is also found in phreatic waters in groundwater monitoring bores and submerged caves in the Penola and Mt Gambier region. It was reported from the Pines sinkhole at Tantanoola (Leijs et al. 2015) and is likely to occur in the Fossil – Tank Cave system. It lacks body pigment and eyes. Leijs et al. (2015) suggested that *K. crenarum* occupies the larger cavities in the Mount Gambier limestone karst aquifer while *K. hornei* also occupies the smaller fissures. Both species are suggested to have evolved from epigean (surface water dwelling) species in the last 1 million years.

The freshwater Glenelg Spiny Crayfish *Euastacus bispinosus* has been recorded at the Pines Sinkhole in Tantanoola and Gouldens Waterhole nearer Mt Gambier (Whiterod

et al. 2014) and has also been found at from the Fossil – Tank Cave complex (Pete Wolf pers observ.).

While there are no comprehensive faunal surveys from this single cave, the diverse regional stygofauna makes it likely that numerous species remain to be reported from the complex. In addition, it is significant that the cave is the type locality (ie, the place from which the characteristics of the species is defined) for at least one stygofaunal species.

Chronology

Year	*Event*
37-15 Ma	Limestone floor develops offshore in south-eastern SA.
15-10 Ma	Neogene Tectonics - limestone floor begins to be lifted from the sea due to large regional tectonic uplift, becoming the Gambier Limestone Plain. The large Tartwaup Fault (hingeline) develops along Mount Gambier-Tantanoola-Millicent region.
5 Ma	Extensive volcanics (termed the 'Newer Volcanics') commenced in the region.
1-2Ma	Mount Burr Range volcanoes erupt along Tartwaup Fault, adjacent to Green Waterhole-Tank Cave complex locality.
528 ka	Oldest dated megafauna fossils in the region at Naracoorte Caves.
134 ka	Oldest dated megafauna from Mt Gambier region (Kilsby's Sinkhole).
125 ka	Possible inception of Green Waterhole – Tank Cave system, followed later by lowering of regional water table and subsequent cave collapse forming Green Waterhole cave entrance.
~65 ka	Dates for megafauna from Green Waterhole.
60-65 ka	First arrival of people on the continent of Sahul (Australia and New Guinea).
~50 ka	Probable arrival of Bunganditj (Boandik) people in Green Waterhole region (before 50 ka).
6-5 ka	Mt Shank and Mt Gambier erupt creating Blue Lake crater. Both events feature in local indigenous oral histories.
Pre-1836	Green Waterhole well-known to local Bunganditj (Boandik) people as it is located adjacent to the nearest volcano ('The Bluff", part of the Mount Burr volcanic range) making it very accessible to obtain drinking water from.
Post 1836	First located by European explorers/settlers and identified as best water access for horses, bullocks and other stock.

Pre-1859	Likely period when the hand-dug well over the south-eastern water chamber was dug to service passing traffic, leading to eventual Government Water Reserve designation .
1859	Enclosed by survey as a Government Water Reserve and indicated on surveyor's map. No name was ascribed to it on the map at that time.
1930s	Regional pine forestry industry established utilising rich volcanic soils of the Mount Burr Range and the plains surrounding Green Waterhole – Tank Cave area.
1964	The first fossils were recovered from the cave by early local scuba divers.
1968–1969	Aslin collection and Ron and Valery Taylor collection are made.
1979	First expedition by Flinders University led by RT Wells & DLG Williams.
1987	Second expedition by Flinders University led by RT Wells & C Newton.
1988	P Horne compiles detailed speleological report on the cave diving gridding and fossil recovery operation.
2006	Expeditions led by TH Worthy and A Camens of Adelaide University.
2015	Julian Hume visits site.
2020	Julien Louys presents to a forum including DEW staff, SA Museum representatives and CDAA on the significance of the fossil cave. This leads to preparation of a heritage assessment by working group.

References

Baird, R. F., 1985. Avian fossils from Quaternary deposits in 'Green Waterhole Cave', south-eastern South Australia. Records of the Australian Museum 37(6): 353–370.

Horne, P. 1988. "FOSSIL CAVE" (5L81) underwater palaeontological and surveying Report 1987-1988. South Australian Underwater Speleological Society Inc. Project Report Number 1. [Digitised Sept 2006]

Horne, P., 1993. Lower South East Cave Reference Book: an Illustrated Catalogue of the Registered Caves, Sinkholes and Associated Karst Features of the Lower South East Region of South Australia. P. Horne and the Cave Exploration Group of South Australia (Inc.), Adelaide

Leijs, R., Bradford, T., Mitchell, J.G., Humphreys, W.F., Cooper, S.J.B., Goonan, P., King, R.A., 2015. The evolution of epigean and stygobitic species of *Koonunga* Sayce, 1907 (Syncarida: Anaspidacea) in Southern Australia, with the description of three new species. PLoS ONE 10(8): e0134673. doi:10.1371/journal.pone.0134673

Lewis, I., 1984. Cave and sinkhole morphology of the lower southeast karst region. B.A. Hons thesis, Department of Geography, Flinders University. 119 pp.

Lewis, I. and Stace, P., 1980. Cave diving in Australia. The authors, Adelaide, South Australia. 176 pp.

Louys, J. 2019. *A cave diver's guide to fossil discoveries – our obligations*. Guidelines 148: 12-15.

Louys, J., 2018. Practice and prospects in underwater palaeontology. *Palaeontologia Electronica* 21.2.22A: 1-14.

Louys, J. 2018. The underwater fossils of Australia: ice-age megafauna from Mt Gambier. Guidelines 143: 26-31.

Newton, Cate A. 1988. "A taphonomic and palaeoecological analysis of the Green Waterhole (5L81), a submerged Late Pleistocene bone deposit in the lower southeast of South Australia", Thesis for Honours Degree of Bachelor of Science at the Flinders University (School of Biological Sciences).

Pledge, N. S. 1980. "Macropodid skeletons, including: *Simosthenurus Tedford*, from an unusual "Drowned Cave" deposit in the South East of South Australia", Rec. S. Aust. Mus. 18(6): 131-141.

Prideaux, G. J., 2004. Systematics and evolution of the sthenurine kangaroos. *University of California Publications in Geological Sciences* 146, i–xvii, 1–623.

Rich, P. V. & J. van Tets, 1982. Fossil birds of Australia and New Guinea: their biogeographic, phylogenetic and biostratigraphic input. In 'The fossil vertebrate record of Australasia' (eds P.V. Rich & E.M. Thompson): 235-384. Monash University Offset Printing Unit, Clayton.

Stock J.H. & Iliffe T.M. 1990. A new Australian crangonyctid amphipod with a habit convergent to the Old World genus *Niphargus*. Stygologia, 5(3), 137-142.

Thurgate, M.E. 1995. Sinkholes, caves and spring lakes: an introduction to the unusual aquatic ecosystems of the Lower South East of South Australia. Occasional Paper Number 1. South Australian Underwater Speleological Society, Adelaide.

Thurgate, M.E., Gough, J.S., Clarke, A.K., Serov, P., & Spate, A. 2001. Stygofauna diversity and distribution in Eastern Australian cave and karst areas. Records of the Western Australian Museum Supplement No. 64: 49-62.

Webb, J. A., Grimes, K. G., & Lewis, I. D. (2010). Volcanogenic origin of cenotes near Mount Gambier, southeastern Australia. Geomorphology, 119(1-2), 23–35. doi:10.1016/j.geomorph.2010.02.015

Whiterod, N.S., Sweeney, O.F., and Hammer M.P. 2014. Assessing the status of a disjunct population of the endangered crayfish *Euastacus bispinosus* in a karst rising-spring habitat in southern Australia. Aquatic Conservation 25(5): 599-608.

Williams, D.L.G., 1980. Catalogue of Pleistocene vertebrate fossils and sites in South Australia. Transactions of the Royal Society of South Australia 104(5): 101-115.

Zeidler, W. 1983. Freshwater and some terrestrial invertebrates. In Tyler, M.J., Twidale, CR, Ling, J.K. and Holmes, J.W. (eds), Natural history of the South East: 187-204. Royal Society of South Australia Inc., Northfield, Adelaide.

Zeidler, W. 1985. A new species of crustacean (Syncarida: Anaspidacea: Koonungidae) from sinkholes and caves in the south-east of South Australia. Transactions of the Royal Society of South Australia 109: 63–75.

Acknowledgements

This Summary of State Heritage Place was prepared using findings from the 2021 Heritage Assessment Report for the Green Waterhole – Tank Cave Fossil Complex.

The 2021 Assessment Report was prepared in collaboration by the following contributors:

- Dr Julien Louys, Griffith University
- Pete Wolf and Peter Horne, Cave Divers Association of Australia
- Dr Liz Reed and Dr Diego Garcia-Bellido, University of Adelaide and SA Museum
- Dr Mary-Anne Binnie, Ben McHenry and Neville Pledge, SA Museum
- Dr Trevor Worthy, Dr Rod Wells and Dr Gavin Prideaux, Flinders University
- Ian D Lewis, Steve Bourne and Anna Pope, SA Department for Environment and Water

SITE DETAILS

Green Waterhole - Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Lot 550, Princes Highway, Tantanoola 5280

FORMER NAME:	Green Waterhole, Fossil Cave. Tank Cave name unchanged since discovery in 1980's.	
DESCRIPTION OF PLACE:	North-western section of Green Waterhole/Tank Cave system containing significant fossil deposits.	
DATE OF CONSTRUCTION:	~125ka	
REGISTER STATUS:	Recommended for listing, 2021	
LOCAL HERITAGE STATUS:	Nil	
CURRENT/PREVIOUS USE:	Pre-1836: First Nations access to natural drinking water as evidenced by stone tools recorded in thesis research. 1836–1940's: Government Water Reserve used by European settlers for stock and domestic freshwater supplies. 1964–present: Recreational cave diving and discovery/ongoing recovery of Pleistocene fossil remains of animals and birds.	
LOCAL GOVERNMENT AREA:	Wattle Range	
LOCATION:	**Street No.:**	Lot 550
	Street Name:	Princes Highway
	Town/Suburb:	Tantanoola
	Post Code:	5280
LAND DESCRIPTION:	**Title**	CR/5762/955
	Plan No.:	H420600
	Section:	550
	Hundred:	Hindmarsh
	Encumbrance:	Native Title claim: First Nations of the South East #1 Mining Licences, exploration (petroleum): PEL 680
MAP REFERENCE (Centre of entrance)	37° 43' 54.68" S, 140° 31' 49.34" E	

PHOTOS

Green Waterhole - Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Lot 550, Princes Highway, Tantanoola 5280

Entrance sinkhole (doline) to Green Waterhole, 2017.
Rounded upper rim of sinkhole indicates older age of entrance

Excavation party from Flinders University at Green Waterhole; Photo: Rod Wells 1979

PHOTOS

Green Waterhole - Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Lot 550, Princes Highway, Tantanoola 5280

Cave Diver Peter Blackmore in Green Waterhole cave;
white calcite flakes draped over boulders (source of creamy coloured bones);
three stakes and fossil search reference gridlines in foreground
Photo: Ian Ploenges 1987

Fossil bed in Green Waterhole cave. Photo: Ian Ploenges 1987

PHOTOS

Green Waterhole - Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Lot 550, Princes Highway, Tantanoola 5280

Green Waterhole cave entrance lake showing a line of grid marker stakes
Photo: Peter Rogers 1979

In situ fossil femur in 'Elephant room', Jane Bowman, 2018

PHOTOS

Green Waterhole - Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Lot 550, Princes Highway, Tantanoola 5280

Honours student Cate Newton viewing bones being collected during 1987 dives, Rod Wells

Fossilised snake skeleton near H11 in the Cave Complex. Toby Passauer, 2018

PHOTOS

Green Waterhole - Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Lot 550, Princes Highway, Tantanoola 5280

'Bone Room' in Green Waterhole/Tank Cave system - Photo: Stewart Don, 2019

'Dark Room' fossils, Green Waterhole-Tank Cave system - Photo: Pete Wolf 2019

PHOTOS

Green Waterhole - Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Lot 550, Princes Highway, Tantanoola 5280

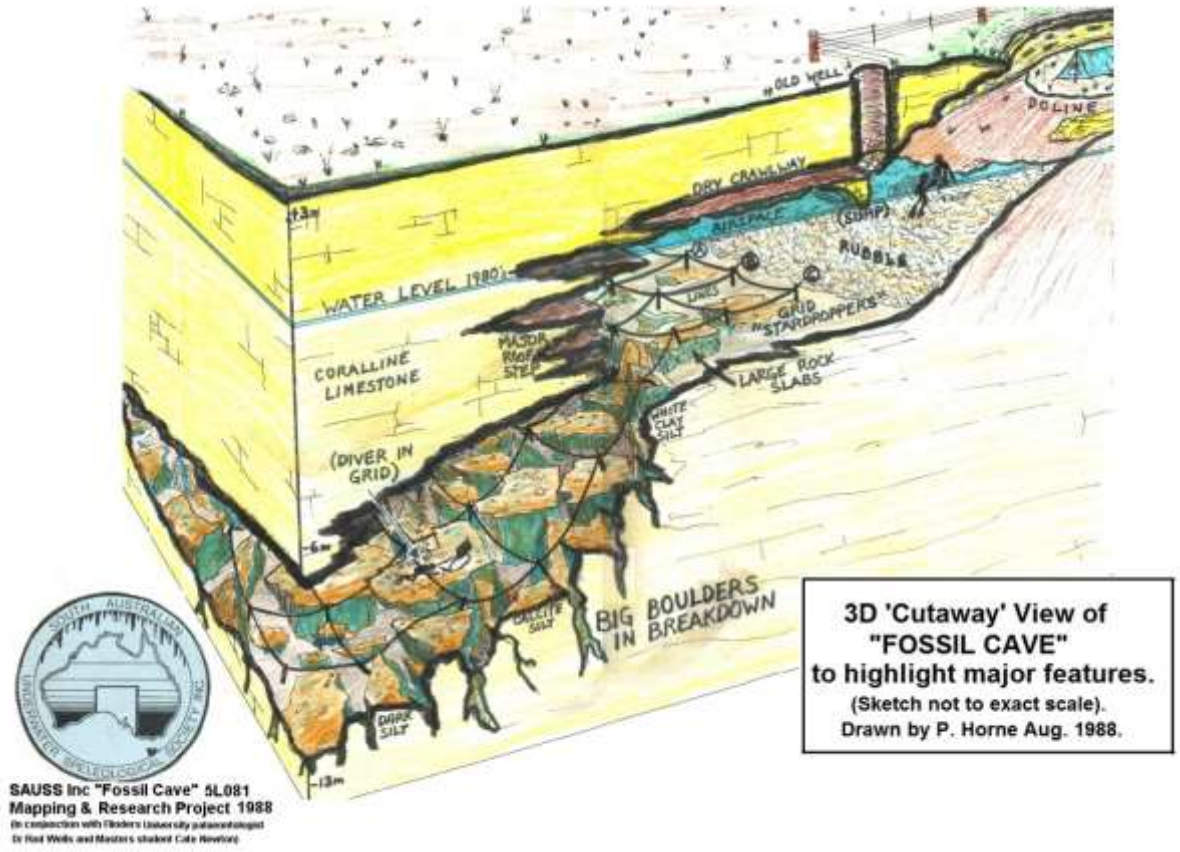
Green Waterhole fossil find: *Simosthenurus occidentalis* - Photo: Rod Wells 1979
(semi-articulated skeleton as found on first day of diving)

Green Waterhole fossil finds, Flinders University - Photo: Rod Wells 2021

PHOTOS

Green Waterhole - Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Lot 550, Princes Highway, Tantanoola 5280



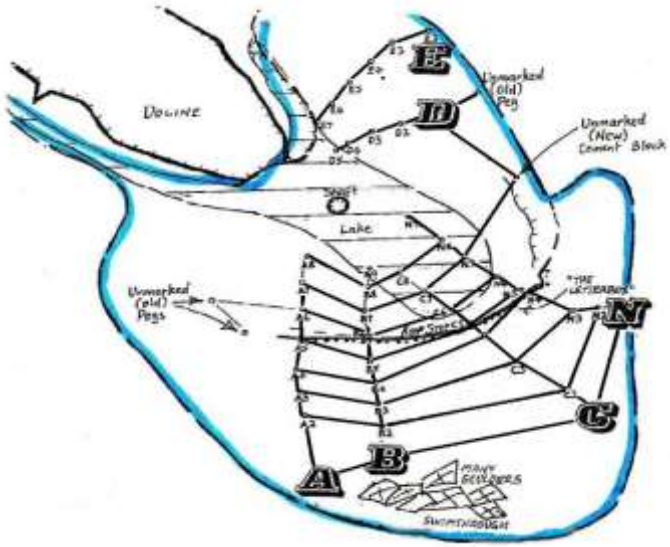
3D Cutaway diagram of Green Waterhole indicating entrance (doline), submerged boulder-strewn chamber floor and portion of underwater grid system installed by cave divers for systematic fossil recovery from the dark sediment distributed throughout the chamber. The view is from the north-east. The artist is Peter Horne, coordinator of the South Australian Underwater Speleological Society Inc. (SAUSS), whose members formed the diver recovery team for the fossil excavation. This diagram is also Figure 28 in the reference report Horne P, 1988.

PHOTOS

Green Waterhole - Tank Cave Fossil Complex **PLACE NO.: 26530**

Green Waterhole Water Reserve (L81), Lot 550, Princes Highway, Tantanoola 5280

Map showing full extent of Tank Cave system as currently known
Cave Divers Association of Australia, 2021



Original plan view of Green Waterhole showing grid pattern and reference system installed by cave divers in 1978. This allowed accurate recording of locations of individual fossils to enable researchers to assess distribution patterns and bone associations. Map and artwork by Peter Horne. This diagram is Figure 22 in the reference report Horne P, 1988.