South Australian
HERITAGE COUNCIL

BETTER HERITAGE INFORMATION
SUMMARY OF STATE HERITAGE PLACE

Saltia Creek Rhythmite Locality

Saltia Creek Rhythmite Locality SHP 14818, c.2000.

Source: DEW Files

ENTRY IN THE REGISTER

Description or notes with respect to a place entered in the South Australian Heritage Register in accordance with either the *South Australian Heritage Act 1978* or the *Heritage Places Act 1993.*

The South Australian Heritage Council may correct errors or inaccuracies in the Entry in the Register in accordance with s21 of the *Heritage Places Act 1993.*

NAME: Saltia Creek Rhythmite Locality **PLACE NO.:** 14818

ADDRESS: Nukunu Country
2120 Flinders Ranges Way, Quorn SA 5433
CT 5780/814 D24725 Q1
Hundred of Woolundunga

CONFIRMED IN THE SOUTH AUSTRALIAN HERITAGE REGISTER:

10 October 2002

DESIGNATED AS A PLACE OF GEOLOGICAL SIGNIFICACE:

10 October 2002

S16 CRITERIA SATISFIED UNDER *HERTIAGE PLACES ACT 1993*

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

COMMENTARY ON THE LISTING

Additional information provided as a part of the content of the South Australian Heritage Register in accordance with s14(6) of the *Heritage Places Act* 1993 'hold information in association with the Register'.

KNOWN AS: Saltia Creek Elatina Formation, Saltia Creek - Pichi Richi Pass [Designated as a place of geological significance]

STATEMENT OF HERITAGE SIGNIFICANCE

The Saltia Creek Rhythmite Locality records direct evidence of approximately 60 unbroken years of neap-spring tidal cycles within the cuspate laminations of alternative consolidated sediment layers, known as rhythmites. The excellent preservation of the Saltia Creek Rhythmite Locality rhythmites within the Elatina Formation, dated at over 635 million years old, has allowed researchers to determine ancient tidal cycles and palaeoclimates, particularly those associated with the 'Snowball Earth' theory and the poorly-understood Elatina (Marinoan) Glaciation which ended approximately 635 million years ago. It is likely the Saltia Creek Rhythmite Locality will yield further information which will contribute to the complex history of South Australia's Precambrian glaciations.

STATEMENT OF DESIGNATION

Designated Place of Geological Significance

The rhythmites present at Saltia Creek, particularly in Pichi Richi Pass were deposited during the Elatina (Marinoan) glaciation, a poorly understood glaciation as a part of the Cryogenian period when the globe was near completely covered by ice. Saltia Creek Rhythmite Locality presents a unique insight into a complete ~60-year succession of neap-spring tidal cycles preserved within the Elatina Formation. The site is an exceptional example of rhythmites in the State and is highly likely to yield information regarding palaeoenvironments, glaciations and tidal activities that shaped the geology of the State.

Elements of Significance

Elements of heritage significance include:

- Elatina Formation exposures,
- Rhythmite structures.

Elements not considered to contribute to significance of place include:

- Human-made objects, trails and roads, vegetation, fencing and signage.

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

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

The rhythmite sediments at Saltia Creek were deposited during the Elatina glaciation approximately 680 Ma. The well-exposed laminated deposits contain cyclical layers referred to as rhythmites.

When listed, the cyclical laminations of the rhythmites were believed to have resulted from 11-22 year cycles associated with solar controls such as sunspots or the earth's rotation. However, continued research as recent as 2023 has determined that the rhythmic layers are more likely a result of neap–spring tidal cycles spanning an entire 60-year succession.

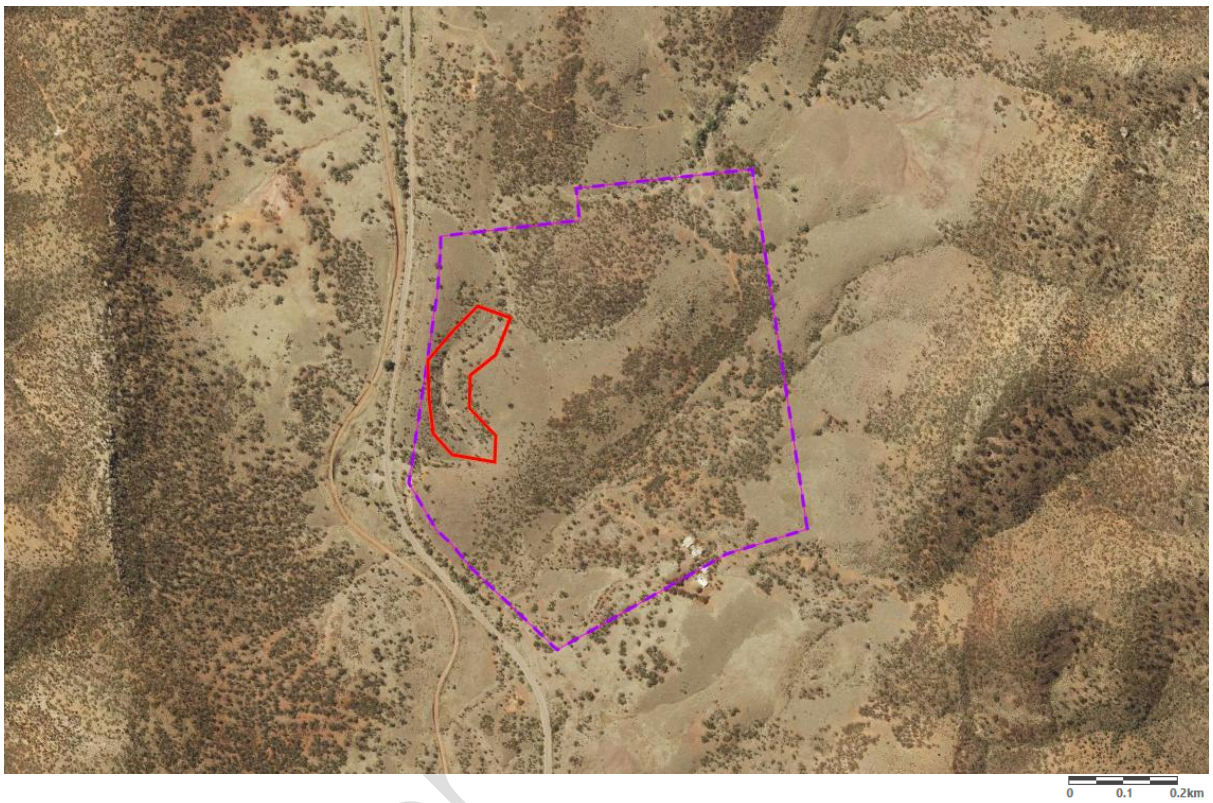
Other well-known rhythmites are found at Marino Rocks, Hallett Cove within the Reynella Siltstone Member. However, the layers at Marino Rocks are considerably thicker and thus suggest a different depositional environment. Similar rhythmites within the Elatina Formation are found North of Saltia Creek at Warren Gorge and are of a similar quality, though displaying a shallower depositional environment and intermittent deposition. The excellent continuous deposition at Saltia Creek Rhythmite Locality makes it highly relevant for geological study.

Understanding of the tidal rhythmites at Saltia Creek Rhythmite Locality is still developing. However, through continued research, the evidence provided by the Elatina Formation will likely yield further information regarding the 'Snowball Earth' theory and the study of palaeoenvironments such as the effects of glaciations, sea level, and tidal activity on the State's geology.

SITE PLAN

Saltia Creek Rhythmite Locality **PLACE NO.: 14818**

2120 Flinders Ranges Way, Quorn



Saltia Creek Rhythmite Locality, 2120 Flinders Ranges Way, Quorn CT 5780/814 D24725 Q1 Hundred of Woolundunga,

N ↑

LEGEND

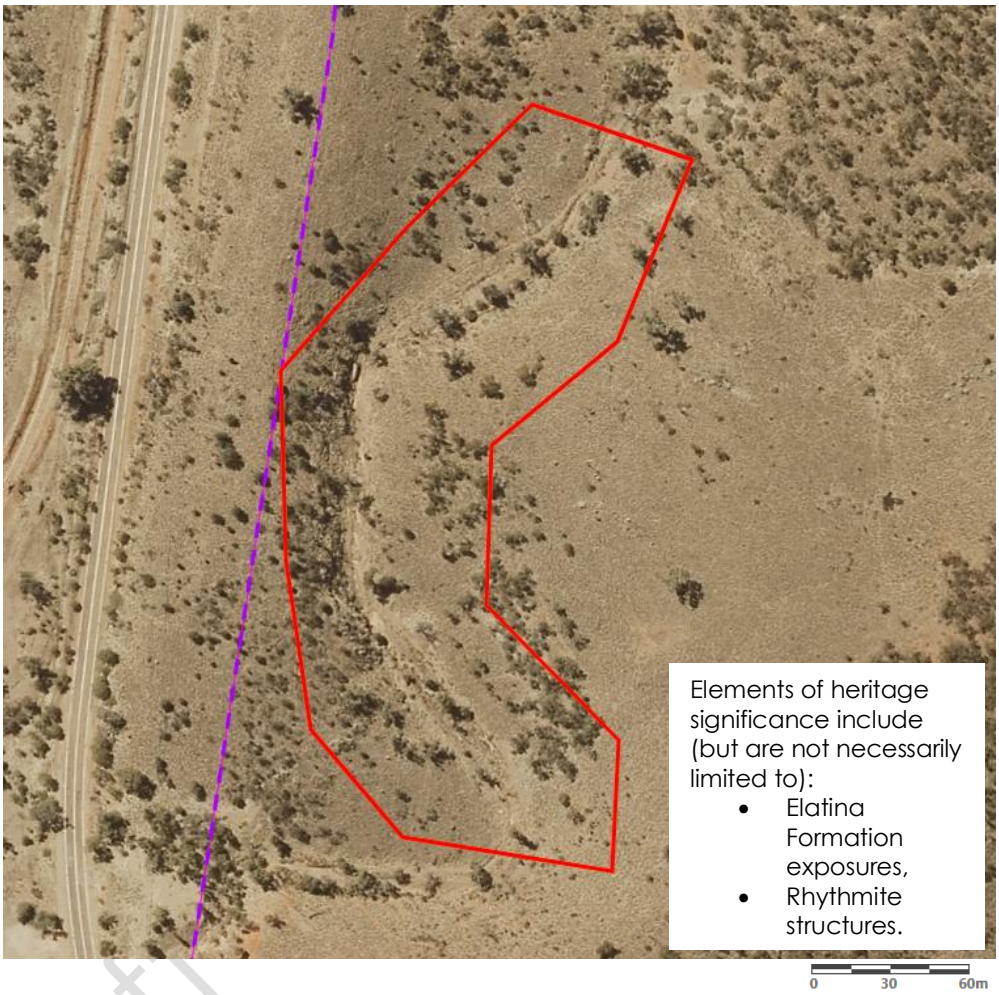
Parcel boundaries (Indicates extent of Listing)

Outline of Elements of Significance for State Heritage Place

SITE PLAN - DETAIL

Saltia Creek Rhythmite Locality **PLACE NO.: 14818**

2120 Flinders Ranges Way, Quorn



Saltia Creek Rhythmite Locality, 2120 Flinders Ranges Way, Quorn, CT 5780/814 D24725 Q1 Hundred of Woolundunga.

N ↑

LEGEND

Parcel boundaries (Indicates extent of Listing)

Outline of Elements of Significance for State Heritage Place

PHYSICAL DESCRIPTION

The Saltia Creek Rhythmite Locality, located within Pichi Richi Pass, contains an outcropping of the 720-635-million-year-old (Ma), Cryogenian Elatina Formation. Pichi Richi Pass, though not officially defined, refers largely to a section of a narrow pass that the Pichi Richi Railway passes through. Generally, the Pichi Richi Pass follows Saltia Creek for approximately 3km along the main road between Port Augusta and Quorn.[1] The Elatina Formation is predominantly sandstone.

Rhythmites at Saltia Creek Rhythmite Locality. c.1999.

Source: DEW Files

The State Heritage Place includes a 300m long exposed outcrop of the Elatina Formation on the bank between two sharp bends in the Saltia Creek.[2]

The Saltia Creek Rhythmite Locality demonstrates cyclic tidal rhythmites, which are rock formations believed to demonstrate neap-spring tidal current cycles within layers of thin, alternating rock laminations. The laminations are cuspate and made up of dark, clay bands of siltstone, and lighter 2-16mm clastic laminae. Each lunar month contains two fortnightly neap tides and two fortnightly spring tides[3] And Saltia Creek Rhythmite Localiy demonstrates approximately 60 unbroken years of neap-spring tidal cycles.

Elements of Significance:

Elements of heritage significance include:

- Elatina Formation exposures,
- Rhythmite structures.

Elements not considered to contribute to significance of place include:

- Human-made objects, trails and roads, vegetation, fencing and signage.

HISTORY OF THE PLACE

Geological Setting

The Saltia Creek Rhythmite Locality was formed during the Cryogenian period, approximately 720 to 635 Ma. During the Cryogenian, it is believed that the earth was covered almost entirely by glaciers, a phenomenon known as 'Snowball Earth'. Specifically, the Saltia Creek Rhythmite Locality is believed to have formed during the Elatina (Marinoan) glaciation, the second major glaciation to have occurred across what is now Australia. A starting date for the Elatina glaciation is not widely agreed on, but it is believed to have ended approximately 635 Ma, at the end of the Cryogenian.[4]

Sediments deposited in Adelaide Rift Complex (ARC) or Adelaide Geosyncline during the Elatina glaciation indicate that an ice sheet was most likely located approximately 100km to the west of Saltia Creek Rhythmite Locality.[5] This glaciation deposited the Elatina Formation regionally through fluvioglacial (glacial river) events. It is exposed in several places in the Central Flinders Ranges including between Saltia Creek and Buckaringa Gorge around 40 km to the North. The Elatina Formation also has exposures at Hallett Cove. Saltia Creek provides excellent exposures as does another location in Warren Gorge, found between Saltia Creek and Buckaringa Gorge.

At Saltia Creek Rhythmite Locality, exposed sediment does not demonstrate evidence of melting ice causing sedimentary deposition.[6] The rhythmites within the Elatina Formation also do not include dropstones or any other exotic rocks called 'lonestones' typical of many silty glacial sediments.[7] Analysis of the structure of rhythmites in Pichi Richi Pass has revealed evidence of changes to ocean temperature and winds. It is thus hypothesised that the Elatina Formation was deposited during a potential interglacial or interstadial (a warmer period during a glaciation) period, as these changes would not have been present had ice cover existed.[8]

Other rhythmites resulting from the Elatina glaciation occur at Warren Gorge, to the North of Pichi Richi Pass and at Marino Rocks, Hallett Cove. However, rhythmites in each region display evidence of slightly different deposition environments. For example, the structure of Warren Gorge (Elatina Formation) and Marino Rocks

(Reynella Siltstone Member)[9] rhythmites suggests a shallower depositional environment.[10]

The absence of bioturbation (mixing up of sediment by organisms) during the Proterozoic allowed the creation of rhythmites with clearly laminated layers.[11] Soft-sediment deformation of the layers has been used to draw conclusions regarding the globe's palaeomagnetism and the site's palaeolatitude. These studies have demonstrated that during the Neoproterozoic, the globe was glaciated close to the equator.[12]

Numerous theories have attempted to explain the creation of the Saltia Creek Rhythmite Locality rhythmites. At the time of listing in 2002, it was believed that the 11- to 22-year cycles recorded in the laminae were the result of solar processes such as solar flares.[13] A revised hypothesis considered both solar and tidal processes including semidiurnal to lunar nodal cycles.[14] Subsequent studies favoured a purely tidal origin,[15] and this is currently the most widely accepted hypothesis, however more recent research returned to the possibility of solar influence,[16] and also ebb-tides associated with the moon and earth's rotation.[17] Currently, the neap-spring tide cycles and ebb and flow action are considered to be the most likely cause, giving rise to the rhythmites cuspate folds.[18]

Cycles recorded in the rhythmites' structure can be used in palaeogeophysics research to infer ancient tidal cycles and the rotation and orbit of the earth.[19] Relationships between the Earth and Moon can also be further understood. It is also hypothesised that further study of rhythmites may contribute to an understanding of the origin of the Moon.[20] The information yielded from the sediment at Saltia Creek Rhythmite Locality, when combined with data from the Reynella Siltstone Member, records cycles of months, years and hours and has been used to create an averaged calculation of the distance between the earth and moon at the time of deposition.[21]

The Elatina Formation is exposed in several other places in the Central Flinders Ranges, including between Saltia Creek and Buckaringa Gorge approximately 40 km to the North. Exposures of the formation also exist at Hallett Cove.[22] Saltia Creek Rhythmite Locality provides excellent exposures as does another location in Warren Gorge, found between Saltia Creek and Buckaringa Gorge.

Human History

The Nukunu People are Traditional Owners of the southern Flinders Ranges, including the Saltia Creek Rhythmite Locality.

The Nukunu People managed the land around Quorn and its surrounding areas, often taking part in cultural burns that have recently been reinstated after having been prohibited on Nukunu Country.[23] The importance of water to Nukunu People has also been documented, where water is often sparse in the Flinders Ranges.

Additionally, the name 'Pichi Richi' is believed by Anthropologist Norman Tindale to have been derived from 'pituri', a narcotic plant used for hunting emus by baiting water and as an intoxicant by First Nations groups. Hunting and other cultural practices were undertaken in the immediate area including trade when the seasons permitted as Pichi Richi Pass was a major trading route for pituri.[24] The Nukunu land in Port Augusta is also the starting point of Australia's longest songline, titled the Urumbala.[25] Pichi Richi Pass has had many names including 'Richman Pass' and later 'Peachey Ritchie'.[26] The Nukunu People were devastated by the smallpox outbreaks along the Murray River likely around 1824-32.[27] In 1849, between only 50 and 100 Nukunu People were recorded.[28]

In 1859, Charles Simmons laid out the town of Saltia. The origin of the 'Saltia' name is currently unknown. Construction of the nearby Pichi Richi Railway which passes through Pichi Richi Pass, began in 1876 from Port Augusta. The area was frequently passed through until the final train ran in 1970.

The rhythmites at Saltia Creek Rhythmite Locality were first published in scientific literature in 1981 by G. E. Williams[29] and have been researched extensively since. Most publications have focused on the formation of the rhythmites, however some have analysed the laminations to infer palaeoenvironments, palaeolatitudes[30] and to explore planetary geology.[31]

Williams published further papers on the Saltia Creek Rhythmite Locality in 1991 and 2000. This research included a major coring project comprising three drill holes to determine the extent of cyclicity.[32]

In 1992, sediment from Saltia Creek was collected to analyse geochemistry and the presence of heavy minerals at the site.[33] Several other studies in the 1990's demonstrated that at the time of deposition, the Adelaide Fold Belt was positioned near the equator.[34] The tidal rhythmites at Pichi Richi Pass continue to be recognised as 'critically important' with 'soft-sediment deformation structures' which had previously been used to identify palaeolatitudes during the Cryogenian and demonstrate that glaciation reached near the equator, supporting the Snowball Earth theory.[35]

In 2023, it was determined that the rhythmic layers are more likely a result of neap–spring tidal cycles spanning an unbroken 60-year succession. The Saltia Creek Rhythmite Locality and surrounding area is regularly visited by students as it provides excellent opportunities for geological education.

Aboriginal Cultural Considerations

The *Heritage Places Act 1993* makes provision for the identification, recording and conservation of places and objects of non-Aboriginal heritage significance. The

protection and preservation of Aboriginal heritage is provided for under the *Aboriginal Heritage Act 1988*. Contact the Aboriginal Heritage Unit for listings.

CHRONOLOGY

Year	Event
4-1.6Ga	Archaean–Palaeoproterozoic age.
1Ga	Neoproterozoic begins.
~720 Ma	Cryogenian Period begins. Period of glaciations. Sturt glaciation (700-665 Ma). Elatina ('Marinoan') glaciation which, while the start is poorly understood, is believed to have ended ~635Ma. The Elatina Formation is deposited, including the Saltia Creek Rhythmite Locality.
635-538 Ma	Cryogenian Period ends, along with the Elatina glaciation. 635-538 Ma encompasses the Ediacaran Period.
538 Ma	Neoproterozoic (including the Ediacaran) ends. Cambrian Period starts.
1981	The Saltia Creek Rhythmite Locality is published in scientific literature by G. E. Williams
1986	The Saltia Creek Rhythmite Locality is recognised as a Geological Monument by the SA Division of the Geological Society of Australia in 'Geological Monuments in South Australia'.
1995	31 August: Identified to the State Heritage Authority in Flinders Ranges Heritage Survey.
1997	10 April: Provisionally Entered in the South Australian Heritage Register and designated as a place of geological significance. 9 October: Confirmed in the South Australian Heritage Register.
2002	9 May: Entry removed from South Australian Heritage Register due to incorrect Certificate of Title. 14 May: Provisionally entered under delegated authority with the correct Certificate of Title. 10 October: Confirmed as a State Heritage Place and Designated as a place of geological significance.

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SITE DETAILS

Saltia Creek Rhythmite Locality **PLACE NO.: 14818**

2120 Flinders Ranges Way, Quorn 5433

FORMER NAME:	Creek banks with cyclical laminations	
HISTORIC THEME/S	Theme 1 Natural Envrionment 1.1 Tracing climatic and topographical change	
AGE OF FORMATION:	Cryogenian (~720 - 635 Ma)	
REGISTER STATUS:	Identified to Heritage Branch 31 August 1995 Provisionally Entered 10 April 1997 Designated 10 April 1997 Confirmed 9 October 1997 Removed from the State Heritage Register 9 May 2002 Provisionally Entered (under delegate authority) 14 May 2002 Designated 10 October 2002 Confirmed 10 October 2002	
CURRENT USE:	Creek bed	
LOCAL GOVERNMENT AREA:	The Flinders Ranges Council	
LOCATION:	**Street No.:**	2120
	Street Name:	Flinders Ranges Way
	Town/Suburb:	Quorn
	Post Code:	5433
LAND DESCRIPTION:	**Title Reference:**	CT 5780/814 D24725 Q1
	Hundred:	Hundred of Woolundunga

REVISIONS

Date	Changes
13 February 2026	SAHC modified template to include an image at the beginning of the document.

[1] Manning, G.H. (2012), 'P', *A Compendium of the Place Names of South Australia*. <https://published.collections.slsa.sa.gov.au/placenamesofsouthaustralia/P.pdf> [accessed 4 June 2025].
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[27] Adelaide AZ (N.D.) 'Nukunu nation, rich in ritual and sacred sites of east Spencer Gulf, overrun by colonial agriculture from 1849'.
[28] Adelaide AZ (N.D.) 'Nukunu nation, rich in ritual and sacred sites of east Spencer Gulf, overrun by colonial agriculture from 1849'.
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