

# THE REGOLITH AND LANDFORMS OF THE ANSTEY HILL RECREATION PARK, WITH PARTICULAR EMPHASIS ON THE GUN EMPLACEMENT.

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## INTRODUCTION

The Gun Emplacement is a prominent regolith and landscape feature within the Adelaide area that has for long received research attention from Earth scientists. As it is a preserved remnant of ancient landscape materials, its characteristics and evolution are important for understanding the long-term regolith and landscape evolution of the Adelaide district. The close proximity to Adelaide of such a significant landscape feature that has not received recent detailed published investigation warrants it forming the subject of this study.

The Gun Emplacement (GE) occurs along the range front associated with the NNE-SSW trending Eden Fault. The GE is a small erosional plain bounded by a semi-circular escarpment exposing sections of ferruginised sediments, and is about 2 m high on its northern side and up to 10 m high on the south. The original thickness and lateral extent of the ferruginised sediment is not known.

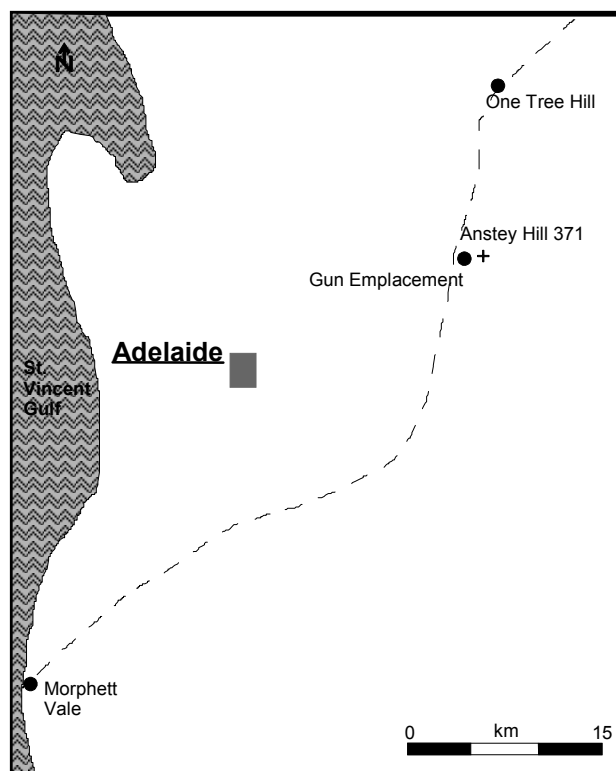
Anstey Hill Recreation Park (AHRP) is approximately 19 km NE of the Adelaide CBD (Figure 1). During the 1970s, Anstey Hill Recreation Park was earmarked for subdivision and housing development. Strong representation by the South Australian Division of the Geological Society of Australia, along with the National Trust of South Australia and SA's Field Naturalists' Society, however, developed a case to preserve the site from subdivision, in order to maintain its historical and scientific significance (Toteff & McBriar 1979). In 1978 the site was purchased by the State Planning Authority and added to the Anstey Hill Reserve.

The AHRP mainly consists of rocks of the Adelaide Geosyncline. The otherwise covered bedrock can be viewed in the six small quarries scattered throughout the area as well as limited *in situ* bedrock exposures and along road cuttings. The dominant vegetation types within AHRP are eucalypts such as Blue Gums and Pink Gums, and the Southern Cypress Pine. Wattles and Banksias are also common within the region.

The climate of the Adelaide region is considered to be mild. Annual averages include rainfall between 600 mm and 900 mm, with annual minimum temperatures around 10°C. and annual maximum temperatures around 20°C (Bureau of Meteorology 2003).

## PREVIOUS RESEARCH

Major W.H. Edmunds, a cartographer during the Boer War (1899-1902), made the first known reference to the Gun Emplacement in a series of "Topographic Maps of South Australia" from 1926 (Fenner 1939, McBriar 1976). Fenner (1939) commented that the name probably came about because, from a military viewpoint, the high flat area would be a good defensive vantage point over Adelaide.



**Figure 1:** location of the Gun Emplacement. Howchin's "Dead River" is shown approximately as a dotted line, after Howchin (1933)

In 1932 Howchin published the second part of his “Dead Rivers” papers. In it he proposed that a palaeochannel flowed in a southerly direction from Robertstown towards Adelaide and through to Morphett Vale (Figure 1). He describes the Gun Emplacement as the third in a series of river terraces formed within the area from a palaeo-drainage system, or as he called it a “dead river”. He mentions the soft sandstones underlying the harder “quartz conglomerate” of the Gun Emplacement which are now commonly referred to as the North Maslin Sand. The North Maslin Sand was noted to lie unconformably on the “old rocks”, the Pre-Cambrian of the Mount Lofty Ranges (Drexel *et. al.* 1993)

Fenner (1939) described the Gun Emplacement as a “platform of ferruginous sands”. Unlike Howchin (1932), Fenner (1939) also noted that the quartz capping could be traced some way up the slope to the east as well as 70 m to 80 m to the south. He could not find conclusive evidence that the Gun Emplacement was the left bank of the palaeochannel described by Howchin (1932). The lack of evidence of a corresponding western bank to this “dead river” valley was of main contention. Indeed, Fenner (1939) questioned whether the dead river ever existed. Fenner observed a coarsening of grain-size towards the hillslope within the ferruginous capping, which partly led to his theory for the evolution of the Gun Emplacement being derived from the “heavily burdened” channels which flowed from the uplifted ranges to the east. These conditions could have produced alluvial fans, of which the Gun Emplacement may be a remnant. These alluvial fans may have at one stage covered more of the Adelaide Plains area, but have since been eroded. Not to be mistaken for other ferruginous “grits and sandstones” of differing composition on the Adelaide Plains within the region, Fenner made it clear that the Gun Emplacement is younger than the other ferruginous remnants in the region, and post-dates tectonic activity along the Eden Fault, because the sediments are not recognisably displaced where they cover the fault. From this he concluded that the GE formed between the Pliocene to Recent times. Correlation with the other ferruginous “grit and sandstone” mentioned by Fenner can no longer be found, due to the effects of urbanisation. Fenner also recognised that the Eden Fault may not be just one fault but possibly a series of smaller or splinter faults, described here as a fault zone.

Twidale (1976) refuted Fenner’s theory, and commented that the Gun Emplacement was neither alluvial in origin nor was it transported. Twidale cited intermittent ferruginous mantles along the Eden Scarp from Golden Grove to Marino. The siliceous and ferruginous materials were believed to have been derived from “disintegration” of the summit laterites of the Mount Lofty Ranges, as well as tectonically isolated plateaus to the east (Twidale 1976).

Between 1955 and 1979, six known reports were commissioned for several reasons for the area known as Anstey Hill Recreation Park:

- 1955 - A report was carried out by the Engineering Geology and Mineral Resources Section (Whitten 1955) in order to consider a suitable site for pressure reducing storage tanks. It concluded that a hill c.a. 500 metres N.E. of the Gun Emplacement was suitable for the tanks. Although situated between the Eden Fault to the west and a subparallel splinter fault close by to the east, the quartzite bedrock was thought to be stable enough for the tanks. In the end another site was used.
- 1964 - A report by the Department of Mines SA Non Metallics Section (Cremsie 1964). Test drilling was carried out on the Anstey Hill sand deposits. It found excessive amounts of clays and silts, and concluded that no further testing was necessary.
- 1967 - The Department of Mines SA Mineral Resource Division (Russ 1967). A report was produced on the Anstey Hill Quarry white clay deposit. Concurring with drilling results and laboratory testing, the report concluded that the quarry, which was in operation at the time, would be viable for future use. This quarry borders the southern fence of the AHRP.
- 1973 - A report by the Department of Mines SA Exploration Services Division (Nelson 1973). This report was associated with the search for a suitable location for the Adelaide-Mannum water treatment works. Seismic refraction traverses helped to locate a ridge underlain by dolomite and quartzite, which was stable enough for such construction. The present day location of the treatment works is that which was investigated in the report.
- 1977 & 1979 - Two reports for the Geological Monuments Subcommittee of the SA Division of the Geological Society of Australia were compiled. The first (McBriar & Mooney 1977) emphasised the geological significance of the Gun Emplacement as well as its usefulness in teaching geomorphology and land use studies (McBriar 1977). The second (Toteff & McBriar 1979) reported on the success of the purchase of the land containing the GE, and reinforced the significance of the Gun Emplacement.

In 1983 a comprehensive concept report was submitted by the Department of Environment and Planning for AHRP (Spooner 1983). It included study results on vegetation, fauna, topography, human impact, agriculture, mining, and general geology. Its purpose was to give an overview of the region in order to find

out how best to utilise the landscape of the Reserve.

### PRELIMINARY OBSERVATIONS

The Gun Emplacement contains a sub-horizontal ferruginous capping of interbedded mottled sandstones with weathered lenses of ironstone gravels. Sub-horizontal bedding and occasional cross-bedding occurs within the sandstone and the gravel. The capping is between 4 m and 9 m in thickness, although vegetation obscures the full extent. It is underlain by between 5 m and 9 m of medium-rained quartzose red sands and conglomeritic lenses, with their full extent also obscured by the vegetation. The quartz grains in both the capping and the underlying sands are sub-angular to sub-rounded.

The ferruginous capping and the red sands appear to have banked up against the Eden-Fault scarp, indicating tectonic activity prior to accumulation. The ferruginous sediments occur on both sides of the Eden Fault, although exposures to the east of the fault are at higher elevations, possibly suggesting tectonic activity after sediment accumulation, or else that there was previously a greater thickness of sediment accumulated against the fault, with erosional remnants expressed at variable topographic levels.

A conglomerate layer of about 2 m thick underlies the red sands, and contains interbedded gravels with ferruginous clasts that occur within the zones with a preferential orientation of approximately NE-SW. The conglomerate is polymictic, with extra-formational angular quartz and quartzite cobbles.

The conglomerate layer and the horizontal surface of the GE may indicate an alluvial-plain depositional environment, rather than displaying a sloping surface typically associated with alluvial fan sedimentation. The cross-bedding and channel structures within the upper most highly ferruginised part of the sequence further reflect a fluvial environment of deposition.

### REGOLITH-LANDFORMS

The mapped area (Figure 2) is bounded on each side by bitumen roads, except the south-west corner near the Gun Emplacement, where an operating quarry forms the boundary. The landscape is predominantly low hills incised by contemporary drainage channels. All the channels drain towards the west. Most of the area is covered in vegetation, varying in density across the area, with 418 native and introduced species having been recognised (Spooner 1983).

27 regolith-landform units (RLUs) have been established throughout the study area and have been placed within four main regolith groups.

#### Alluvial Sediments

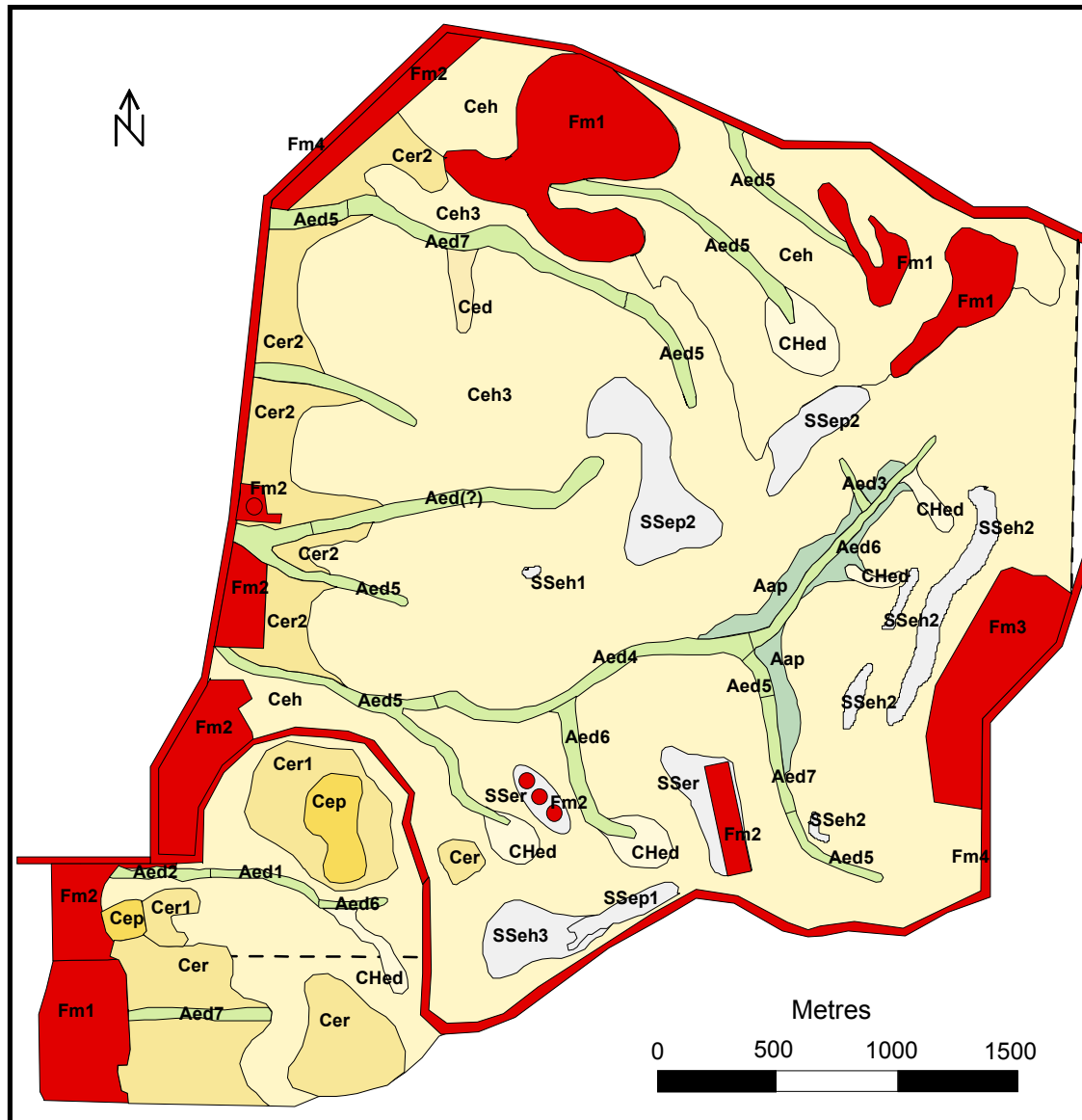
Seven RLUs have been mapped in this group. All of them are drainage depressions considered to be contemporary ephemeral channels. Distinctions between the alluvial depressions derives from vegetation types: predominantly Sheoak (*Allocasuarina verticillata*) (Aed<sub>1</sub>); eucalypts/ red gums (*Eucalyptus camaldulensis*) (Aed<sub>2</sub>); densely vegetated with tall thin eucalypts (Aed<sub>3</sub>); common reeds (*Phragmites australis*) (Aed<sub>4</sub>); grasses and shrubs (Aed<sub>5</sub>); grasses with scattered eucalypts (Aed<sub>6</sub>); and dense covering of immature and mature eucalypts and shrubs (Aed<sub>7</sub>). One RLU is used for alluvial overbank deposits, which is colonised by native grasses and sedges (*Lepidosperma spp.*) along with scattered eucalypts (Aap). Specific species names have been included where possible.

#### Colluvial sediments

The most extensive regolith type within the AHRP is mass wasting soil creep and sheet flow deposits. On the hill slopes the mass wasting deposits includes quartzose and lithic pebbles, gravels, cobbles, and boulders. Categorisation of the colluvial sediments includes: types with quartzite clasts (Ceh<sub>1,2</sub>); dense vegetation cover (Ceh<sub>3</sub>); open rehabilitated hill face (Ceh); erosional plain (Cep); drainage depression (Ced); and erosional rises (Cer).

#### Saprolith

The Reserve is covered by shallow soils, with bedrock exposures confined to the higher regions of the study area. These outcrops can be seen along the ridge in the east (SSeh<sub>2</sub>); the rounded hill in the south known as Anstey Hill with a <5 cm cover of soil, grasses and sparse eucalypts on the exposed quartzite (SSeh<sub>3</sub>); the worked foundations for the tanks and the water treatment plant (SSer); and the ridge top surface with thick cover of vegetation (SSep<sub>2</sub>). Slightly lower lying outcrops are grass-covered (SSep<sub>1</sub>), and a lens of quartzite boulders and pebbles can be seen on a westerly facing hill (SSeh<sub>1</sub>).



**Figure 2:** Regolith-landform map, Anstey Hill Recreation Park. The Gun Emplacement is located in the southwest corner, labelled as "Cep". Legend is included in Table 1.

### Fill

Obvious anthropogenic structures are included in this category: former quarry sites (Fm<sub>1</sub>); man made structures/ private property (Fm<sub>2</sub>); cleared land/ paddock (Fm<sub>3</sub>); and bitumen roads (Fm<sub>4</sub>).

### CONCLUSIONS

This study provides the first regolith-landform map of this area. It gives an overview of the landforms of the Reserve and will be useful in conjunction with any future research and proposals of AHRP, or any previous research that has been carried out in the area. Further regolith mapping north along the Eden scarp at the same scale may aid in correlating the Gun Emplacement with other ferruginous exposures. Further logging of sediment sections and detailed descriptions of the regolith that comprises the Gun Emplacement will form the main basis for the Honours study soon to be completed in this area.

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**Table 1:** Legend for regolith-landform map in Figure 2.

**Regolith-Landform Units (RLUs).**

- |   |  |
|---|--|
|  | Aed, Alluvial erosional depression   |
|   | 1. with predominantly Sheoak ( <i>Allocasuarina verticillata</i> ).                        |
|   | 2. with predominantly Red Gums ( <i>Eucalyptus camaldulensis</i> ).                        |
|   | 3. dense vegetation with tall thin Eucalypts.  |
|   | 4. dense common Reeds. ( <i>Phragmites australis</i> ).                                    |
|   | 5. with grasses and mostly introduced shrubs, Long-Leaved Box, and Red Gum                 |
|   | 6. with grasses and scattered Eucalypts  |
|   | 7. with dense cover of medium to large Eucalypts and shrubs.                               |
|  | Cer, Colluvial erosional rise  |
|   | 1. soils, grasses, more dense tree and shrub cover.  |
|   | 2. soils, grasses, less dense tree and shrub cover.  |
|  | Cep, Colluvial erosional plain   |
|  | Ceh, Colluvial erosional hill  |
|  | CHed, Sheet flow deposit erosional depression  |
|  | Aed, Alluvial drainage depression.   |
|  | Aap, Alluvial plain.   |
|  | SSEh, Slightly weathered bedrock.  |
|   | 1. quartzose cobbles and boulders  |
|   | 2. quartzose exposure  |
|   | 3. exposed bedrock covered by thin soil and grasses  |
|  | SSEp, Slightly weathered bedrock on erosional plain.                                       |
|   | 1. cleared land with grasses and exposed bedrock   |
|   | 2. ridge top surface with thin soils and thick cover of low shrubs on exposed bedrock      |
|  | SSer, Slightly weathered bedrock on erosional rise, exposed bedrock due to anthropogenics. |
|  | Fm, Altered landscape due to human activity.   |
|   | 1. former quarry   |
|   | 2. private property  |
|   | 3. cleared land/ paddock   |
|   | 4. bitumen road.   |
|  | Boundary of Anstey Hill Recreation Park.   |