

Place Details

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Great Artesian Basin Springs: Witjira-Dalhousie, Dalhousie ruin via Oodnadatta, SA, Australia

Photographs



List National Heritage List

Class Natural

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Summary Statement of Significance

Witjira-Dalhousie Springs is one of a suite of nationally important artesian springs in the Great Artesian Basin, which is the world's largest artesian basin. The artesian springs have been the primary natural source of permanent water in most of the Australian arid zone over the last 1.8 Million years (the Pleistocene and Holocene periods). These artesian springs, also known as mound springs, provide vital habitat for more widespread terrestrial vertebrates and invertebrates with aquatic larval young, and are a unique feature of the arid Australian landscape.

As these artesian springs are some distance from each other in the Australian inland, and individually each one covers a tiny area, their isolation has allowed the freshwater animal lineages to evolve into distinct species, which include fish, aquatic invertebrates (crustacean and freshwater snail species) and wetland plants. This results in a high level of endemism, or species that are found nowhere else in the world.

Witjira-Dalhousie Springs is nationally significant as it holds a suite of species which are genetically and evolutionarily distinct from other Great Artesian Basin springs, including three endemic freshwater snails, five endemic fish species and at least seven endemic crustaceans (isopods, amphipods and ostracods). The outflows of Witjira-Dalhousie Springs also support at least one endemic plant known only from the spring complex, a native tobacco, as well as at least six plant species better known from wetter areas to the south, including duck weed, which are indicative of a wetter past.

Mound springs in arid and semi arid Australia are associated with traditional stories and song lines, rain making rituals and evidence for concentrated Aboriginal occupation during dry seasons and periods of drought. The Witjira-Dalhousie Mound Springs are an outstanding example of how mound springs act as a refuge. The spring's significance is illustrated by the exceptionally large number of traditional song lines and story lines that originate or pass through the springs, the density of artefacts and the large size of Aboriginal camps at the springs, some up to a kilometre in length and thousands of square metres in extent (AARD 2008).

Witjira-Dalhousie Springs is regarded as one of the best examples of an artesian 'mound' spring complex in Australia, and Yeates (2001) also considers it "the best place (in Australia) to see the artesian processes and artesian springs in a natural state".

Official Values

Criterion A Events, Processes

Witjira-Dalhousie Springs is one of a suite of important artesian discharge springs in the Great Artesian Basin (GAB) for endemic fish, invertebrates (including hydrobiid gastropod molluscs) and plants (ANHAT 2005 & 2008). Witjira-Dalhousie is the most important place in the Australian arid zone for endemic fish (ANHAT 2005; Allen *et al* 2002; DEW 2007c; Morton *et al* 1995a, p.95). Witjira-Dalhousie Springs has also been ranked by CSIRO as a nationally 'highly significant' semi-arid and arid refugia in Australia for regional endemics of aquatic invertebrates (isopods, ostracods, and hydrobiid molluscs) and fish (Morton *et al*, 1995a, p.11, p.95 & p.133).

GAB artesian springs are important for illustrating the role of evolutionary refugia for relict animal and plant species (Morton *et al*, 1995a, p.11), which have evolved into distinct and endemic species in the GAB springs. Witjira-Dalhousie Springs contain five endemic species of fish: the Dalhousie mogurnda (*Mogurnda thermophila*), Dalhousie catfish (*Neosilurus gloveri*), Dalhousie hardyhead (*Craterocephalus dalhousiensis*), Glover's hardyhead (*C. gloveri*), and Dalhousie goby (*Chlamydogobius gloveri*) (Fensham *et al* 2007, p.13 & p.42; Allen *et al* 2002; DEW 2007c; Morton *et al* 1995a, p.95). Witjira-Dalhousie Springs contain three endemic hydrobiid freshwater snail species: *Austropyrgus centralia*, *Caldicochlea globosa* and *Caldicochlea harrisi* (Fensham *et al* 2007, p.13 & p.42; ANHAT 2005 & 2008; Perez *et al* 2005; Morton *et al* 1995a, p.95; Ponder and Clark 1990, p 301; Ponder *et al* 1995, p.554). Witjira-Dalhousie Springs also has a phraetoicidean isopod (*Phreatomerus latipes*), which is endemic to Witjira-Dalhousie and the Lake Eyre springs, and two endemic amphipod species (*Phreatochiltonia anophthalma* and *Austrochiltonia dalhousiensis*), and five endemic ostracods (*Ngarawa dirga*, *Candanopsis sp.*, *Cyprideis sp.*, *Darwinula sp.* *Entocytheridae sp.*) (DEW 2007c; Morton *et al* 1995a & b). The outflows of Witjira-Dalhousie Springs also support at least one endemic plant known only from the spring complex, a native tobacco, *Nicotiana burbidgeae*, as well as at least six relict plant species better known from mesic areas to the south, including: duck weed (*Lemna disperma*), swamp twig-rush (*Baumea arthropophylla*), spike rush (*Eleocharis geniculata*), a fringe-rush (*Fimbristylis ferruginea*) and two herbs: shield pennywort (*Hydrocote verticullata*) and creeping brookweed (*Samolus repens*) (DEW 2007c; DEH(SA) 2007a; Morton *et al* 1995a, pp.95; Morton *et al* 1995b, pp.55-56; Mollemans 1989, pp.65-66; McLaren *et al* 1985, pp.9-12).

Criterion B Rarity

Extant artesian springs in the GAB are a geographically rare phenomenon, each one covering a tiny area within the basin. (Ponder 1989 p 416, Wilson 1995 p 12). Witjira-Dalhousie Springs is regarded as one of the most important artesian springs because of its isolation, relative intactness and the extinction of other springs in the GAB (Morton *et al* 1995a, p.95 & p.133; Morton *et al* 1995b, pp.55 & 64-65; Wolfgang Zeidler pers. comm. 1/3/2005; Ziedler and Ponder 1989, p.ix).

Criterion D Principal characteristics of a class of places

Mound springs in arid and semi arid Australia are associated with traditional stories and song lines, rain making rituals and evidence for concentrated Aboriginal occupation during dry seasons and periods of drought. The Witjira-Dalhousie Mound Springs are an outstanding example showing the principle characteristics of mound springs as a class of Aboriginal cultural places. They are located in one of the driest zones in Australia and the Lower Southern Arrernte and the Wangkangurru Traditional Owners relied on the springs as a refuge during the dry season and times of drought. They are associated with an exceptionally large number of traditional song lines and story lines (Hercus and Sutton 1985; 64; Davey, Davies and Helman 1985), rainmaking rituals were performed there (Kimber 1997) and the density of artefacts and the large size of Aboriginal camp sites, some measuring up to a kilometre in length and thousands of square metres in extent, is unusual (Lampert 1985; Florek 1987, 1993; Kimber 1997; AARD 2008).

The GAB is the world's largest example of an artesian basin with its associated artesian springs an important component of the system (Harris 1992 p 157, Perez *et al* 2005). It is regarded as the best example of such an artesian system in Australia (Yeates 2001, pp.64-65; Morton *et al* 1995a, p.11, p.95 & pp.132-134; Morton *et al* 1995b, pp.65-66). Artesian springs are the primary source of permanent fresh water within the arid zone since at least the late Pleistocene (the last 1.8 Million years) and are therefore a unique feature of the arid Australian landscape (Ponder 1986 p 416; Morton *et al* 1995b, p. 55; Bowler 1982, pp.35-45). As the primary natural source of permanent fresh water in most of the arid zone, GAB artesian springs represent vital habitat for more widespread terrestrial vertebrates, and invertebrates with aquatic larvae (Ponder 1986, p 415). Witjira-Dalhousie Springs is one of a suite of important artesian discharge GAB Springs that are outstanding examples of the endemism exhibited by artesian springs individually and collectively. Species found at Witjira-Dalhousie Springs include endemic freshwater hydrobiid snails *Austropyrgus centralia*, *Caldicochlea globosa* and *C. harrisi*, and five endemic fish species, the Dalhousie mogurnda (*Mogurnda thermophila*), Dalhousie catfish (*Neosilurus gloveri*), Dalhousie hardyhead (*Craterocephalus dalhousiensis*), Glover's hardyhead (*C. gloveri*), and Dalhousie goby (*Chlamydogobius gloveri*) (Fensham *et al* 2007, p.13 & p.42; Perez *et al* 2005; Allen *et al* 2002; DEW 2007c; Ponder 2003; Fensham and Fairfax 2004; Morton *et al* 1995a, pp.55-56).

Witjira-Dalhousie Springs is regarded as one of the best examples of an artesian 'mound' spring complex in Australia (Morton *et al* 1995a, p.95 & pp.133), and Yeates (2001) also considers it "the best place (in Australia) to see the artesian processes and artesian springs in a natural state" (Yeates 2001, pp. 64-65). Kreig (1989) also states "as a geological feature the (Dalhousie Anticline) springs complex is unique in Australia. It illustrates on a huge scale the cause and effect of an artesian mound system", including "top of aquifer, mound spring material ... and large pools and rivulets of artesian water all convincingly displayed". These geological values are amply illustrated within the springs complex place, the core or 'hub' of the Dalhousie Anticline (Kreig 1989, p.26).

Criterion I Indigenous tradition

Witjira-Dalhousie Mound Springs has outstanding heritage value to the nation for its association with an exceptional density of story or song lines most of which are associated with mound springs (Hercus and Sutton 1985; 64). There are twenty four recorded song lines that originate or pass through Witjira-Dalhousie Mound Springs including: the Kestrel story, the Printi and the Goanna Women, the Rain Ancestor (*Anintjola*), the Dog story, the Frill Neck Lizard story, the Boy from Dalhousie, the Goanna Party and the Echidna Woman, Old Man Kingfisher and Old Woman Kingfisher, the Blind Rainbow Snake, Old Man Rainbow Snake, Perentie and the Boys, the Big Boys, the Perentie Goanna Camp, the Perentie Staked His Foot and the Two Boys song line. Unlike the traditions associated with the mound spring groups at Lake Eyre and Lake Frome, a tradition has been recorded that explains why some of the mound springs at Witjira-Dalhousie produce hot water (Hercus nd.; Hercus and Sutton 1985).

Description

The Great Artesian Basin (GAB) is one of the largest artesian systems in the world and occupies about 22% of the Australian continent. Artesian springs lie around the rim of the GAB, occurring in complexes of springs known as a 'supergroup', and are the natural outlets of the artesian aquifers from which the groundwater of the GAB flows to the surface.

The artesian springs, also known as mound springs, are loosely divided into recharge springs and discharge springs. Recharge springs are primarily found along the GAB's eastern rim on the Great Dividing Range where the GAB aquifers outcrop in an area of relatively high rainfall allowing recharge. The recharge springs release excess GAB recharge water or, in topographic lows, intercept the GAB recharge aquifers. The western margin of the GAB also has an area where the GAB aquifers outcrop but recharge is minimal as rainfall is low and intermittent. Discharge springs are those that release groundwater that has entered the GAB from the recharge zones, which flows towards the GAB's southern, southwestern, western and northern margins. Groundwater dating research has found that water in the furthest areas from the recharge areas has been moving through the GAB's porous rock strata (aquifers) for up to a million years. Witjira-Dalhousie Springs are regarded as a discharge spring complex and consists of at least five active artesian springs together with a few semi-active artesian springs immediately adjacent. Sixty artesian springs exist in all.

There are eleven supergroups in the main part of the GAB extending from Bourke in New South Wales and Lake Eyre in South Australia, and two outlier spring supergroups on Cape York Peninsula, including one on the Peninsula's northern tip. The GAB springs and spring complexes number around six hundred. However one 'spring' may represent between two and four hundred spring outlets and supergroups may be regional clusters of such springs, often covering relatively small areas. GAB springs range in size from small springs only a few metres across, such as Bundoona in southern Queensland, to major complexes of up to sixty springs with quite large pools such as Witjira-Dalhousie Springs, in northern South Australia. Some GAB artesian springs have associated discharge mounds that consist of mud, but most of the springs, especially the discharge springs, deposit calcium carbonate or other salts from the mineral-rich waters discharging from the springs. These evaporites typically form characteristic salt deposits around the spring outflow that can extend for several hundred metres as a distinctive white tail, sometimes yellow or even black, often with a central carbonate mound grading into sulphate and chloride salts. In many instances, particularly among South Australian GAB springs, these deposits combine with wind-blown sand, mud and accumulated plant debris to form mounds around the spring outflow. The resulting formation can resemble a small volcano, colloquially called a 'mound spring'. Many of the Queensland GAB springs are "softer" and fail to develop anything more substantial than a mound of a few centimetres to a few metres in height (Fensham and Fairfax 2004), hence the use of the more readily interpreted term of 'artesian spring' rather than 'mound spring'.

Mound formation of GAB springs is influenced by a range of factors, including groundwater discharge and evaporation rates, hydrochemistry, influence of organic material versus organic carbonate precipitation and local subsidence of the mound. Dating of GAB springs using thermoluminescence, uranium-thorium and carbon-14 dating of quartzose sands and carbonate springs deposits have produced dates up to more than 740 000 years. Research (Habermahl 2006) has found that large spring complex deposits reflect geological and hydrological changes in eastern and central Australia during the Quaternary (the last 2.6 million years) and provide an understanding of long-term changes prior to human intervention.

Habermahl (2006) also notes that groundwater dating, using carbon-14 and chlorine-36 studies, has found water aged several thousand years near recharge areas and more than a million years near the centre of the GAB. The groundwater moves slowly, at less than one metre per year to approximately five metres per year, generally in a south, southwest, west direction and also northwards in the northern portion of the GAB.

Witjira-Dalhousie Springs comprise a discrete supergroup of GAB discharge springs. This is the most northerly group of GAB springs in South Australia and is isolated from the other supergroups in South Australia as well as Queensland. The Witjira-Dalhousie Springs lie approximately 250 kilometres southsoutheast of Alice Springs and 120 kilometres north of Oodnadatta within the Witjira National Park, which is jointly managed by Indigenous traditional owners and South Australia's Department of the Environment and Heritage.

The Dalhousie supergroup contains approximately 60 springs including both active and extinct mounds, and contains a wide variety of geological features associated with the evolution and development of GAB artesian mound springs not seen in other springs. The springs environs extend over an area of approximately 50 980 hectares, and the individual springs are surrounded by well-developed wetland vegetation, including large areas of the inland Paperbark (*Melaleuca glomerata*). Flow rates at Witjira-Dalhousie Springs are the highest in the GAB, with 41% and 90% of the natural discharge of the GAB in Australia and South Australia respectively, and results in overflow 'tails' which can extend for ten kilometres.

The Witjira-Dalhousie Springs form the only permanent surface water for 150 kilometres in any direction (DEH 2008:

Macfarlane 2005). The importance of this resource to Aboriginal people is reflected in the number and types of sites recorded at Witjira-Dalhousie. Eight Aboriginal archaeological sites and thirty traditional story sites (AARD Register 2008) have been recorded although others probably occur in the area. The Aboriginal archaeological sites include old camps, stone arrangements and stone knapping sites. Some of the camps are exceptionally large with dense scatters of artefacts extending over a kilometre. Most of the tradition and story places are associated with mound springs.

GAB artesian springs are a significant refuge in arid and semi-arid Australia, providing one of the few sources of natural permanent water. Estimates of the age of artesian springs have concluded that individual springs may last for up to a few hundred thousand years, but spring groups collectively may last possibly up to several million years. The presence of such permanent freshwater in inland Australia over the past few million years has provided habitat for a wide array of fish, invertebrates and plants that have been “stranded” in GAB artesian springs as inland Australia has dried out.

Ecologically GAB artesian springs are considered an evolutionary refuge as they allow wetland dependent (specialised habitat) species to persist as their original geographic range becomes uninhabitable due to drying over an extended period of time because of climatic change.

With the contraction of their main range, relictual species are hypothesised to have evolved different characteristics from their original stock, leading to the high levels of endemism (the frequency of species with restricted distributions) present in isolated GAB artesian spring groups (Brown and Gibson 1983; Morton *et al*, 1995, p.11, p.119 & p.134). Artesian springs provide the localised habitat requirements for a suite of endemic fish and aquatic invertebrate species, including hydrobiid molluscs, isopods, ostracods, amphipods, copepods and flatworms (Morton *et al*, 1995a, p.11, p.119 & p.134).

GAB artesian springs, such as Witjira-Dalhousie Springs, hold plants and animals that have evolved into new species found nowhere else. The presence of endemic species, and large peat mounds, indicates that some GAB springs have been active for a very long time. Hydrobiid snails are the best studied of these endemic groups. Hydrobiid snails are the most diverse of all freshwater gastropods and frequently have small distribution ranges, resulting in high levels of endemism (Perez *et al* 2005). This makes them excellent candidates for evolutionary studies on endemism and speciation and for use as potential indicators (surrogates) of the importance of environments such as mound springs for other, less well-studied freshwater taxa (Ponder pers. comm. 2004, Perez *et al* 2005). Hydrobiid snails are particularly well represented in GAB artesian springs with well over twenty three taxa and five genera (Perez *et al* 2005), although each artesian spring complex or aggregation is separated by hundreds of kilometres. It has been hypothesised that this is a result of ancestral Gondwanan hydrobiids being stranded by the increasing aridity of inland Australia and being isolated in the permanent waters of artesian springs (De Deckker 1986, Ponder 1986, Perez *et al* 2005). Recent work has demonstrated that the GAB hydrobiid snails have evolved in three separate radiations, one in Queensland and two in South Australia, with the Queensland hydrobiids and those of South Australia, including Witjira-Dalhousie Springs, being completely unrelated (Perez *et al* 2005).

The Witjira-Dalhousie Springs, on their own and collectively with the other significant discharge springs comprising the GAB springs, are notable examples of the endemism exhibited by GAB artesian springs. Witjira-Dalhousie Springs have three species of endemic freshwater snails, five species of endemic fish, and six species of endemic crustacean (DEW 2007c; Morton *et al* 1995a & b; Ponder 2004; Perez *et al* 2005). There are also at least six southern relict plant species from when the arid zone was more mesic and at least one endemic species only found at the springs (DEW 2007c; DEH(SA) 2007a; McLaren *et al* 1985, Morton *et al* 1995a & b; Mollemans 1989). In addition at least two species of frog, 21 species of reptile, 149 species of birds, five species of mammals, seven species of freshwater snail, and 112 species of vascular plants are known from the vicinity of the springs from a species list generated by the Australian Natural Heritage Assessment Tool (ANHAT 2008) and as detailed in the Witjira National Park Draft Plan of Management (DEH, 2008, pp.28-31).

History

The Lower Southern Arrernte and Wangkangurru people are responsible for the Witjira-Dalhousie Mound Springs which are an integral part of their *Altyerre/Tjukurpa*, traditional law and custom (DEH 2008; Ah Chee 2004). The Lower Southern Arrernte name for Witjira-Dalhousie Mound Springs is *Irrwanyere* which means “the healing springs”. The Wangkangurru name for the springs is *Witjira* which is the name for the local paperbark tree (*Melaleuca glomerata*) (Hercus and Sutton 1985; DEH 2008; Ah Chee 2004).

The artesian mound springs of the Great Artesian Basin (GAB) were central to the survival of Indigenous groups in the semi-arid and arid areas of central, southern, eastern and northern Australia for at least the last 5,000 years (Lampert 1985).

The densest concentration of mound springs in this area occurs at Witjira-Dalhousie (Hercus and Sutton 1985). During the 1970s and 1980s Luise Hercus interviewed many of the traditional owners of the springs around the Lake Eyre Basin, including Witjira-Dalhousie Mound Springs. Hercus's research indicated that the vast majority of the springs in the basin had traditional stories and song lines associated with them. The only springs that didn't were where the water was undrinkable (Davey, Davies and Helman 1985).

The information Dr. Luise Hercus gathered during her linguistic work over 35 years indicated that each individual spring at Witjira-Dalhousie had a story associated with it, although some of those stories are now lost. She also recorded twenty four separate story and song lines associated with the mound springs at Witjira-Dalhousie which is exceptional when compared with the number of story lines associated with other mound springs sites in the GAB (Hercus and Sutton 1985). One of the most important song lines that originates at Witjira-Dalhousie is the Two Boys song line which is a Kingfisher 'Dreaming'. In the story the Two Boys crossed the Simpson Desert and then looped through Queensland and back to just north of Witjira-Dalhousie in the Finke River area. This song line contains information on every waterhole or soak that was known in the Simpson Desert. Following this song line meant you could cross the Simpson Desert using the available water (Hercus and Sutton 1985; Hercus and Potezny 1994).

The Two Boys story also describes the introduction of new elements in the performance of rituals. This includes the use of feathers as ritual decorations where previously only paint was used in the *Warrthampa* ceremony. This ceremony, associated with the Emu story, also required a new and special way of vibrating and rattling boomerangs together (Hercus and Potezny 1994).

Other song lines associated with the Witjira-Dalhousie mound springs include; the Kestrel story, the Printi and the Goanna Women, the Rain Ancestor (*Anintjola*), the Dog story, the Frill Neck Lizard story, the Boy from Dalhousie, the Goanna Party and the Echidna Woman, the Blind Rainbow Snake, Old Man Rainbow Snake, and stories associated with the activities of Perentie, the monitor lizard.

Unlike the mound springs in the Lake Eyre and Lake Frome supergroups, Witjira-Dalhousie has hot springs, which in Aboriginal tradition are explained by the story of the 'boy who stole'. The story recounts how a boy stole a sacred object from an initiation ceremony and as he was being chased he stole a fire stick from an Ancestral Mosquito Woman. Upon reaching Witjira-Dalhousie he tried to get rid of the fire stick by putting it in one of the springs and as it was still burning it made the water hot (Hercus and Sutton 1985).

The weather and rainfall at Witjira-Dalhousie is extremely unreliable and unpredictable (Davey, Davies and Helman 1985; Kimber 1997). Lower Southern Arrernte and Wangkangurru use of the Witjira-Dalhousie area is unusual when compared with other parts of the GAB where people were less reliant on mound springs (Badman 2000). In drought or dry seasons the Lower Southern Arrernte and Wangkangurru were tethered to the Witjira-Dalhousie mound springs, which had very limited food resources. They remained there until it rained and they could spread across the country again to use the newly available resources. It is not surprising therefore that Witjira-Dalhousie Mound Springs was an important Rain Dreaming centre where Lower Southern Arrernte and Wangkangurru people gathered to sing songs to influence rain storm ancestors (Kimber 1997).

Ceremonies were conducted at Witjira-Dalhousie to ensure that the rain fell. The first description of these rain ceremonies was in 1886 by H. Dittrich. The description reports that there were a number of songs sung, the first being the one to get rid of the flies, then the cold water rain song, followed by the meat-food song then one for the rains that would bring grass and insects (Kimber 1997). There were other rain centres spread across the area as well as a vast interlinking network of traditional rain stories and rain-stone sites. A Traditional Owner, now deceased, stated to Hercus the reason for such a large network of rain sites "it is because clouds go everywhere" (Hercus nd.). Rain stories came into Witjira-Dalhousie and originated in Witjira-Dalhousie. Rain was a critical part of survival as Witjira-Dalhousie is in one of the most arid areas of Australia.

The concentration of Lower Southern Arrernte and Wangkangurru at Witjira-Dalhousie during the dry months has resulted in exceptionally large, dense and complex campsites around the mound springs, some up to a kilometre in length and thousands of square metres in extent (AARD 2008). These sites consist of large numbers of stone artefacts, hearths and grinding stones. Sites found beyond the mound springs are less complex and are scattered across the landscape and tend to be smaller in size (Lampert 1985; Florek 1987, 1993; Kimber 1997).

The vast majority of Lower Southern Arrernte and Wangkangurru sites associated with the Witjira-Dalhousie Mound Springs date from the late Holocene. The dating is based on the site stratigraphy and the predominance of late Holocene small tools, tools including tulas, pirris, microliths and seed grinders. Only three springs, Witjira-Dalhousie, West Finnis and Welcome Springs, have evidence for earlier occupation emerging from sediments that might be older than the late Holocene (Lampert 1985).

The South Australian artesian spring supergroups, including the Witjira-Dalhousie Springs complex and the Lake Eyre springs supergroup, also played a vitally important part in the European exploration of Central Australia. The first recorded European sighting come from surveyors working on the Adelaide to Darwin Telegraph Line in December 1870. However Witjira-Dalhousie Springs did not become a focus for the line as the spring complex was too far to the east of the proposed direct route. Rather repeater stations were established at Charlotte Waters and Blood Creek, north-west of Witjira-Dalhousie Springs. Construction of the telegraph thus followed the direct 'spring route' and the South Australia artesian springs were used as 'stepping stones' by European explorers such as Eyre (1839), Babbage (1856), Warburton (1858) and Stuart (1859-62) (GABCC 1998, p.8).

However, Europeans moving into central Australia continued to visit and use the springs at Witjira-Dalhousie. During 1875 Lutheran missionaries on their way to Hermannsburg were forced to stay at Witjira-Dalhousie for over ten months due to drought indicating the importance of the springs (Morton and Mulvaney 1996). The excitement and wonderful impression created by the Witjira-Dalhousie 'spring country' was described by Giles (1894) in the following way, "an almost illimitable sight expanse of – welcome sight! – waving green reeds, with large pools of water at intervals ..." (Cohen 1989, p.13' in Ziedler and Cohen 1989). The party initially named the springs Lady Edith Springs for Lady Edith Ferguson (wife of the Governor of South Australia), however at her request, the name was changed to her family name Dalhousie.

The first pastoral lease in the area, which later became part of the Mount Dare property, was taken up by Ned Bagot in 1872 with the Dalhousie Homestead, stockyards and outbuildings constructed in the following decade. Initially sheep were the mainstay of pastoralism but by the early 1900s the focus shifted to cattle. Although many bores were sunk on Mount Dare station, Witjira-Dalhousie Springs remained vital for the survival of stock. The land was marginal pastoral country and, during the brief history of the industry, various leases were abandoned, particularly from the start of the twentieth century until just prior to the First World War. (DEH(SA), 2007e).

The creation of the pastoral runs did not immediately affect Aboriginal use and occupation of the mound springs and their cultural associations with their land. This changed when the influenza epidemic of 1919-1920 was followed by a measles outbreak. The epidemics had a devastating affect on the Aboriginal population and by the 1930s people were reduced to camping at ration depots and at stations where the pastoralists allowed them to stay (Nicholson et al 1999).

The Dalhousie homestead was abandoned in about 1925. In the 1930s the lease was purchased by Edwin Lowe. The Lowe family held the lease till it was purchased by the South Australian Government in 1985 (Nicholson *et al.* 1999). In 1986 the area was declared a National Park. The Irrwanyere Aboriginal Corporation was formed to facilitate the management of what is now the Witjira National Park and Witjira-Dalhousie Mound Springs. On 5 October 1995, Traditional Owners and the South Australian Government signed a "Joint Management Agreement" and a 99 year lease for a large part of the Park. The Traditional Owners became the primary managers of the National Park. The lease between the South Australian Government and the Irrwanyere Aboriginal Corporation was the first in South Australia that let Aboriginal people manage a reserve gazetted under National Parks and Wildlife Act (ATNS 2007; DEH 2008).

Condition and Integrity

The Witjira-Dalhousie Springs are located in Witjira National Park, which was declared on 21 November 1985 in recognition of its scientific and cultural values. Since the declaration of the National Park steadily increasing tourism has been noted as a potentially significant threat requiring management. Threats from tourism are both obvious (eg trampling by foot traffic and surface damage from vehicles) and less obvious (eg modification of water chemistry by the use of soaps, and sunscreens, by bathers in the springs).

Witjira-Dalhousie Springs has a range of feral species including camels, cattle, horses and rabbits. Although commercial grazing activities were suspended once the park was declared, trampling by feral stock, together with tourist foot traffic, remains a threat to the integrity of springs at Witjira-Dalhousie. Elsewhere in the wider GAB, trampling, and modification of the spring to improve access for stock in grazing areas, remain a serious threat to artesian springs. Trampling (also known as pugging) modifies the physical structure of the microhabitat, which are small scale habitat zones with different environment conditions, and if serious enough, removes the microhabitat entirely. Conversely, removal of grazing pressure altogether may also be a significant threat, at least in South Australia, where total exclusion of grazing appears to encourage overgrowth of water plants such as *Phragmites* and loss of microhabitat. However, this has not been reported from any of the Witjira-Dalhousie Springs outflows. Lastly, the spread of the introduced mosquito fish (*Gambusia affinis*) is a threat to the freshwater endemics of all the GAB artesian springs. *Gambusia* has not yet been reported in Witjira-Dalhousie Springs.

A July 2003 monitoring survey by South Australia's Department of the Environment and Heritage found hundreds of

Date Palm (*Phoenix dactylifera*) seedlings (parent stock of which are historical plantings from the 1800's) establishing at the springs, with some smaller pools drying up where there are heavy infestations of Date Palm. The South Australian Witjira National Park website notes: "that the origin of the date palms is still being debated. Romantics believe the trees were planted by Afghan cameleers, but there is firm evidence that dates were planted by the Lewis family who took over the lease of Dalhousie in 1896" (DEH(SA), 2007e). However there has also been excellent recovery of native plants since the park was proclaimed and subsequent application of feral animal controls (including the effects of the Rabbit-Calciavirus disease).

The endemic species associated with GAB artesian springs, particularly the vascular plants and invertebrates, appear to be highly sensitive to changes in water flow or conditions at the springs. This is at least in part due to the dependence of many species on microhabitats such as seepages of only a few millimetres depth. Over the last 120 years a range of human activities have impacted on GAB artesian springs. The most serious is groundwater extraction, primarily but not exclusively due to numerous uncapped artesian bores and inefficient earth drains, resulting in draw-down of water pressure at the spring, and the loss or modification of microhabitat and ultimately the extinction of the spring. Groundwater extraction has already been implicated in the extinction of many GAB artesian springs and has been partly addressed by the extensive GAB bore-capping programme. Extraction for other uses such as mining and town water supply remains a substantial impact. Draw-down remains the most serious threat to GAB artesian springs. For example Fensham *et al* (2007) note that some of the South Australian artesian discharge springs, such as the Venable and Priscilla spring groups in the Lake Eyre supergroups, have lost a suite of 'locally' endemic species including hydrobiid snails and crustaceans, most likely due to groundwater extraction (Fensham *et al* 2007, pp.14-16 & pp.41-45).

To provide recent historical condition information a recognised GAB hydrogeology expert, Dr M.A. (Rien) Habermehl, provided the following statement:

"Four petroleum exploration wells drilled in the region east, west, north, northeast and east of Witjira-Dalhousie Springs during the 1960s did not encounter oil or gas, and were converted into waterbores and flowed from the Great Artesian Basin aquifers from the 1960s onwards. The wells west and northeast of Witjira-Dalhousie Springs, which were as close as approximately 10 and 20 km from the springs, were plugged (filled with cement) by the South Australian (SA) Mines Department during the late 1980s and early 1990s. The well east of Witjira-Dalhousie Springs was rehabilitated with a new control valve, and at the request of the SA Department of the Environment left flowing artesian groundwater at a reduced rate during the late 1980s and early 1990s. The well north of Witjira-Dalhousie Springs in the Northern Territory was rehabilitated with a new control valve in the early 2000s, and left flowing artesian groundwater. Both of these latter two wells (one in SA and one in NT) are located in between the red sand dunes of the Simpson Desert and created and maintain large lakes of fresh water in this arid environment, which has attracted birds and other wildlife in this arid region. This wildlife has been diverted from Witjira-Dalhousie Springs and is anomalous to the arid Simpson Desert region".

Dr Habermehl goes on to state:

"The long term artesian groundwater flow from the wells, which obtain(ed) their flowing artesian groundwater from the same Great Artesian Basin aquifers as the Witjira-Dalhousie Springs, will have had an effect on the artesian pressures and flows of the Witjira-Dalhousie Springs. The continuing, substantial flows from the two wells in SA and NT could still influence the Dalhousie Springs (Dr M.A. (Rien) Habermehl, BRS, pers.comm., 30 Oct. 2007)."

Smith (1989) also stated that Witjira-Dalhousie Springs "discharge appears to have declined over the approximately 11 year period between gaugings, with total spring discharge 6% lower in 1985 than in 1974, total spring discharge in 1974 was 651 L/s (20 500ML/y) ... total spring discharge in 1985 was 612 L/s (19 300ML/y)", a ML/y being a flow of 1 000 000 litres of freshwater per year. However Smith also states that this finding needs to be qualified by the fact that "the ill-defined channels and thick vegetation and make discharge rate measurements difficult ... seasonal, climatic and diurnal influences may have an unknown effect upon results ... total spring discharge values include a 30% estimated values obtained when channel configuration was unsuitable for flow gauging or vegetation too thick". Smith sums up by noting "the 6% discrepancy between 1974 and 1985 may well lie within the limits of experimental error" (Smith 1989, p.30), and recommends further monitoring resolution on the methods (Smith 1989, p.34-35).

The GAB Sustainability Initiative (GABSI) is a jointly funded initiative of the Federal and State governments and pastoral bore owners. GABSI aims to preserve the pressure of the GAB, and reduce water waste, through rehabilitating uncontrolled bores and replacing bore drains with polyethylene pipes, tanks and troughs for livestock water. Although a substantial number of bores are now being fully controlled with water distributed by pipelines to tanks and troughs, about 80% of the total outflow from the Basin is still wasted because of inefficient water delivery systems.

Condition report drawn from - Fensham *et al* 2007; Dr Habermehl pers.comm. 30/10/07; Wetlands Australia 2004; Morton *et al* 1995a, p.119; Ponder pers. comm. 1/3/2005; Fairfax and Fensham 2002; Fensham and Fairfax 2003;

Smith 1989.

Location

About 50,700ha, 118km north of Oodnadatta and 38km south-east of Mount Dare Station, comprising the Dalhousie Springs Zone, Witjira National Park Management Plan Draft 2008. The exact boundary description of this zone can be obtained from the Department of the Environment, Water, Heritage and the Arts or the South Australian Department for Environment and Heritage. An approximate boundary is the area enclosed by a line joining the following points of Latitude and Longitude (GDA94) consecutively: 26.4708S 135.4251E, 26.4631S 135.4248E, 26.4557S 135.4257E, 26.4481S 135.4281E, 26.4414S 135.4314E, 26.4349S 135.4311E, 26.4279S 135.4276E, 26.4222S 135.4259E, 26.4163S 135.4251E, 26.3931S 135.4255E, 26.3874S 135.4263E, 26.3828S 135.4272E, 26.3772S 135.4293E, 26.3719S 135.4321E, 26.3516S 135.4475E, 26.3472S 135.4518E, 26.3315S 135.4727E, 26.3275S 135.4791E, 26.3249S 135.4850E, 26.3230S 135.4912E, 26.3221S 135.4957E, 26.3184S 135.5011E, 26.3150S 135.5082E, 26.3127S 135.5144E, 26.3111S 135.5224E, 26.3107S 135.5289E, 26.3115S 135.5623E, 26.3135S 135.5719E, 26.3157S 135.5779E, 26.3187S 135.5836E, 26.3222S 135.5889E, 26.3264S 135.5935E, 26.3311S 135.5975E, 26.3388S 135.6022E, 26.3473S 135.6051E, 26.3532S 135.6060E, 26.3591S 135.6060E, 26.3634S 135.6054E, 26.3686S 135.6246E, 26.3708S 135.6306E, 26.3737S 135.6363E, 26.3773S 135.6416E, 26.3837S 135.6483E, 26.3912S 135.6535E, 26.3967S 135.6561E, 26.4024S 135.6578E, 26.4082S 135.6587E, 26.4141S 135.6587E, 26.4200S 135.6579E, 26.4285S 135.6551E, 26.4338S 135.6522E, 26.4387S 135.6486E, 26.4432S 135.6443E, 26.4471S 135.6394E, 26.4504S 135.6340E, 26.4541S 135.6250E, 26.4556S 135.6187E, 26.4564S 135.6122E, 26.4565S 135.6056E, 26.4557S 135.5991E, 26.4535S 135.5899E, 26.4572S 135.5884E, 26.4619S 135.5859E, 26.4674S 135.5819E, 26.4762S 135.5740E, 26.4804S 135.5693E, 26.4918S 135.5697E, 26.5106S 135.5756E, 26.5201S 135.5774E, 26.5290S 135.5771E, 26.5348S 135.5758E, 26.5433S 135.5723E, 26.5504S 135.5684E, 26.5577S 135.5633E, 26.5621S 135.5590E, 26.5661S 135.5541E, 26.5725S 135.5443E, 26.5767S 135.5356E, 26.5787S 135.5294E, 26.5801S 135.5197E, 26.5802S 135.5007E, 26.5793S 135.4929E, 26.5772S 135.4854E, 26.5743S 135.4788E, 26.5711S 135.4733E, 26.5662S 135.4673E, 26.5607S 135.4624E, 26.5559S 135.4590E, 26.5599S 135.4493E, 26.5611S 135.4409E, 26.5611S 135.4329E, 26.5598S 135.4258E, 26.5568S 135.4176E, 26.5529S 135.4109E, 26.5469S 135.4042E, 26.5394S 135.3986E, 26.5313S 135.3947E, 26.5231S 135.3927E, 26.5149S 135.3922E, 26.5071S 135.3931E, 26.5000S 135.3952E, 26.4927S 135.3989E, 26.4858S 135.4041E, 26.4801S 135.4105E, 26.4744S 135.4188E, then directly to the point of commencement.

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