Department of Science, Information Technology and Innovation

Western Queensland Tertiary Springs Group

Hydrogeology and ecology

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Front Cover: Edgbaston Springs and a spring (imaginatively) called “New Big”. There is Spinifex in the foreground, free water in the mid-ground, with some scalding in front and the far right rear. Photo: Queensland Herbarium.

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Overview

The term ‘desert spring’ conjures images of exotic oases: bubbling crystal pools shaded by rustling date palms, creating welcome verdure amidst barren sandy wastes. The ‘oases’ of inland Australia are different. Often muddy and stagnant instead of clear and bubbling, dwindling to slimy green puddles towards the end of the dry; tiny and hidden instead of lush and flamboyant. Most subtle of all are the small water sources fed by localised aquifers – springs and native wells or *mikiri* – hidden deep within gorges in low stony ranges, guarded by waves of red desert dunes, or soaking into sandy flatlands.

In some areas these small oases provided the only reliable water source across hundreds of kilometres and dictated all human and animal activity during dry times. They were critical to the survival and movement of Aboriginal people over thousands of years. From the 1860s they were ardently sought and relied upon by early white settlers. Both Aboriginal people and the early pastoralists had an encyclopaedic knowledge, borne of necessity, of even the tiniest water sources. The importance of these waters is reflected in the rich mythology and varied testaments to human activity, indigenous and European, surrounding them.

With the advent of bore drilling and excavation of large dams, many of these small oases have slipped into obscurity. While they could provide sufficient water for a small family, a boundary rider’s hut or a flock of sheep, their flows are rarely sufficient for modern household needs or thirsty mobs of cattle. And with our faster mechanised mode of moving through country, they are no longer critical as camp spots, stopovers or change stations. Some have ceased flowing and are long forgotten. However even the more accessible springs which remain active are likely to be passed at speed with barely a backward glance. A few remain well-known by local townsfolk, opal miners and graziers, although are seldom relied upon as they were up until a century ago.

The focus of this chapter is those springs which emanate from local Tertiary sandstone aquifers in inland Queensland and northern New South Wales (Figure 128; Table 20). They may have flow paths restricted to a few hundred metres but often provide isolated and important sources of permanent water. While research over the past decade has documented the location, hydrogeology, biological values and cultural history of Great Artesian Basin (GAB) springs in inland Australia (Fensham et al., 2004; Silcock et al., 2014, this report; Powell et al., 2015), our knowledge of the location and activity status of non-GAB springs in the aridlands remains very patchy (Brim-Box et al., 2008).

Springs in recharge areas along the eastern edge of the GAB share many characteristics with non-GAB springs (Fensham et al., 2011), but are not considered here (See Fensham et al., 2011; and Silcock et al., 2014 for a discussion of these outcrop springs). After a succession of wet summers, water can seep out of saturated substrate, including sandstone ranges, sandy creekbeds and dunes or sandridges, for some months but then the same areas may be dry for years. Our focus here is those areas where water is, or was at the time of pastoral settlement, present for more than 70% of the time.

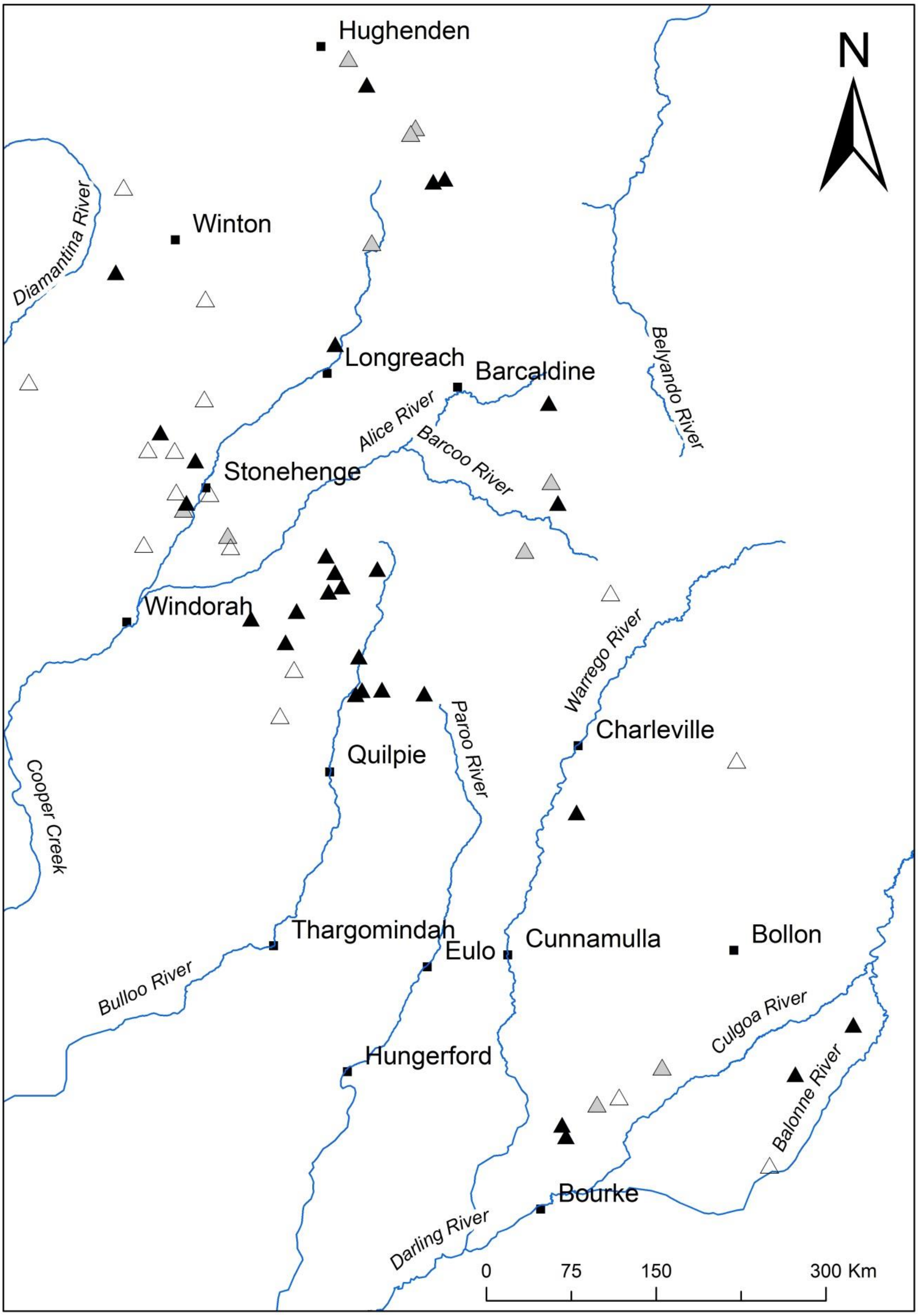

Figure 1. Spring complexes emanating from Tertiary (non-GAB) sandstone within the boundary of the GAB, western Queensland and northern New South Wales. Spring complexes with 100% active springs (solid triangles), partially active (grey triangles) and 100% inactive (open triangles) are identified.

Table 1. Summary of the status of the Tertiary springs at the complex, wetland and vent scale.

	Complex			Spring		Vent	
	Active	Partially active	Inactive	Active	Inactive	Active	Inactive
Outcrop	30	11	22	106	62	107	62
Discharge	0	0	0	0	0	0	0

Hydrogeology

The Tertiary included many periods of extensive deposition that blanketed inland Australia with sandstone. Since this time the sandstone has been eroded away leaving remnants of the former surface. The most extensive areas of these Tertiary sandstones occur at the heads of the major catchments, the Bulloo, Paroo, and Coopers Creek.

The sandstone has been extensively altered by weathering processes and indurated and clay-rich strata that are relatively non-porous predominate. The springs probably have their source with rainwater percolating through fissures in the impermeable material until it hits a zone of porous sandstone that has been relatively unaffected by weathering Figure 2. This recharges local aquifers which are confined by the impermeable sandstone and/or the underlying Cretaceous sediments of the Winton formation. Under this mechanism the lag between recharge and discharge is probably in the order of decades (Leblanc et al., 2015). These aquifers are exposed through erosion at the edge of the Tertiary land surface, and most springs (75%) occur at the base of escarpments in gorges or incised gullies (Figure 3). They are disconnected from the aquifers of the GAB, which are much deeper and below the Cretaceous sediments (Habermehl 1982). Some occur within or adjacent to streams in broad creek valleys or on sideslopes, but are still fed from surrounding Tertiary sandstone range. Water is generally slightly acidic and has low conductivity, reflecting its relatively short residence time (probably years to decades).

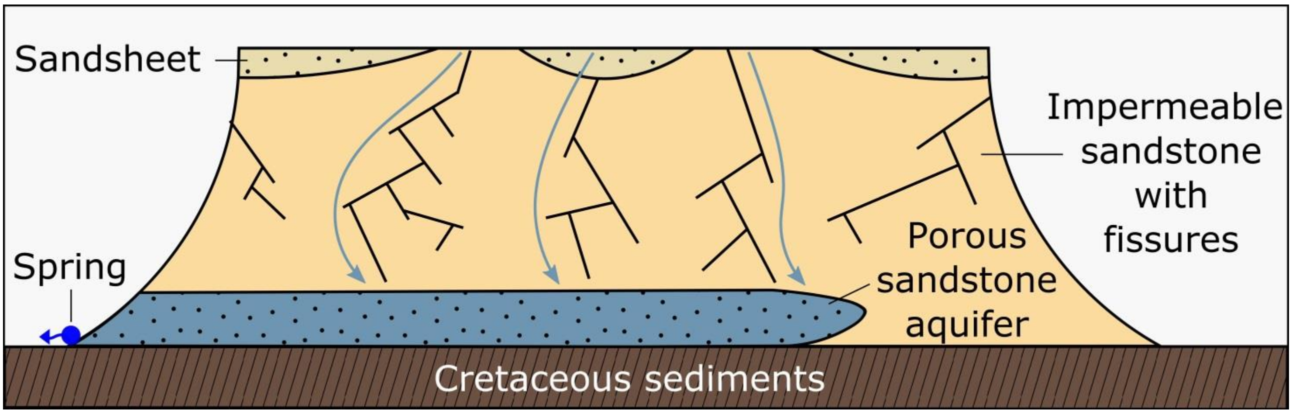

Figure 2. Conceptual diagram of a typical Tertiary sandstone spring at base of escarpment, where a porous sandstone aquifer is exposed by erosion of the plateau. This aquifer is confined by impermeable sandstone above and Cretaceous sediments of the Winton formation below. Unconnected GAB aquifers (not shown) occur at depth below these sediments. The aquifer is fed by local rainfall through fissures in the impermeable sandstone.

The Grey Range and associated range systems and the Goneaway Tablelands are the major areas of Tertiary sandstone in the study area. Springs are not distributed evenly, with some areas harbouring spring clusters while large expanses have no springs. The highest concentration of Tertiary springs occurs in the northern Grey and Gowan Ranges on the watershed separating the Bulloo-Barcoo catchment and in the Stonehenge district on both sides of the Thomson River (Figure 128). Idalia National Park/Highlands and two 'mother plateaux' on Budgerygar and Swan Vale (Figure 3) are characterised by especially high concentrations of springs. There are also clusters of Tertiary springs in the Great Dividing Range along the eastern edge of the semi-arid zone, in the western Desert Uplands between Muttaburra and Hughenden, south-west of Winton and in the Charleville district.

There is a line of springs from Culgoa Floodplain to Lila Springs, many of which are unlikely to emanate from the GAB as discussed by Silcock et al. (2013). Three of these, including Nulty, Scrubber (Figure 3) and Colless Springs, are associated with the Tertiary land surface which outcrops east of Enngonia. All seem to be permanent, although Nulty is the largest and its excavated pool maintains a constant water level (Brian Bambrick, pers.comm.). Colless and Scrubber are soaks emanating from rocky ground and both fluctuate with recent rainfall. To the east, Cowragil (Figure 3) and Cumborah springs are both considered to be Tertiary rather than part of the GAB Bogan River supergroup. Colless differs from all other Tertiary springs visited in that it emanates from near the top of a ridge, rather than the footslope or drainage line, but seems to be permanent (Figure 3).

Other non-GAB springs were documented across the study area in basalt.

Figure 3. Tertiary springs of western Queensland and northern New South Wales: Black Spring, Budgerygar, the biggest Tertiary spring in the study area (top left); Harlow vent 2, on ironbark/poplar box flat, Idalia National Park (top right); Scrubber Spring atop a stony ridge, Stanbert, east of Enngonia (middle left); Cowragil Spring, The Springs, south of St George (middle right); and Goon Goon Spring, Evengy, west of Stonehenge (bottom).

Biological values

Unlike GAB discharge springs, which are permanent, unusual and ancient, outcrop springs including Tertiary springs, tend to be more dynamic and less unusual as a habitat type (Fensham et al., 2011). Although overall diversity is higher for non-GAB springs than rockholes, no endemic species have been recorded at any non-GAB springs in the study area. Non-GAB springs are, in general, not floristically distinct from GAB outcrop springs (Fensham et al., 2004) and were grouped as 'outcrop springs' by Fensham et al. (2011).

Despite the lack of endemism, some geographically isolated populations of more mesic species of plants were recorded (Figure 140). The fern *Cyclocorus interruptus* is only known from one arid-zone population, at Alice Spring on New Haven in the Grey Range. The fork fern *Psilotum nudum* is recorded from two arid-zone springs (Boundary on Purtora north of Blackall and William on Carisbrook south-west of Winton), the latter representing an especially disjunct population. A third fern, *Lindsaea ensifolia* subsp.*ensifolia*, is also known from only two arid-zone populations in Queensland, William Spring (Figure 4) and Dripping Spring on Highlands in the Grey Range.

The Endangered *Microcarpaea agonis* occurs in the wetland at Bore Spring on Idalia. This is only the second known population, the other record being from a seasonal swamp west of Millmerran in 1996. Black tea-tree (*Melaleuca bracteata*) is common further east but is restricted to springs in more arid areas and characterises Tertiary springs from Budgerygar to Stonehenge (Figure 4).

Larger springs support fish populations, including rainbow fish, glassfish, gudgeons and spangled perch. Their ecological significance also lies in providing sources of water in areas that otherwise have little permanent water. Koalas have been observed in the vicinity of some Tertiary springs, including on Stoneleigh which represents the western edge of koala's distribution. Yellow-footed rock wallabies and numerous species of water-dependent birds drink from these small water sources.

Figure 4. *Lindsaea ensifolia* subsp. *ensifolia* at William Spring, Carisbrooke (left), and black tea-tree forest at Arno Spring, north-west of Yaraka

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