

2021 Eyre Peninsula Groundwater Dependent Ecosystem Report Cards

Overview and Red Gum GDE Condition Summary

Why are we checking on the health of Groundwater Dependent Ecosystems?

One of the objectives of the [Water Allocation Plan \(WAP\) for the Southern Basins and Musgrave Prescribed Wells Areas \(PWAs\) \(2016\)](#) is to minimise the impact of the licensed take of groundwater on ecosystems that depend on the prescribed groundwater resource, collectively known as Groundwater Dependent Ecosystems (GDEs). The WAP aims to keep risk from licensed groundwater extraction to the GDEs low, maintaining the GDEs in the condition, and at the locations and extents they occurred at in 2016. To ensure this aim is achieved, the Eyre Peninsula Landscape Board has developed a program to monitor changes in flora condition and/or extent, as well as groundwater levels, at a group of GDEs within the Southern Basins and Musgrave PWAs. Changes are measured against a 2016 baseline, and results are interpreted to identify possible impacts of licensed groundwater extraction on the GDEs since 2016.

What are Groundwater Dependent Ecosystems?

GDEs rely on groundwater to meet all or some of their water requirements to sustain the diverse communities of plants, animals, fungi and microbes which live in them. Groundwater provides a vital and reliable source of water to all GDEs, whether they are entirely dependent on groundwater, or only need groundwater seasonally or episodically (irregular or occasional water). This is particularly true on the Eyre Peninsula because of the generally low rainfall environment and the lack of surface watercourses in the region.

A number of studies (found [here](#)) have identified two types of representative GDEs as priority for monitoring on the EP. The first, Red Gum (*Eucalyptus camaldulensis*) woodlands, are entirely or partially reliant on groundwater. Red Gums are deep rooted plants that are able to switch between water sources depending on availability. They use surface or soil water during wet conditions and can be entirely dependent on groundwater during drought conditions. The second type of priority GDE is wetlands. These receive seasonal, intermittent or continuous groundwater contribution and are often dominated by plants such as Tea-Trees (*Melaleuca spp.*) and reeds. These ecosystems are both relatively well understood, and there are established methods for monitoring them.

What affects GDE health?

Changes in groundwater quantity (e.g. depth, extent, duration) and quality (e.g. salinity) affect the condition and survival of GDEs. The GDE monitoring program therefore aims to relate the condition of GDE vegetation to groundwater levels and quality. Changes in groundwater can be caused by factors we cannot control, such as changes in rainfall and temperature, but also by factors we can control, such as the extraction of groundwater. In the PWA, groundwater extraction is controlled through implementing the [WAP](#). The WAP sets out the principles governing how groundwater

should be shared fairly to benefit communities, GDEs and economic development. To make sure the WAP is working, it is reviewed every five years. The results of the GDE monitoring program are one factor taken into account during these reviews. If we find the extraction of groundwater is negatively impacting the GDEs, then the rules governing extraction will be modified.

Selection of monitoring sites

The GDE monitoring program has been designed so that the effects of factors we can control (water extraction) can be distinguished from those we cannot (climate variability). We therefore monitor licensed extraction sites, located in the areas that can be influenced by water extraction activities, and also monitor control sites. Control sites are located where conditions are similar to those at the licensed extraction sites, except they are located outside the areas that can be influenced by water extraction. We can identify the effects of uncontrollable influences at the control sites. Then, comparing the control sites to the licensed extraction sites, we can distinguish any additional effects that are caused by water extraction. Five Red Gum GDE sites (three licensed extraction and two control) and two wetland GDE sites (one licensed extraction and one control) have been selected for monitoring.



Location of GDE monitoring sites

How is Red Gum GDE condition measured?

To monitor the condition of Red Gum GDEs, the condition of individual Red Gum trees is measured using a [method developed by Nick Souter](#) (2018). For each tree, characteristics such as leaf extent, leaf density, leaf die off, growth at branch tips, and the presence of flowers and seeds, are assessed visually and given a score using a standard system. The characteristic scores are used to calculate a Red Gum Condition Index (RCI) score for each tree. At each site 50 trees are assessed, and the average RCI score is calculated for the site. The same 50 trees are assessed annually at each site, and the average RCI score for the site is compared to that from previous years. We can thus determine whether there has been a change in the average Red Gum condition at the site over time.

Groundwater and climate data

At both wetland and Red Gum GDE sites, monitoring wells with data loggers and rainfall gauges have been installed. These are used to monitor groundwater levels and rainfall amount and intensity at the sites. Regional climate data such as maximum daily temperatures and historic rainfall data from nearby weather stations is also analysed.

What do we do with the monitoring data?

For each of the GDE sites, report cards are produced annually and published on the Eyre Peninsula Landscape Board website. These report cards present the results of the GDE monitoring program, evaluating any changes and trends in GDE vegetation condition, groundwater level and rainfall at the site. The Red Gum GDE report cards presenting the results of monitoring are published annually. Report cards for the wetland GDEs are under development and will be published soon.

The findings from the monitoring program are interpreted to determine the likely causes of any changes in GDE condition. If it is found that there is a decline in groundwater levels and a decline in GDE condition at the licensed extraction sites, but not at the control sites, then it is possible the decline is caused by extraction of groundwater. If this occurs, then this will trigger further investigation, a review and possible amendment of the WAP to ensure the objective to maintain the health of GDEs is achieved.

Summary results of 2021 Red Gum GDE monitoring

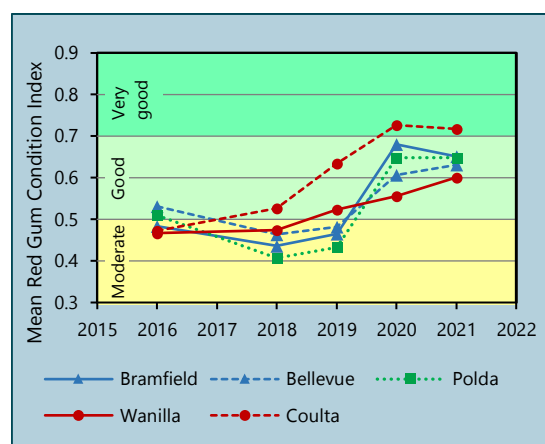
Monitoring results show that in the Musgrave PWA there has been no negative impact of licensed groundwater extraction on the Red Gum GDEs between October 2016 and October 2021. Following a net improvement in Red Gum condition between 2016 and 2020 at both the extraction sites (Bramfield and Polda) and the control site (Bellevue), Red Gum condition has remained stable and good during 2021 (see table and Graph 1).

Red Gum condition at Wanilla has improved every year since 2016 and remained good through 2021. The net improvement in Red Gum condition at Wanilla for the 2016 to 2021 period is however 11% lower than at Coultas (control site for Wanilla), where condition is very good (see table and Graph 1). A longer data set is however required to determine whether these differences are statistically significant, and what may be causing them if they are.

The maintenance of good and very good Red Gum condition in 2021 at all Red Gum GDE sites has been supported by higher than average total annual rainfall in the Musgrave PWA and higher than average June and July rainfall at all sites. This has resulted in good groundwater recharge, with groundwater water levels at all sites being higher in December 2021 than they were in December 2020. With the exception of Coultas, groundwater levels at all sites do, however, still remain lower than levels in June 2018, when automatic data loggers were installed at bores at all sites.

Monitoring into the future

Tree condition and groundwater level monitoring will continue on a yearly basis. A study is also going to be undertaken in 2022-2023 to confirm definitively whether the Wanilla and Coultas Red Gums are using local groundwater. This will be done by looking at stable chemical isotopes that occur in the local groundwater, and which are a "signature" for a groundwater source, and comparing these to the isotopes occurring in tree sap.



Graph 1 Change in Red Gum Condition Index, 2016 to 2021, at all monitored Red Gum GDE sites

Overview of monitoring results at Red Gum GDEs

Site	Type of Site	Red Gum Condition			Groundwater levels ⁴		
		RCI Score 2021	Condition 2021	Change 2020-21	Trend 2016-21	Change (m) Jun 2018 to Dec 2021	Change (m) Dec 2020 to Dec 2021
Musgrave PWA							
Bramfield	Licensed extraction	0.65	Good	-3%	+17%	-0.33	+0.45
Bellevue	Control for Bramfield ¹	0.63	Good ²	+2%	+10%	-0.27	+0.21
Polda	Licensed extraction	0.65	Good	0%	+14%	-0.49	+0.11
Southern Basins PWA							
Wanilla	Licensed extraction	0.60	Good	+4%	+13%	-0.32	+0.02
Coultas	Control for Wanilla ¹	0.73	Very good ³	-1%	+24%	+0.45	+0.65

¹ No licensed extraction

² Good - RCI of 0.50 to 0.69

³ Very Good - RCI of ≥ 0.70

⁴ Changes at one representative well at each site

For more information

Follow the links below to access other key documents:

- [Water Allocation Plan for the Southern Basins and Musgrave Prescribed Wells Areas](#)
- [A Guide to the Water Allocation Plan, Southern Basins and Musgrave Prescribed Wells Areas, Eyre Peninsula](#)
- [Monitoring, Evaluation and Improvement Plan for the Southern Basins and Musgrave Prescribed Wells Areas Water Allocation Plan](#)

- Access the 2021 site specific Red Gum GDE report cards [here](#)

- Access the full report on assessment of Red Gum condition in 2018 [here](#):

Müller K. L., N.J. Souter and Australian Water Technology (2019). *Eyre Peninsula Groundwater Dependent Ecosystem Data Analysis: Red Gum tree condition data (five sites)*. A report for Natural Resources Eyre Peninsula, Department for Environment and Water, Port Lincoln, South Australia.

Links to other supporting scientific reports can be found [here](#)

DEW (2021). [Musgrave and Southern Basins Prescribed Wells Areas, 2019-20 water resources assessment](#), DEW Technical Note 2021/15

DEW (2021). [Musgrave Prescribed Wells Area, 2019-20 groundwater status overview](#)

DEW (2021). [Southern Basins Prescribed Wells Area, 2019-20 groundwater status overview](#)

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