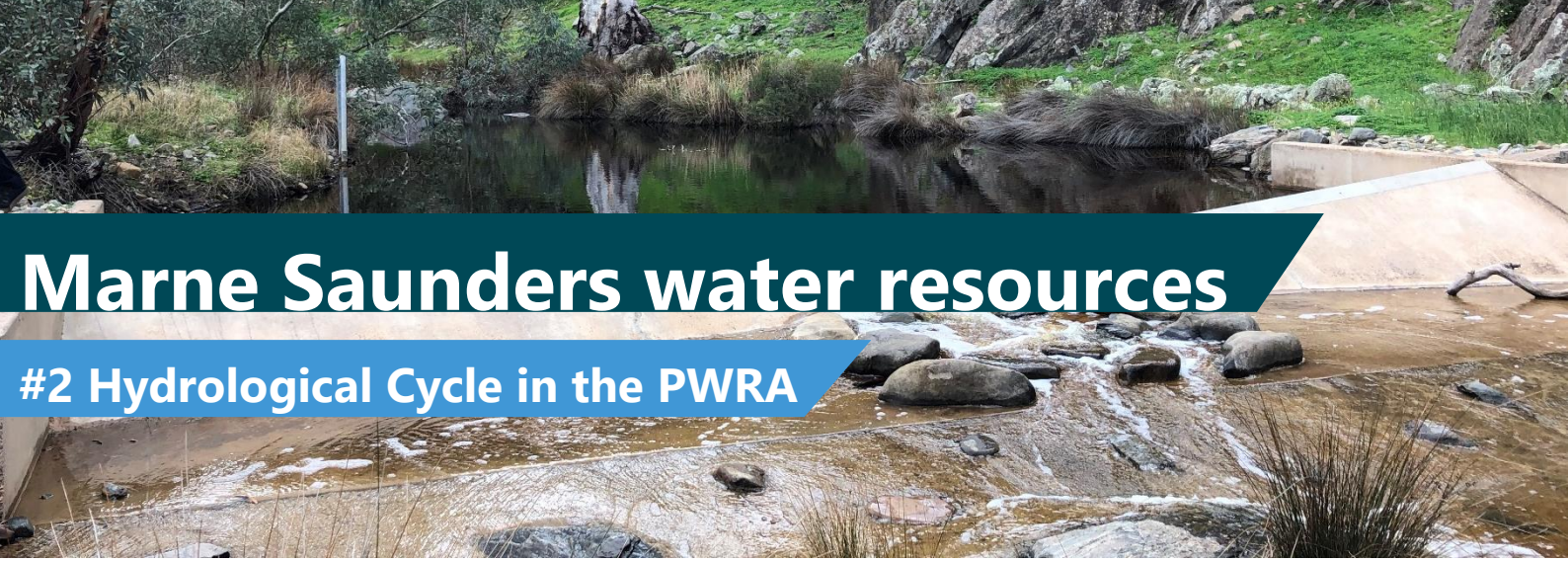


Marne Saunders water resources

#2 Hydrological Cycle in the PWRA

Water resources in the Marne Saunders Prescribed Water Resources Area (PWRA) depend on rainfall which moves through the landscape along a variety of paths. Water resources are strongly interlinked across the area, and actions or changes in one resource can influence another.

An information pack has been developed as an outcome of the Cambrai Water Forum in February 2022. There are 6 papers in the series as supporting information developed for the upcoming meetings in November 2022:

#1: History, Licences, and Allocations

#2: Hydrological cycle in the PWRA

#3: Water development and use

#4: Resource and ecosystem condition

#5: Frequently asked questions

#6: How to address concerns

Overview of water resources and their connections across the Marne Saunders PWRA

The Marne Saunders PWRA can be broadly divided into the hills zone (in the west, with high rainfall) and plains zone (in the east, with very low rainfall), as demonstrated in Figure 1.

Water moves through the landscape along a variety of paths (Figure 2, overleaf). Rainfall is the ultimate source of water in the area. The majority of rainfall leaves the catchment via evaporation or from transpiration by plants.

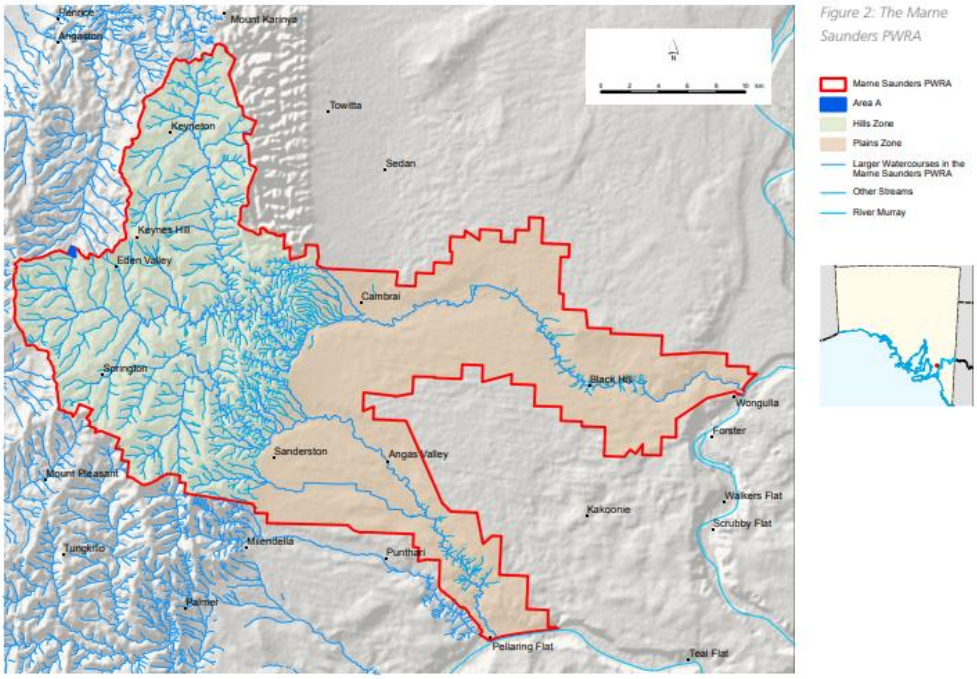
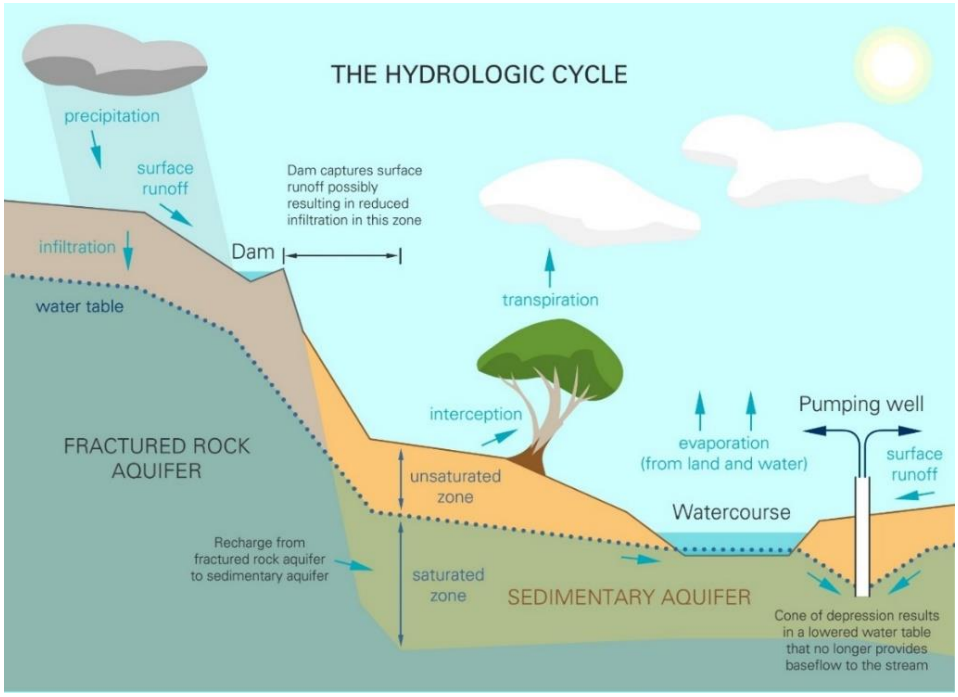


Figure 2: The Marne Saunders PWRA

Figure 1 (right): The Marne Saunders Prescribed Water Resource Area. Orange shading = Plains Zone; Green Shading = Hills Zone

Part of the rain that falls on the ground runs off the land as surface water and makes its way into watercourses. The Marne River and Saunders Creek begin in the high rainfall hills zone, flowing east down the hills, through gorges and then out onto the plains zone, to eventually discharge into the River Murray.



Rainfall and streamflow also seep down into the pores and cracks of water-bearing rock and sediment layers known as aquifers to become underground water (commonly referred to as groundwater). Underground water also flows from higher to lower level, with a general movement of underground water from west to east over the Marne Saunders PWRA.

Figure 2: Paths of water movement through the landscape. Figure courtesy of the former Department for Water, Land and Biodiversity Conservation (DWLBC), and Ecocreative

It is important to note that the different water resources in the Marne Saunders PWRA are strongly interlinked (Figure 2). Actions in one resource can influence another, so they need to be managed together. Surface water running over the land enters watercourses and becomes watercourse water. Underground water can also enter the watercourse as "baseflow" via springs and seeps. Flow in the watercourse can seep through the bed and replenish or "recharge" the underground water. Water can also move between aquifers.

The movement of water through the landscape can be interrupted by water resource development (including dams, weirs and wells), influencing the volume, water quality and pattern of water availability both locally and at the larger scale.

Water resources above ground

Rainfall, and therefore streamflow, is highly variable from year to year. Since 1973, when streamflow measurement began at the gauging station in the Marne gorge, annual streamflow in the Marne River has ranged from zero (in 2018-2020) to 33,500 megalitres (in 1974) (Figure 3, below). Most streamflow comes from the hills where rainfall is highest.

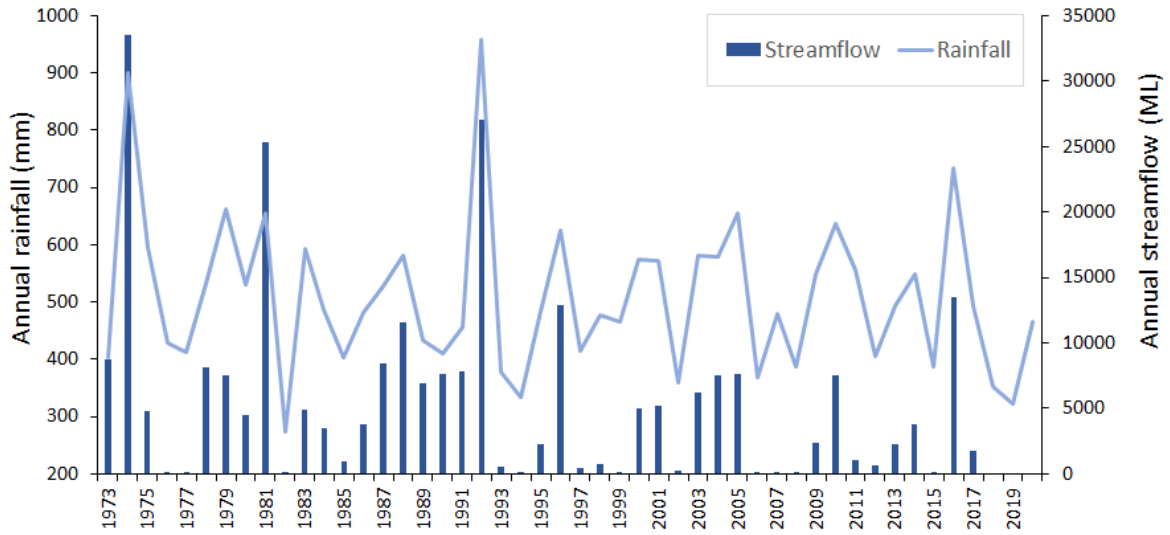


Figure 3: Annual rainfall (Keyneton) and streamflow (Marne gorge) for 1973 to 2020. Data courtesy of Department for Environment and Water.

Flows are strongly seasonal, reflecting the pattern of rainfall, although storm events occur from time to time in drier seasons. Zero flow conditions commonly occur in the drier months, although dry season pools are maintained in some areas by baseflow (inflow of underground water).

Baseflow to watercourses is known to occur throughout the hills and also in some plains locations, such as Black Hill Springs in the Marne River and near Lenger Reserve in Saunders Creek.

Local shallow aquifers in the Black Hill area are thought to be important contributors of the baseflow that maintains the Black Hill springs. Streamflow to the area is important to recharge these local aquifers, and requires a large amount of flow to traverse the stream across the plains. Analysis of flow monitoring data shows that at least 4,000 ML of cumulative annual flow at the Marne gorge is required before streamflow will reach Black Hill.

Water resources below ground

There are two main types of underground water aquifers in the Marne Saunders PWRA: the fractured rock aquifer in the hills and the sedimentary aquifers in the plains.

The fractured rock underground water in the hills generally flows to the east and recharges the sedimentary aquifers at the base of the hills (Figure 4, below).

There are three sedimentary aquifers on the plains, each at a different depth. Figure 4 shows the aquifers from shallowest to deepest:

- Quaternary aquifer
- Murray Group Limestone aquifer
- Renmark Group aquifer

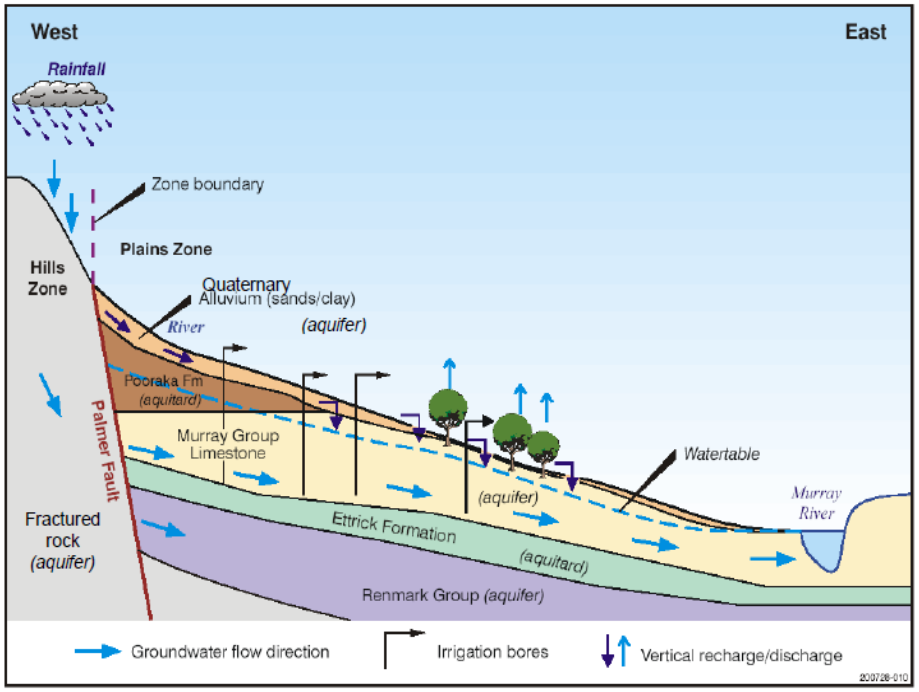


Figure 4: Cross section of key aquifer locations across the Marne Saunders catchment

Currently all licensed water use is from the Murray Group Limestone aquifer.

The limestone aquifer has two major sections: an unconfined section (open to the above soil layers and atmosphere via pores in the rock), and a confined section (covered by impermeable layers of clay deposited by the Pooraka Formation, Figure 4). The confined section of the limestone aquifer lies to the west of Cambrai, while in the east of Cambrai, the aquifer is unconfined (Figure 5, overleaf).

It is important to note that these two sections of the Murray Group Limestone aquifer are recharged by different sources. Streamflow is responsible for the majority of recharge in the unconfined limestone aquifer (east of Cambrai) with minimal recharge also being provided by the low amount of local rainfall.

Impermeable layers called aquitards (such as the Pooraka Formation) restrict streamflow from reaching some aquifers on the plains, such as the western confined section of the Murray Group Limestone aquifer; and the deeper Renmark Group aquifer. Both of these aquifers are thought to be recharged by underground water moving from the fractured rock aquifers of the hills zone, rather than by streamflow.

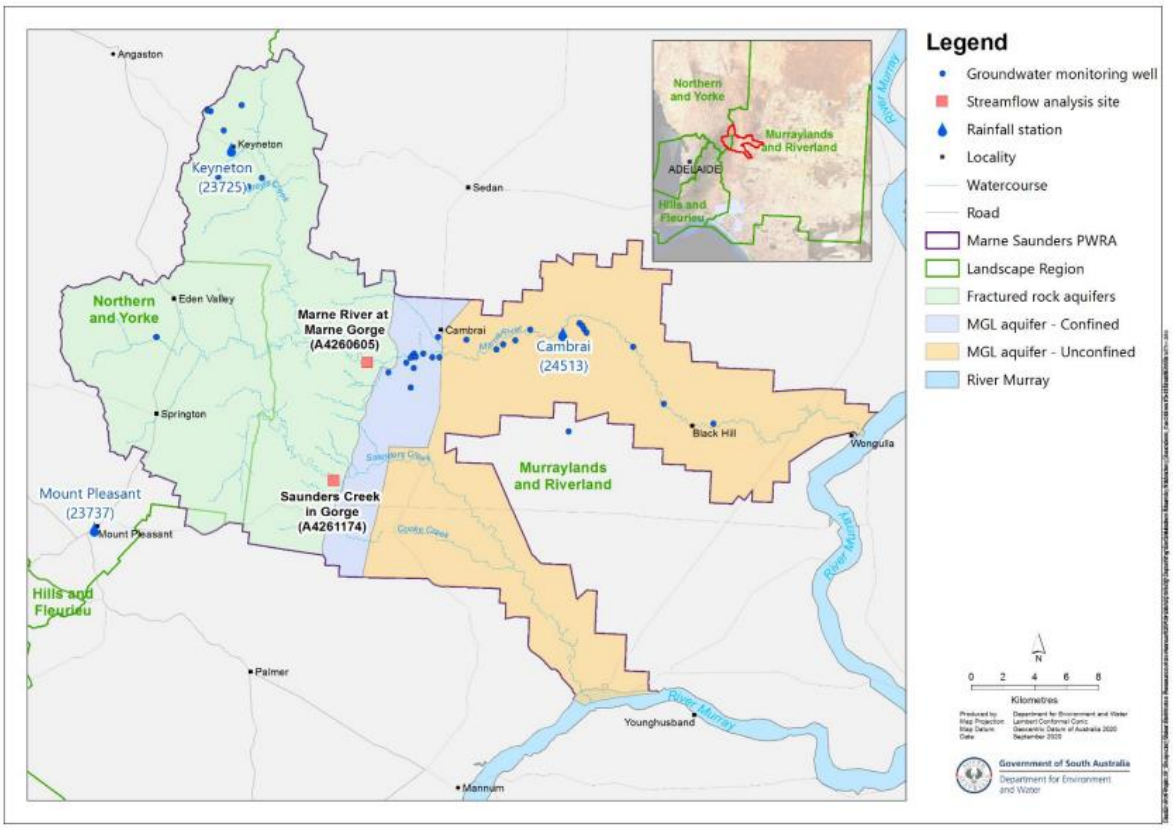


Figure 5: Aerial view of locations of the three key aquifers within the Marne Saunders PWRA: Green shading = Fractured Rock Aquifer; Purple shading = Confined Murray Group Limestone; Yellow shading = Unconfined Murray Group Limestone

More information

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https://www.landscape.sa.gov.au/mr/water/water-allocation-plans/marne-saunders