The hydrogeological process (movement of water through rocks) is complex. The Bet Bet area is dominated by Ordovician deep marine metasediments and is the basement rock. It is an ancient, hard and fractured sedimentary rock in which groundwater is confined to local systems with strongly recharge in winter-spring. This behaviour is indicative of upland fractured rock systems where there is strong connectivity to surface climatic processes.

There is minor outcropping of basalt on the eastern fringe of the Bet Bet targeted area. This is the result of volcanic eruptions and subsequent basalt flows of Mount Mitchell and surrounding volcanic cones, which has caused extensive drainage disruption in the neighbouring catchment.

Salinity processes occurring in the Bet Bet targeted area are shallow local groundwater systems, mostly developed in the sandy weathered material (colluvium) overlying hard fresh granite and the shallow fractured rock groundwater systems associated with the sedimentary hills in the central Bet Bet targeted area.

A veneer of low permeability clay covers much of the granite so that the bulk of the groundwater movement in this granite aquifer occurs within the top metre or two. Seasonal waterlogging is common.

In interpreting long-term groundwater trends, account must be made for climatic variation, therefore a monitoring period of 10 years or more is desirable. Groundwater levels tend to fluctuate seasonally, with heights of recharge peaks corresponding to the amount and timing of rainfall.

There is strong correlation between the falling groundwater levels and the low rainfall period. This largely is due to the fact that in the Bet Bet targeted area, groundwater occurs in local to intermediate groundwater systems rather than regional systems and are affected by local climatic variation. This strong response to climatic variation is reflected as a common feature of most of the groundwater hydrographs.

This combined information helps to develop a conceptual model of the Bet Bet targeted area. The ultimate goal of the project is to help understand the processes occurring that lead to the land degradation problems in the catchment. Knowing how problem has arisen helps to determine the best remediation techniques.

Monitoring in the Bet Bet targeted area

The fundamental purpose of monitoring is to determine long-term trends within a catchment, especially in relation to modified land management practices aimed at mitigating dryland salinity. The collated data can then be related to current land and water use generally to develop management strategies to reduce the risk of rising watertables, salinity, stream salt load, erosion and soil degradation.

In the Bet Bet area the focus on monitoring has expanded to include photo point monitoring (in middle pages). This will help by monitoring any visual changes in the landscape. Along with this, stream quality monitoring will be undertaken. To compliment the current groundwater monitoring network, a series of new groundwater monitoring bores have been installed to fill in data gaps. This style of monitoring provides a 'whole of catchment' approach to studying physical processes.

Groundwater monitoring

There have been 16 DPI piezometers in place since the mid to late 1980s to monitor groundwater conditions. Five new groundwater monitoring bores have been installed as part of the Loddon targeted works to fill in gaps in the monitoring record and areas where monitoring is lacking in the Bet Bet area. Groundwater trends observed in hydrographs in the Bet Bet targeted area all have a common factor. They all show a strong falling groundwater trend from 1996 to the present time.

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Salinity information can be viewed on the DPI website:
http://www.dpi.vic.gov.au/catchmnt/salinity/dryland]

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DEPARTMENT OF
PRIMARY INDUSTRIES

Bet Bet

June 2003

Bet Bet targeted salinity project

Environmental issues in the Bet Bet targeted area

There are significant areas of the Bet Bet targeted area that have succumbed to the effects of rising saline groundwater. Salinity occurs in the main drainage tributaries due to increased saline groundwater inflows. Community assets and productive farmland are in danger from the effects of salt.

The effects of salt are realised in more than just the targeted area itself. Salt load in streams leaving the catchment discharges into the Loddon River, ultimately increasing the overall salt load entering the Murray River

Severe salinity and erosion on Yalong Road

The Bet Bet targeted salinity project is a joint project with the Bet Bet (Lexton) community, the Department of Sustainability and Environment (DSE), the Department of Primary Industries (DPI), the North Central Catchment Management Authority (NCCMA) and Sinclair Knight Merz (SKM)

The project aims to control salt by minimising salt wash-off and reduce groundwater recharge. To understand the areas to be targeted in this manner, it is imperative to understand the hydrogeological processes that cause dryland salinity.

The aim of this brochure is to explain the hydrogeological processes operating in the Bet Bet targeted area, and describe monitoring systems established to further understand processes and monitor project progress.

The type of monitoring undertaken are measuring groundwater levels, stream quality, saline discharge and land use change.

Hydrogeological processes in the Bet Bet targeted area

The Bet Bet targeted area lies in the south-west corner of the Loddon catchment. The western boundary of the Bet Bet targeted area is defined by the high relief southern granite ridges of the Ben Moore and Ben Major ranges on the catchment and groundwater divide between the Loddon and Avoca catchments. The eastern boundary of the area is defined by the sedimentary ridge that abuts the basalt flows of Mount Mitchell and surrounding cones.

The Lexton area was one of the earliest recognised salinity affected areas in the Loddon dryland area. Dryland salinity was first recognised in the mid 1980s. The Bet Bet targeted area (around Lexton) is a priority area as far as salinity management is concerned as it contains some of the most prolific and devastating gully erosion in the Loddon catchment.

There are two types of saline discharge:

- salinity that occurs within tributaries as break-of-slope salinity,
- salinity within the tributaries associated with runoff and saline discharge from the Ben Moor and Ben Major granite ranges.

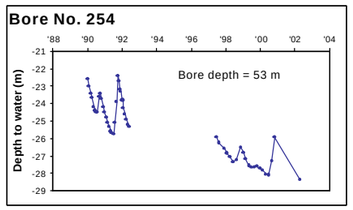
Break-of-slope salinity is associated with the granite as well as the sedimentary hills within the Lexton area.

In the Bet Bet targeted area surface water leaves the catchment via Burnbank and Bet Bet creeks. Bet Bet Creek is the main tributary draining surface water and groundwater from the targeted area. This eventually drains into the Laanecoorie Reservoir.

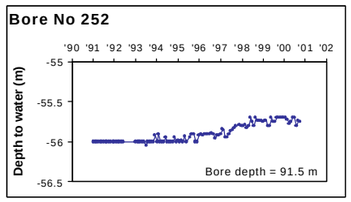
HYDROGEOLOGICAL PROCESSES IN THE BET BET TARGETED AREA

GROUNDWATER HYDROGRAPHS

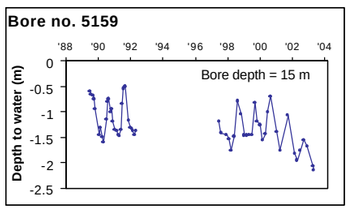
A graph of groundwater levels against time is usually referred to as a *hydrograph.* The pattern of water level variation in a hydrograph is dependent upon the nature of the groundwater system. As well as indicating long-term trends, the hydrograph often also fluctuates according to the seasons. A peak is commonly observed in winter/ spring as a result of recharge during this period. Where there is minimal seasonal fluctuation, only minor recharge to the watertable is suggested, though soil waterlogging or excess runoff may then be significant issues.



Hydrograph shows overall falling groundwater trend with strong response to season climatic variation. Missing data between 1992 to 1998.



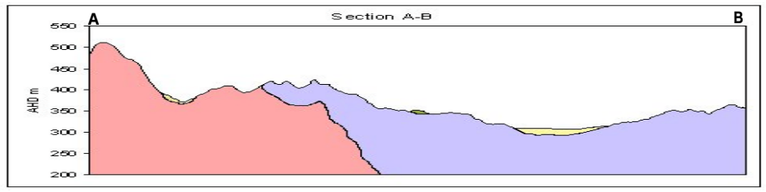
Hydrograph shows an overall rising groundwater trend with slight response to season climatic variation. This is the only bore in the Bet Bet targeted area that shows a rising groundwater trend. It is located on the metamorphic ridge on the groundwater divide between the Avoca and Loddon catchments.

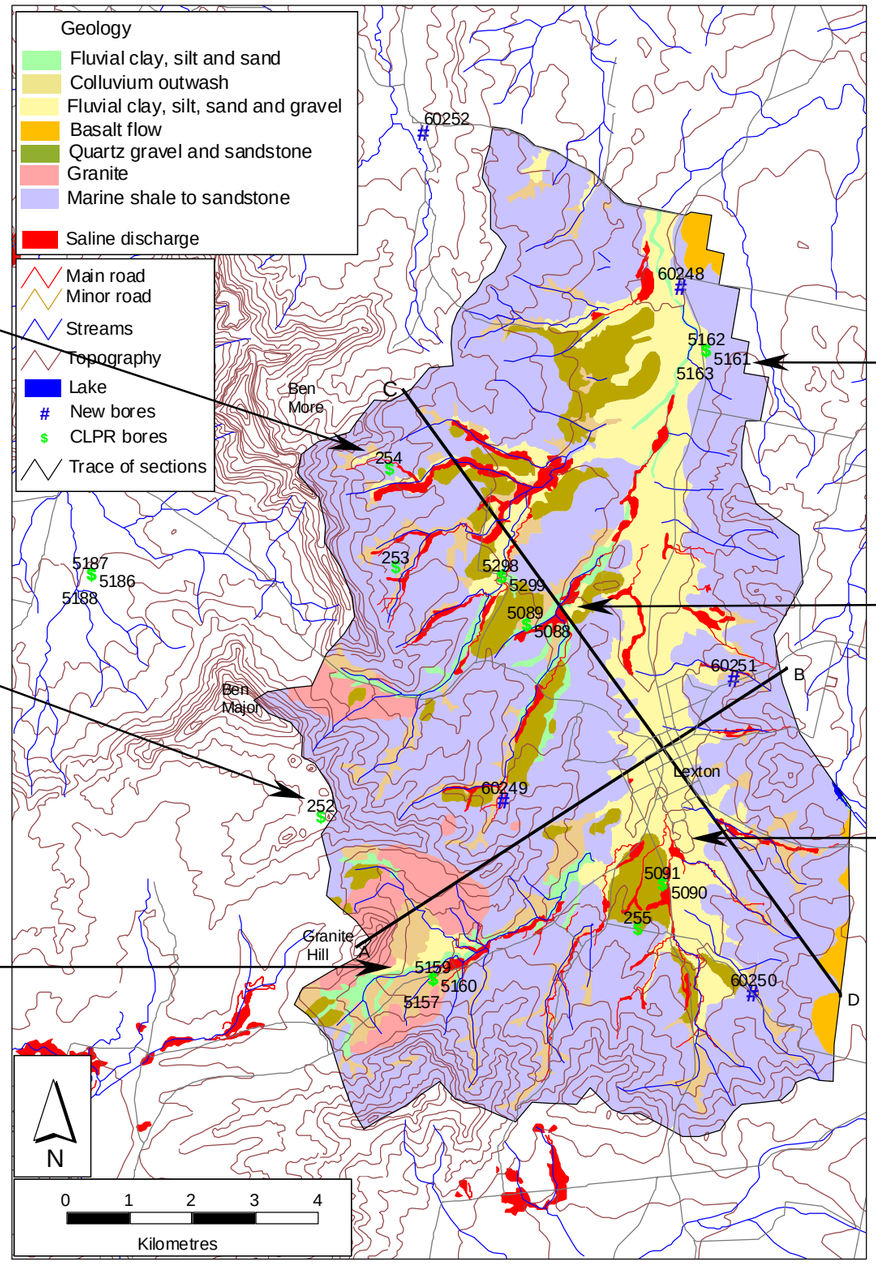


Hydrograph shows an overall falling groundwater trend with strong response to season climatic variation.

KEY BORES

Twenty-one monitoring bores are available in the Bet Bet targeted area to assist in the analysis and reporting of groundwater trends. The bore hydrographs shown here have been selected on the basis of representative trends within a monitoring network and geographic distribution, as well as quality and length of monitoring record.





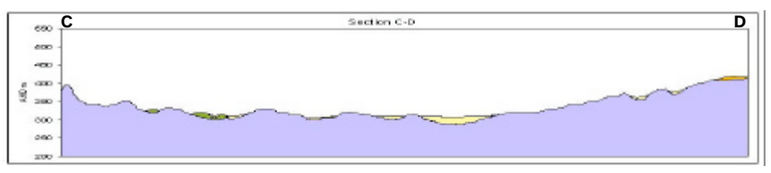
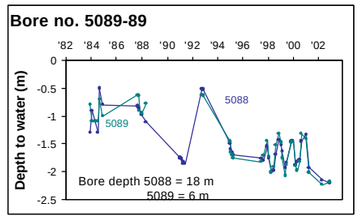


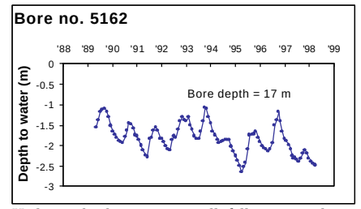
PHOTO POINT MONITORING

This technique is based on a methodology developed in WA for monitoring vegetation and effects of revegetation projects. The aim of photo point monitoring is to use the photographs as an easy method of comparison to record change over time, therefore when the initial photo is taken a clear idea of expected change (e.g. saline area revegetated). A series of photographs taken at the same site over a period of time can provide solid evidence of how that site has changed over time as a result of management decisions.

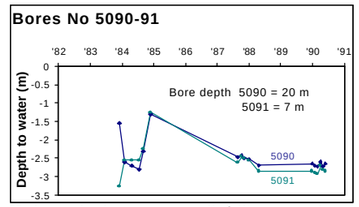
Salinity and gully erosion on drainage line off Yalong Rd



Hydrograph shows an overall falling groundwater trend.



Hydrograph shows an overall falling groundwater trend with strong response to season climatic variation.



Hydrograph shows an overall falling groundwater trend. This bore is located above a discharge site. Interesting to note that bore 5090 is the deeper bore, but has a higher waterlevel that bore 5091.

RAINFALL GRAPHS

The bar graphs in the rainfall chart below indicates the average yearly rainfall from 1980 to 2002. The annual average rainfall for the Lexton station is 611 mm/ yr. From 1994 the annual rainfall for the Lexton station has continued to fall below the yearly average.