

surface is a subsurface basalt flow. This corridor of basalt (that runs beneath the surface from Bet Bet to Wareek) possibly has a significant impact in this catchment. This basalt in some parts is less than 5 m from the surface. The permeability of the basalt is higher than the overlying alluvial plains and likely facilitates preferential groundwater movement in a north-easterly direction.

Infiltration into deep leads occurs where there is hydraulic connection to other aquifers or the surface. Beneath the basalt (in parts) and the alluvial plains are the Madam Hopkins, Great Duke and Bet Bet deep leads, which are part of the Loddon Deep Lead Group.

### Monitoring in the Timor West targeted area

In Timor West the focus on monitoring is expanding to include stream quality and photo point monitoring (see inset). Along with the current groundwater monitoring network, a series of new monitoring bores have been installed to fill gaps and compliment the current monitoring system. This style of monitoring provides a 'whole of catchment' approach to monitoring physical processes.

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

### Stream monitoring

There are six stream quality monitoring stations, five of which (see inset) are pertinent to the Timor West targeted area. The local Landcare facilitator has monitored three of these stations since 1996, another three are new and have only been monitored for the past 12 months. Monthly measurements taken at these sites include salinity, turbidity and soluble phosphate levels.

The graph for BET020 (see inset) shows that the salinity content of Bet Bet Creek at Timor can fluctuate from 1000 EC to 5000 EC in a 12 month period. The salt concentration decreases after rainfall episodes as rainfall dilutes the creek's overall salt content. Current baseline (average) EC for Bet Bet Creek at this station is 4000 EC.

Groundwater and stream salinities in the lower Timor West targeted area are high. Stream salinities in Emu Creek, were greater than 20 000 EC when measured in late 2002.

This is likely to be caused by saline discharge at the base of the Mount Hooghly granite. Groundwater salinities decrease to the south. This is likely to be due to the better quality of water found in the basalt, which has a lower EC than groundwaters in the granite and overlying Shepparton Formation (alluvials).

### Groundwater monitoring

In interpreting long-term groundwater trends, account must be made for climatic variation. Groundwater levels tend to fluctuate seasonally, with heights of recharge peaks corresponding to the amount and timing of rainfall.

Up until spring 1996, hydrographs show peaks and troughs according to rainfall patterns, with underlying rising or flat

groundwater trends. However, since spring 1996 the groundwater levels have dropped significantly and this is reflected in the hydrographs showing an overall fall in water level across the Timor West targeted area.

This combined information will help to develop a conceptual model of the Timor West targeted area, the ultimate goal being to improve understanding of the processes occurring that lead to environmental degradation problems in the catchment. Knowing how the problem arises helps to determine the type and location of effective remediation techniques.

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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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# Timor West

June 2003

## Timor West targeted salinity project

### Salinity issues in the Timor West targeted area

There are significant areas of the Timor West targeted area that have succumbed to the effects of rising groundwater and salinity. Salinity occurring in the main drainage tributaries is 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 into the Murray River.

The Timor West targeted salinity project is a joint project involving the Timor West community, the



Carmanual Creek

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 reducing 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 Timor West targeted area, and to describe monitoring systems established to further understand these



processes and monitor project progress.

The type of monitoring ranges from measuring groundwater levels, stream quality and saline discharge sites to land use change.

### Hydrogeological processes in the Timor West targeted area

The Timor West area lies in the south-west of the Loddon catchment. In the north (Bealiba Range), west (Black Range) and central (Mount Hooghly) areas prominent ridges define the catchment boundary. Between these ridges lie broad alluvial plains incised by drainage lines of the Green Hill, Emu and Carmanual creeks (refer to section A-B on inside map).

Salt was first identified on the slopes of Wiseman Hill (Black Range) in the late 1970s when a plot of lucerne was planted in an attempt to reduce groundwater recharge and thus reduce saline groundwater discharging into streams.

There are two areas of major saline discharge, both are on slopes associated with metamorphic and granite hills.

The hydrogeological process (movement of water through rocks) is complex. In Timor West, surface water leaves the catchment via Emu and Carmanual creeks, then joins Bet Bet Creek (at Bet Bet), that drains into Laanecoorie Reservoir.

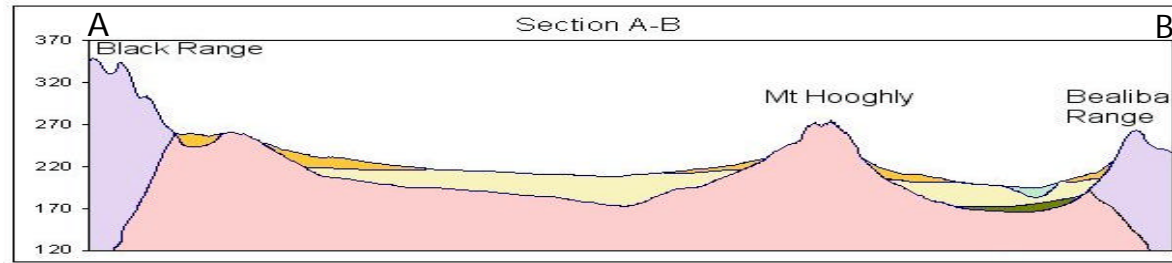
The granite (Mount Hooghly) plays a significant role in surface water runoff and salinity processes in the Timor West area. Much of the groundwater flow in the granite is restricted to weathered clays overlying the hard fresh rock.

At foot slopes, localised and more productive groundwater systems are developed in clayey weathered material (colluvium) overlying fresh granite. Groundwater flow within granite and metamorphic ridges occurs at a local scale in the Timor West area. The adjacent metamorphic ridges contain fractured rock aquifers, occurring on the contact zone between granite and Ordovician slates and sandstones. High recharge is likely to occur on the crests and upper slopes of the metamorphic ridges.

Located beneath the alluvial plains, but close to the

# HYDROGEOLOGICAL PROCESSES IN THE TIMOR WEST TARGETED AREA

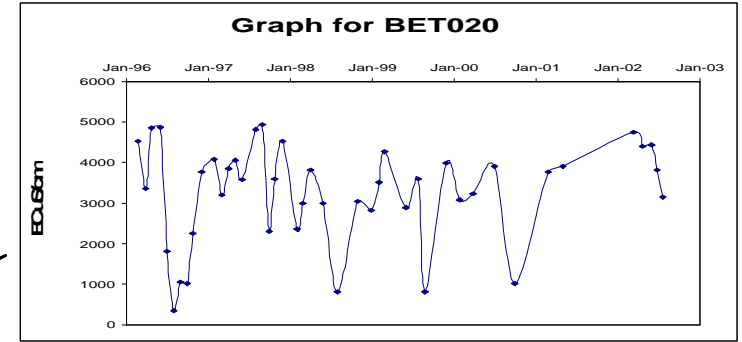
**GROUNDWATER HYDROGRAPHS**  
 A graph of groundwater levels against time is usually referred to as a *hydrograph*. The pattern of water level variation in a hydrograph is dependent upon the nature of the groundwater system. As well as indicating long-term trends, the hydrograph often also fluctuates 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.



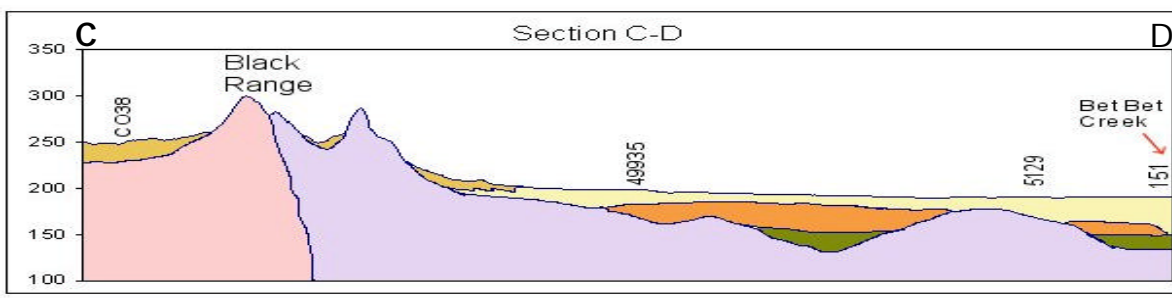
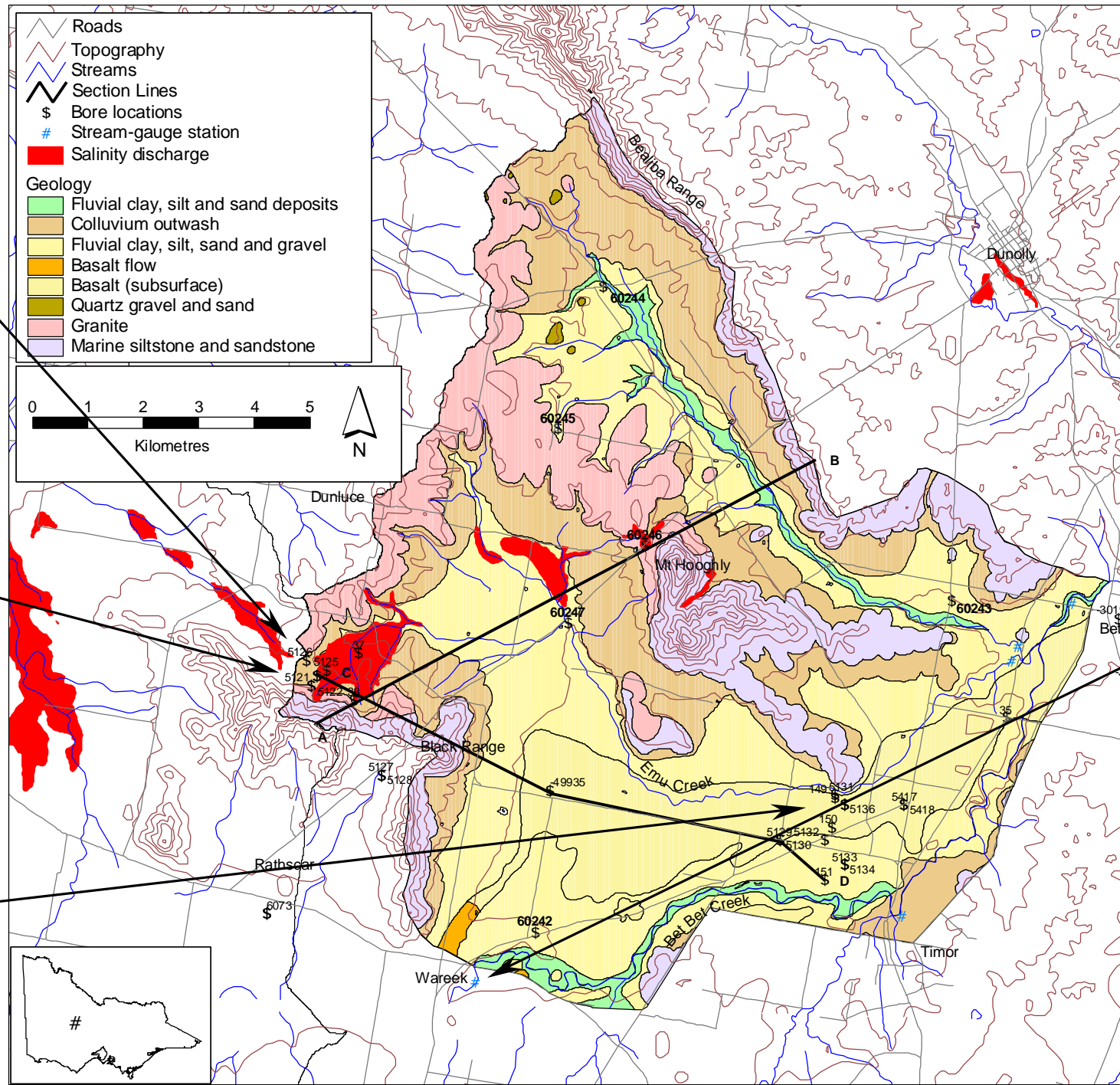
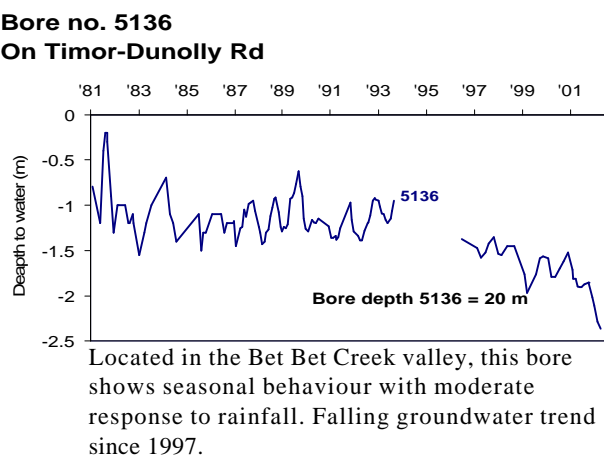
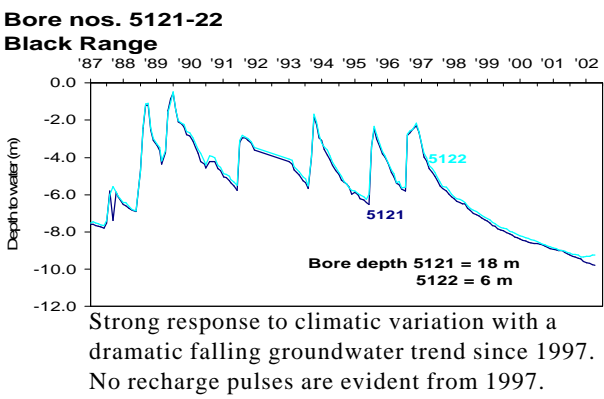
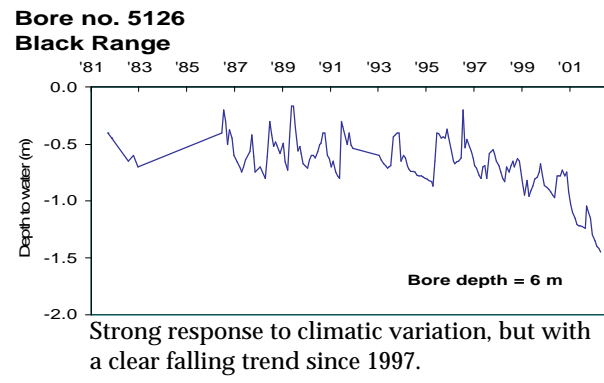
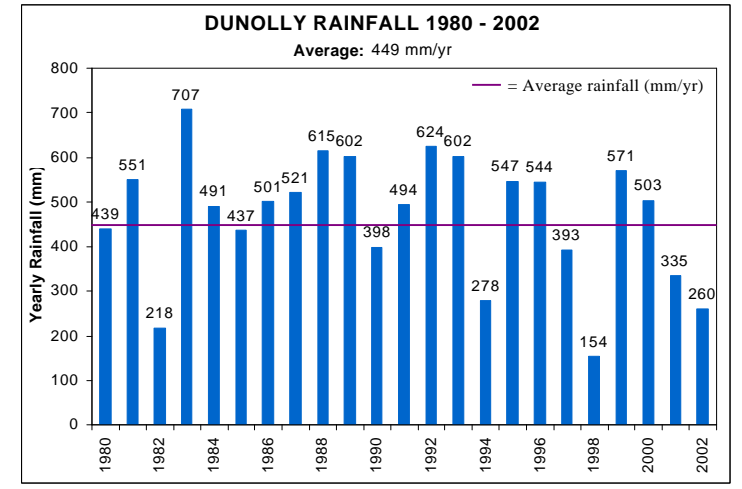
**PHOTO POINT MONITORING**  
 This technique is based on a methodology developed in WA for monitoring vegetation and effects of revegetation projects. The aim of photo point monitoring is to use the photographs as a method of comparison to record change over time. A series of photographs taken at the 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.



**STREAM MONITORING STATIONS**  
 There are six stream monitoring sites located in the Timor West area (five located in the Timor West targeted area appear on this map) on the Bet Bet Creek, Emu Creek and Carmanuel Creek. These have been set-up for ongoing monitoring of water quality as it moves through the Timor West targeted area. Monthly readings are taken of stream salinity and plotted on a graph to display the water quality variation over time.



**RAINFALL GRAPHS**  
 The bar graphs in the rainfall chart below indicate the average annual rainfall from 1980 to 2002. The annual average rainfall for the Dunolly station is 449 mm/yr. The later half of the 1990s were considered dry. Since 1994, there have been five years of significantly below average rainfall. Conversely, there were also two years that exceeded the annual average (1995-96, 1999-2000).



**KEY BORES**  
 Thirty-three monitoring bores are available in the Timor West 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.