MANAGING DROUBT WITHOUT DOUBT

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ABSTRACT

Grampians Region Water Authority is experiencing great pressure through the current period of extended low rainfall.

The drought has impacted the town storage-filling regime for 29 of the Authority's 74 towns located across an area of 60,000 square kilometers. Volumes normally reserved for twelve months or less are being managed to ensure sustained supply for up to fifteen months.

Grampians Water has developed and successfully implemented trigger point modeling. This method of modeling allows excessive consumption to be detected ensuring timely initiation of action to minimise restrictable demand. Trigger point modeling ensures a higher degree of security while keeping the impact on customers to a minimum.

The data presented will identify the success of the practices discussed illustrating how Grampians Region Water Authority manages drought without doubt.

1.0 INTRODUCTION

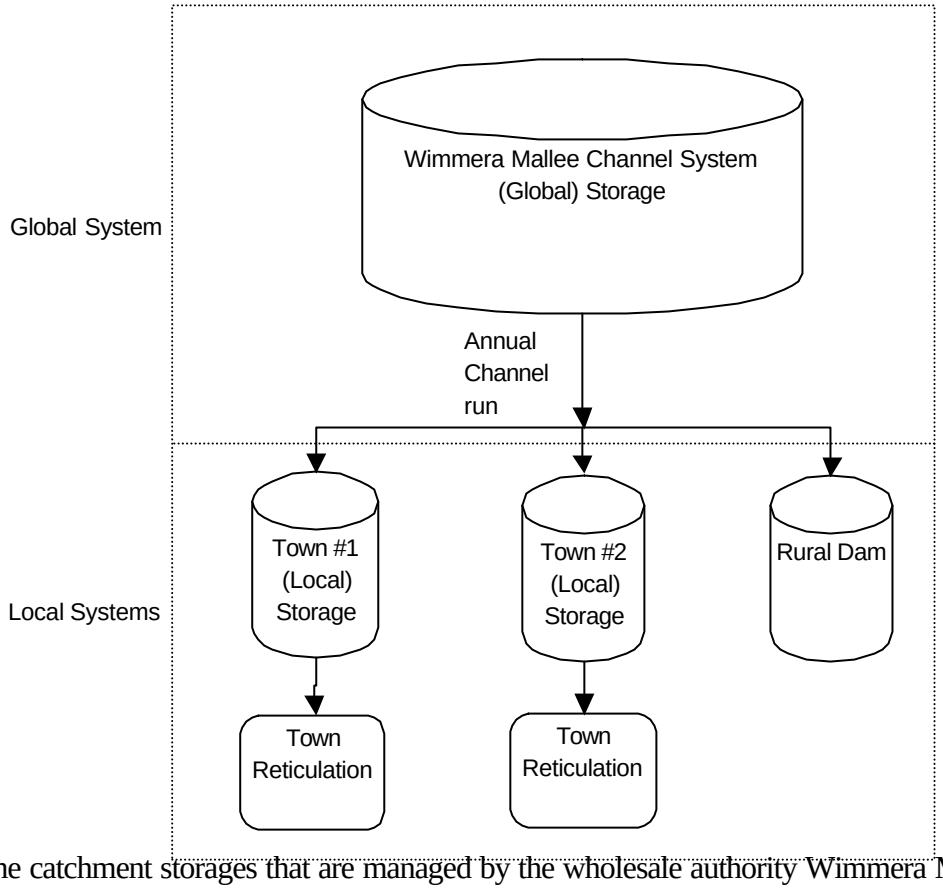
Grampians Water provides water to 74 towns over 60,000 square kilometers of the North West of Victoria. The supply of bulk water comes from five main sources including:

- The Wimmera Mallee Channel System (33 towns, 7 towns partly);
- The Northern Mallee Pipeline (13 towns);
- Normanville Pipeline (1 town);
- Harvested Ground Water (13 towns, 5 towns partly);
- Harvested Local Surface Water. (2 towns, 11 towns partly).

Runoff in northwestern Victoria has been extremely low since 1996 resulting in extremely low reserves in the majority of surface water storages. This has led to implementation of extensive drought response actions across the region. The actions undertaken have differed from system to system. This paper focuses on the twenty-nine towns that receive an annual channel fill to storage from the Wimmera Mallee Channel System.

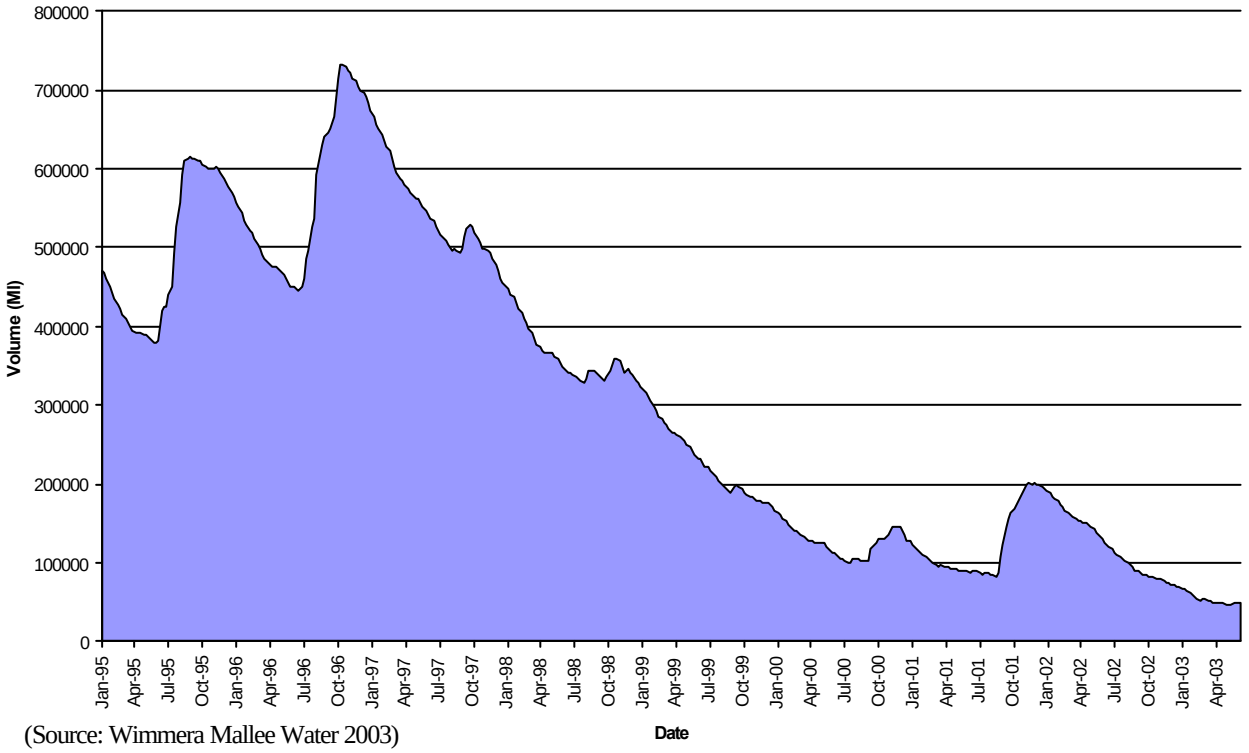
The town storages are operated as balancing basins, which receive water sufficient to supply the town until the next fill arrives, which is usually in around twelve months. A schematic of the system is shown in Figure 1 below.

Figure 1: ***Schematic layout of channel supply to towns***



The catchment storages that are managed by the wholesale authority Wimmera Mallee Water have suffered markedly under the current drought conditions. The following chart shows the drawdown and filling pattern of the storages over the 8 years since 1995.

Figure 2: ***Wimmera Mallee Channel Supply – Volume in store***



(Source: Wimmera Mallee Water 2003)

The Wimmera Mallee Water Annual Report for 1995/96 indicates that the annual channel run loses two thirds of the volume released to evaporation and seepage. Therefore reducing the period of

channel run, which means altering the schedule of town and rural dam fills reduces losses from the system.

In addition, any delay in the filling schedule allows for the possibility of storage inflow prior to deliveries and therefore there is the potential to supply additional water to rural users.

To take advantage of this, Grampians Waters' wholesaler altered the supply schedule. In some instances the alterations required Grampians Water to manage town storages for an extended period. The volume in store had to supply some towns for fifteen months instead of the typical supply period of twelve months.

2.0 PROBLEM

One of Grampians Waters' key objectives is to provide good customer service. This meant that in managing the drought, Grampians Water had to ensure a continual supply of water while at the same time have a minimal impact on customers.

During the development of the Drought Response Plan there were two main problems identified when trying to achieve this objective.

The first problem was to determine what were the most appropriate drought response actions available to:

- ensure a secure supply to Grampians Water customers; and
- ensure that there was sufficient water in storage to cater for the additional demand created by potential emergency use by the rural sector through water carting.

The second problem was to determine the most appropriate time to implement those actions to ensure minimal impact upon Grampians Water customers and the operation of the organisation itself.

3.0 SOLUTION

Grampians Water identified loss mitigation and demand management as the major potential actions available for conserving water in town storages. Furthermore it was thought that the most effective demand management strategy would incorporate a customer education program in conjunction with urban water restrictions

Grampians Water developed a detailed, but relatively simple, trigger point modeling method that incorporated all of the above actions and their timely implementation.

The trigger point models developed were essentially storage drawdown targets consisting of time series curves that show the anticipated volume of water in a particular storage over time, which is then overlaid with the actual drawdown curve for the storage. Comparing the position of the target curve with the actual drawdown curve then provides a useful tool for assessing the level of security for each town supply, providing the basis for considering response actions and their timing. Figure 4 provides a sample target curve.

4.0 USE AND DEVELOPMENT OF THE STORAGE DRAWDOWN TARGET CURVES

4.1 Demand Management Philosophy

Interpretation and use of the restriction curves requires an understanding of the Grampians Water philosophy towards demand management.

The general philosophy is one of sending a message of water conservation to the customer and then trusting that they will respond positively and responsibly. The aim is to achieve water savings but at the same time offer some degree of flexibility to customers. Increased restrictions were only imposed when the operating targets were not being met. The term "education rather than regulation" was used extensively.

This was achieved by using an education program aimed at influencing customer's attitudes towards water conservation coupled with the timely announcement of water restrictions, which was seen as part of that program.

4.2 Development of Storage Drawdown Target Curves

The Storage Drawdown Target Curves were developed based on historical storage drawdown and consumption data.

Step1
The first step was to forecast consumption for each town under each restriction level. The consumption was estimated by multiplying the average weekly consumption by the estimated savings factor for each restriction level. This was based on historical experience and anticipated impacts of customer education.

Step 2
The next step was to forecast average losses from storage. These were determined by subtracting average weekly consumption for each town from the average weekly storage drawdown.

Step 3
A "critical end" storage target was then determined for each town. This particular target contained two key parameters, namely:

- The date of the next scheduled fill; and
- The lowest operating level in the storage.

Step 4
The next step then was to develop the storage drawdown target curve against a timeline. This was done simply by starting from the "critical end" target and working backwards on a weekly basis using the following water balance formula:

Target volume at end of this week = Target volume at the end of the next week
+ the next week's consumption
+ the next week's losses.

4.3 Using the Storage Drawdown Target Curves

Keeping in mind Grampians Waters' demand management philosophy the following table was used in conjunction with the target curves to determine the status of the storage and the basis of any action required.

Storage Status	Actions

Line	Restriction Level	Education Program
Above dotted	None	Ongoing
On dotted	Minor	Ongoing
Below dotted & above dashed	Minor	Detailed
On dashed	Moderate	Detailed
Below dashed & above dark dotted	Moderate	Intensive
On dark dotted	Harsh	Major, focusing specifically on the town

5.0 PERFORMANCE

There are a number of indicators that have allowed Grampians Water to effectively measure how the drought has been managed during the 2002-2003 summer period.

The fact that no town has required to be supplied via an emergency arrangement up to June 2003 and very few customer complaints relating to restriction levels have been recorded indicates that the key objective of customer service has been accomplished.

A case study has been completed on the township of Hopetoun, which has been used by way of an example to further illustrate the effectiveness of the complete Drought Management Plan including the application of the Storage Drawdown Target Curve.

5.1 Review of Historical Climatic Data

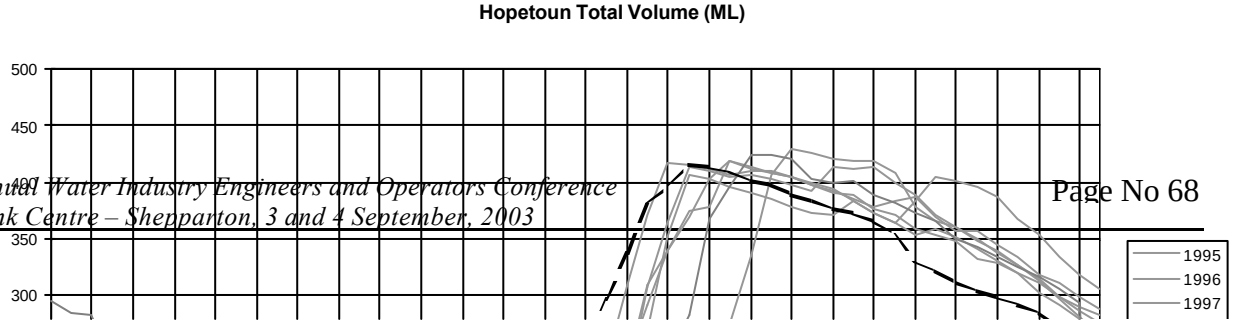
Grampians Water undertook a review of climatic data for Horsham using maximum daily temperatures and rainfall, which emphasized the impact the drought response actions has had in the region including Hopetoun. The review compared weather patterns of the 2002-2003-peak demand period (from November to March inclusive) with others to determine how "hot" and "dry" it was. Temperature data from 1991 to current was evaluated using average maximum daily temperature for the month. Rainfall data was evaluated for the entire 130 year record using monthly rainfall.

The review revealed that the 2002-2003-peak demand period was relatively "hot" and "dry". The period was considered to be the second "hottest" summer in the last 12 years behind only the 2000/01 period. It also showed that the rainfall total for the period was below the median but included one significant rainfall event in February. Rainfall in January and March 2003 were dryer than 90 percent of those months reviewed in 130 years.

5.2 Comparison of Storage Drawdown Against Historical

Figure 3 below is a plot of this years storage drawdown (beginning in the heavy dashed line [2002] and ending in the heavy solid line [2003]) against the preceding seven years since Grampians Water has been in operation.
It illustrates how the rate of storage drawdown was lowered significantly which in turn increased the security of the system from the lowest on record at the end of the fill in August 2002 to a point close to the best on record at the time of writing this report.

Figure 3: ***Hopetoun storage drawdown curve***



5.3 Comparison of Performance Against Target

Figures 4 and 5 below, include the Hopetoun Storage Drawdown Target Curve and the Hopetoun system demand Target. There are two distinct points on the curves that illustrate the effectiveness of the campaign.

Figure 4 shows that prior to 1 November 2002 the storage drawdown rate was matching the target for moderate restrictions using a combination of minor restrictions and an education program. It is worth noting that the sudden drop in storage immediately prior to 1 November resulted from a volume accounting error during the transfer of water between storages.

The customers of Hopetoun were placed on moderate restrictions on 1 November 2002 due to the security of supply being only marginally better than the target for moderate restrictions. The timing opportunity was ideal because the restriction announcement was done in conjunction with a region wide increase in the drought awareness campaign, which was initiated in response to the status of the global system. A marked decrease in the rate of drawdown of the storage was evident. The effect was also evident by the decrease in demand, which is illustrated by the change in gradient on figure 5.

The status of the storage began improving at a steady rate until early February when another intense education campaign was initiated. The campaign included increasing to a harsh restriction level in seven towns. The restriction level at Hopetoun was not altered yet the effect at Hopetoun was dramatic, essentially affecting a response almost equal to the town itself having a harsh restriction level imposed.

The objectives of the Drought Response Plan were met at Hopetoun.

Figure 4: ***Hopetoun storage drawdown target curves, 2002 –2003 peak demand period***

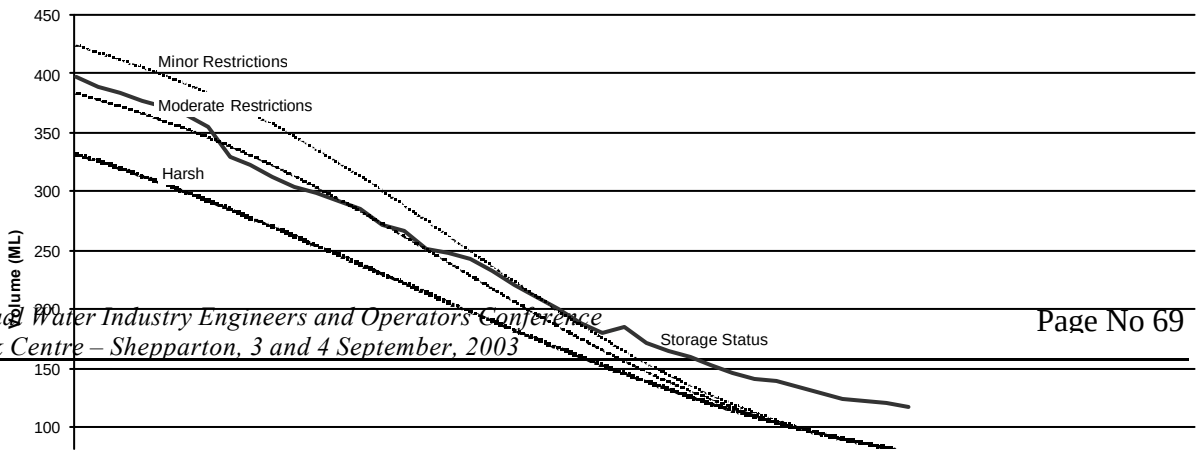
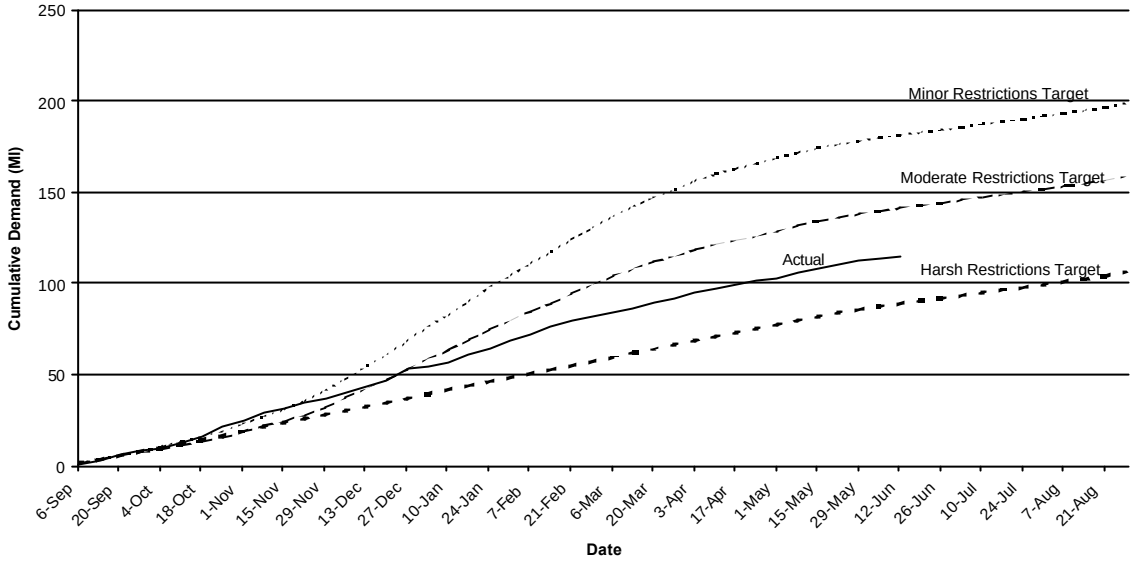


Figure 5: ***Cumulative demand versus target, 2002 –2003 peak demand period***



6.0 CONCLUSION

The Grampians Region Water Authority Drought Response Plan has proven to very successful. The communities served by Grampians Water have achieved a significant reduction in water consumption resulting in a more secure supply for 2004.

That success has in part emanated from the use of trigger point modeling as a means of assessing storage drawdown and initiating response action.

Trigger point modeling has proven to be a simple management tool to develop and manage. The ability to increase precision provides better information to make decisions.

In a future ideal world drought response actions will not be required however water is a scarce resource and shortages are inevitable unless careful management practices are employed. The inclusion of trigger point modeling in your Drought Response Plan can be used effectively, if planned correctly, to enable managing drought without doubt.

7.0 ACKNOWLEDGMENT

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Idea sharing with Wimmera Mallee Water and in particular John Martin and Max Burns is also acknowledged.