

# SA MDB NRM BOARD AUTOMATIC WEATHER STATION NETWORK

## AN INVALUABLE IRRIGATION MANAGEMENT TOOL

N.M. JOHNSTON<sup>1</sup> & M.D. CUTTING<sup>1</sup>

<sup>1</sup> South Australian Murray-Darling Basin Natural Resources Management Board  
PO Box 2343 Murray Bridge SA 5253

### **ABSTRACT**

The SA Murray-Darling Basin Natural Resources Management Board's (the Board) Automatic Weather Station Network was officially launched in April 2007. This paper will outline the key components of the network and its role in facilitating improved irrigation water use efficiency within the SA Murray-Darling Basin region.

The network consists of 22 automatic weather stations and 9 logging rain gauges that have been strategically positioned along the River Murray from the Border to the Lower Lakes. There are also an additional 4 automatic weather stations located in the Mallee Prescribed Wells irrigation area.

The network was primarily established to generate reference crop evapotranspiration data ( $ET_0$ ) to assist the region's irrigators with planning scheduling activities. Other key drivers that contributed to the establishment of the network included:

- Assisting irrigators to better manage reduced water allocations;
- Reducing the reliance on historical pan evaporation & rainfall records so that location & seasonal climatic variation could be better quantified; and
- Provide more accurate inputs for the calculation of annual irrigation efficiency index.

A key component of the network is the associated website that has continually evolved over time as a result of feedback from the Board's irrigation community. Data is updated to the website on an hourly basis and can be viewed at a 15 minute resolution satisfying the needs of even the most particular water user.

Along with a range of standard data summaries graphical representations are available for key data sets together with detailed rainfall and  $ET_0$  charts. A unique feature of the website is the ability to view data across a financial-year, or irrigation season period (1 July-30 June).

A set of crop co-efficients have been developed by the *Irrigated Crop Management Service* covering the major crops types irrigated in the SA MDB region and a series of data interpretation workshops have been conducted by the Board to ensure irrigators are best equipped to make full use of the network & its associated resources.

Early indications are that a high proportion of the regions 3000 water users are utilising the weather station network to assist with irrigation management planning. In the future it is planned to modify & refine the existing crop co-efficients to best match localised growing conditions and industry specific management practices.

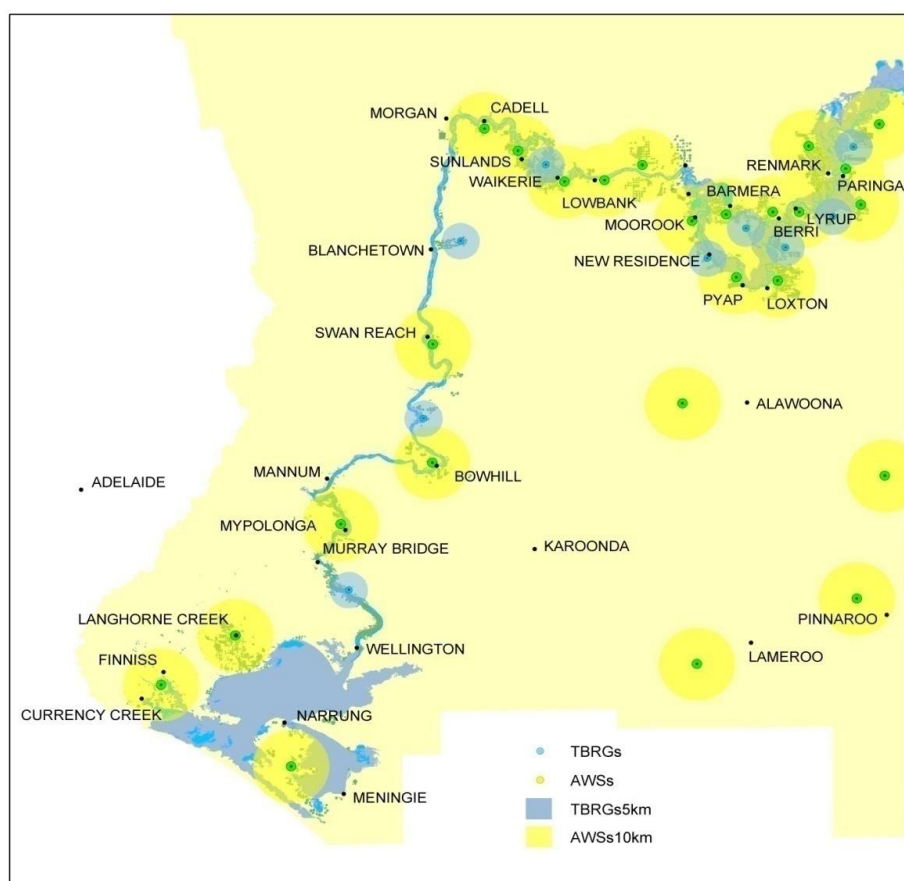
### **Introduction**

The environmental and economic benefits of improved irrigation efficiency are well accepted. Water savings can be passed on as increased environmental flows or used to irrigate additional area. Better water use means a reduction in drainage and an improvement in ground water quality. Increased efficiency translates into lower water and pumping costs and can increase yield and quality: providing better returns for growers.

In the past there has been a reliance on historical climatic averages to determine ‘theoretical’ crop water requirements but with the climate changing it is now very important to generate location, and seasonally specific weather data.

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**Figure 1:** SA MDB NRM Board Automatic Weather Station Network.

## SUMMARY

### **Network Website**

One of the key components of the Board’s Automatic Weather Monitoring Network is the comprehensive website that has been developed for data display.

Data from the SA MDB NRM Board’s weather monitoring network is accessible from the Board’s website: <http://www.samdbnrm.sa.gov.au> with links also available from key regional stakeholder web pages.

The website was developed and continually refined using feedback generated from regional stakeholders with the end result a user-friendly system that is updated on the hour. The website home page is presented in Figure 2 below.

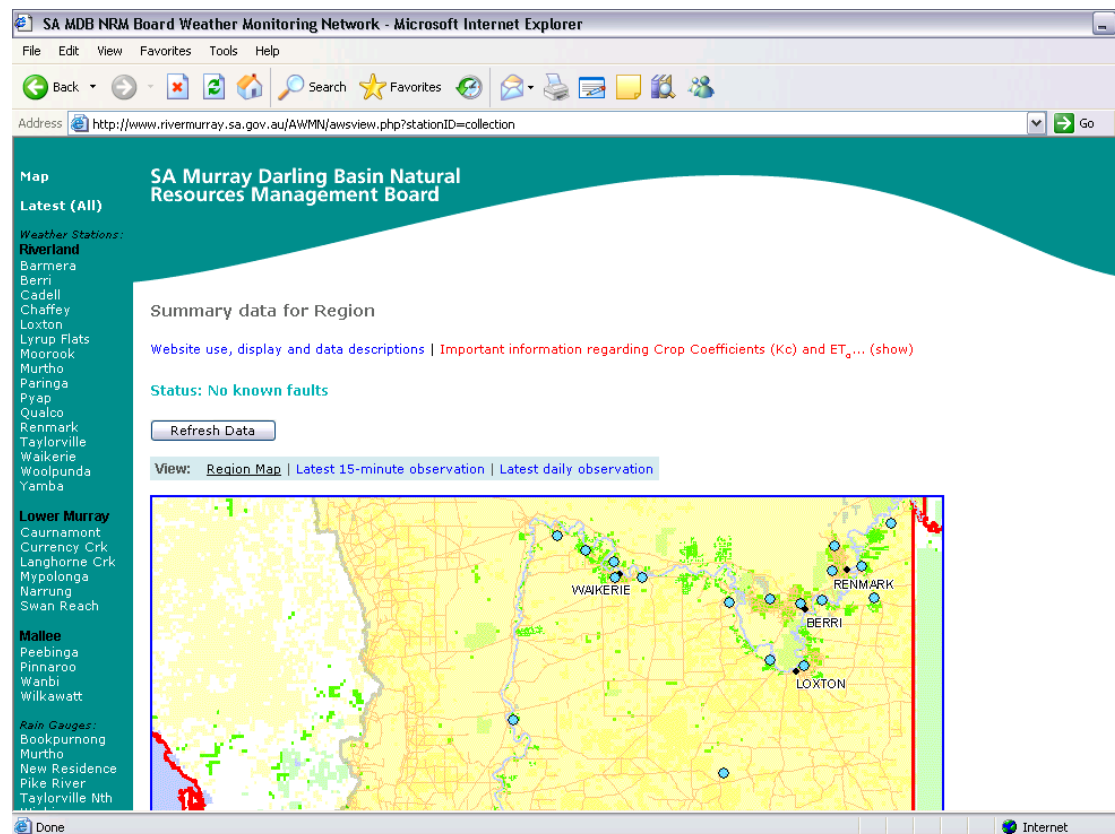


Figure 2: The SA Murray-Darling Basin NRM Board AWMN Home page.

### Available Data Sets

Data from the SA MDB NRM Board's weather monitoring network is accessible from the Board's website: <http://www.samdbnrm.sa.gov.au>

There are three main menus available for accessing information; **Tables**, **Graphs** and **Download**.

The **Tables** menu contains the following data sets:

- **Summary** – displays current observations (updated hourly) and summary data for the previous 24 hours to 9am.
- **15-minute data** – displays the last 24 hours observations in 15-minute intervals. This may reduce to 10 minute intervals in the near future.
- **Daily data** – displays the last 1 months' daily summary data.
- **ET Chart** – displays a calendar for the full record of observations containing daily  $ET_0$  calculations for the 24 hours to 9am.
- **Rainfall Chart** – displays a calendar for the full record of observations containing daily rainfall totals for the 24 hours to 9am.
- **Financial-year Records** – displays monthly  $ET_0$  calculations and rainfall observations for the full record of observations.

The **Graphs** menu contains the following graphical depictions of the data:

- **Air Temp**
- **Humidity**
- **Soil Temp**
- **Radiation**
- **Wind Speed**
- **Rain &  $ET_0$**

The **Download** menu contains archived information that can be downloaded as “csv” files and opened in Microsoft® Excel™ for further analysis, or graphing. The following data sets are enclosed within the **Download** menu:

- **15-minute Archive (last calendar month)**
- **Daily Archive (last calendar year)**
- **Rainfall & ET<sub>0</sub> Archive (all available)**

### **Generating Climatic Data**

There are two approaches to climate-based scheduling using weather data to estimate crop water use:

- Pan evaporation (Epan)
- Evapo-transpiration (ET<sub>0</sub>), estimated from a weather station  
(Source: NSW Agriculture; Irrigation for Horticulture in the Mallee, 2002)

### **Pan Evaporation (Epan)**

Prior to the advent of the automatic weather station, pan evaporation was the standard source of data for climate based irrigation scheduling. A standard Class A pan consists of shallow tank 1.2 m wide. Daily evaporative losses from the pan are recorded in mm.

Crops use a proportion of the daily pan evaporation and the conversion is known as a crop factor and varies according to the growth cycle of each individual crop.

### **Evapo-transpiration (ET)**

The ET calculation is predominantly driven by temperature, solar energy and wind. In conditions of low wind solar radiation dominates, whilst when cloudy and during high winds, wind dominates. Whether under the influence of solar radiation or wind, the amount of water that can be transferred into the air is governed by the humidity.

ET values generated from automatic weather stations estimate the amount of water that would be used by a green, uniform, actively growing crop such as grass. This crop is known as the reference crop.

As with pan evaporation a conversion from the reference crop is used and is known as a crop coefficient.

### **Penman-Monteith Model**

The Penman Monteith model forms the basis for most ET calculations. An Automatic Weather Station (AWS) calculating evapo-transpiration using this model requires as a minimum the following sensors: rainfall, air temperature, relative humidity, wind speed and solar radiation.

The theoretical performance of the Penman-Monteith model is well proven, however, it's accuracy in practice is dependent on the performance of the sensors used on the station. All of the sensors used on the SA MDB NRM Board stations compare with Bureau of Meteorology standards.

(Source: MEA, Automatic Weather Stations & their use in Monitoring Irrigation Efficiency, PUB-WS01)

## **CONCLUSION**

### **Irrigation Scheduling Using Weather Station Data**

#### **Soil Readily Available Water (RAW)**

Understanding the relationship between soil RAW values on a property and the depth of irrigation is essential for implementing efficient irrigation scheduling practices. Applying irrigation volumes that exceed soil RAW figures (unless a deliberate leaching event) will result in drainage beyond the active root zone, wasting valuable water, nutrient & energy inputs.

Daily evapo-transpiration data & crop coefficients can be used as a guide to determine when soil RAW has been fully depleted and irrigation is required.

## **Water Balance Scheduling**

Water Balance Scheduling is adaptable to many different irrigation management practices. Water-balance irrigation scheduling is the day-to-day accounting of the amount of water being used by a specific crop. The advent of automatic weather stations has enabled this practice to become much more accurate and management specific.

Crop water use is impacted by many variables including planting density, cover crops, and cultivar vigour and canopy management and therefore the accuracy of this method is directly related to how closely the crop coefficient reflects existing management practices. In many cases the 'standard' crop coefficient may need to be modified to better match individual circumstances.

Soil water monitoring data can be used to develop property, or even variety specific crop coefficients to achieve desired yields (t/ha) and quality.

Note: Remember to use **crop coefficients** if using **weather station generated evapo-transpiration** and **crop factors** when using **pan evaporation** figures – the two are not interchangeable.

## **Collaboration with the SA Bureau of Meteorology Office**

The SA Bureau of Meteorology office has been of great assistance to the Board in helping to establish the Automatic Weather Monitoring Network. The BoM were part of the Board's project implementation group and provided essential technical guidance to ensure the ongoing success of the network.

A Memorandum of Understanding (MoU) has been developed between the Board and the BoM to foster co-operation and collaboration between the Institutions in the public interest and for their mutual benefit with a view to mutually building a quality data relationship along the River Murray.

A key benefit to working collaboratively with the BoM is the quality control checks that the network's data is subjected to. This process ensures that any data errors are quickly detected and corrective action efficiently implemented, providing confidence to all end data users.

With the BoM being the key data custodian under the Federal Government's National Plan for Water Security it is hoped that the collaborative relationship developed through this project can act as a model for other partnerships with external resource agencies.

## **The Future**

The Board is committed to investing in projects aimed at refining the current set of crop coefficients to make certain the network remains an integral part of irrigation scheduling practices. The Irrigated Crop Management Service (ICMS) at Loxton, SA is a key partner in this work and other on-farm water use efficiency investigations.

The Board is looking at expanding the network into other areas of its broad catchment in the near future and at upgrading its stand alone rainfall recording sites to 'real time' data.

## **REFERENCES**

MEA: *Automatic Weather Stations & their use in Monitoring Irrigation Efficiency*, PUB-WS01 from URL: <http://www.mea.com.au> (Measurement Engineering Australia, Magill SA)

RMCWMB (2002): *Water Allocation Plan for the River Murray Prescribed Watercourse* (River Murray Catchment Water Management Board, Berri South Australia)

SAMDBNRMB (2007): *Weather Data Interpretation Workshop Manual* (South Australian Murray – Darling Basin Natural Resources Management Board)