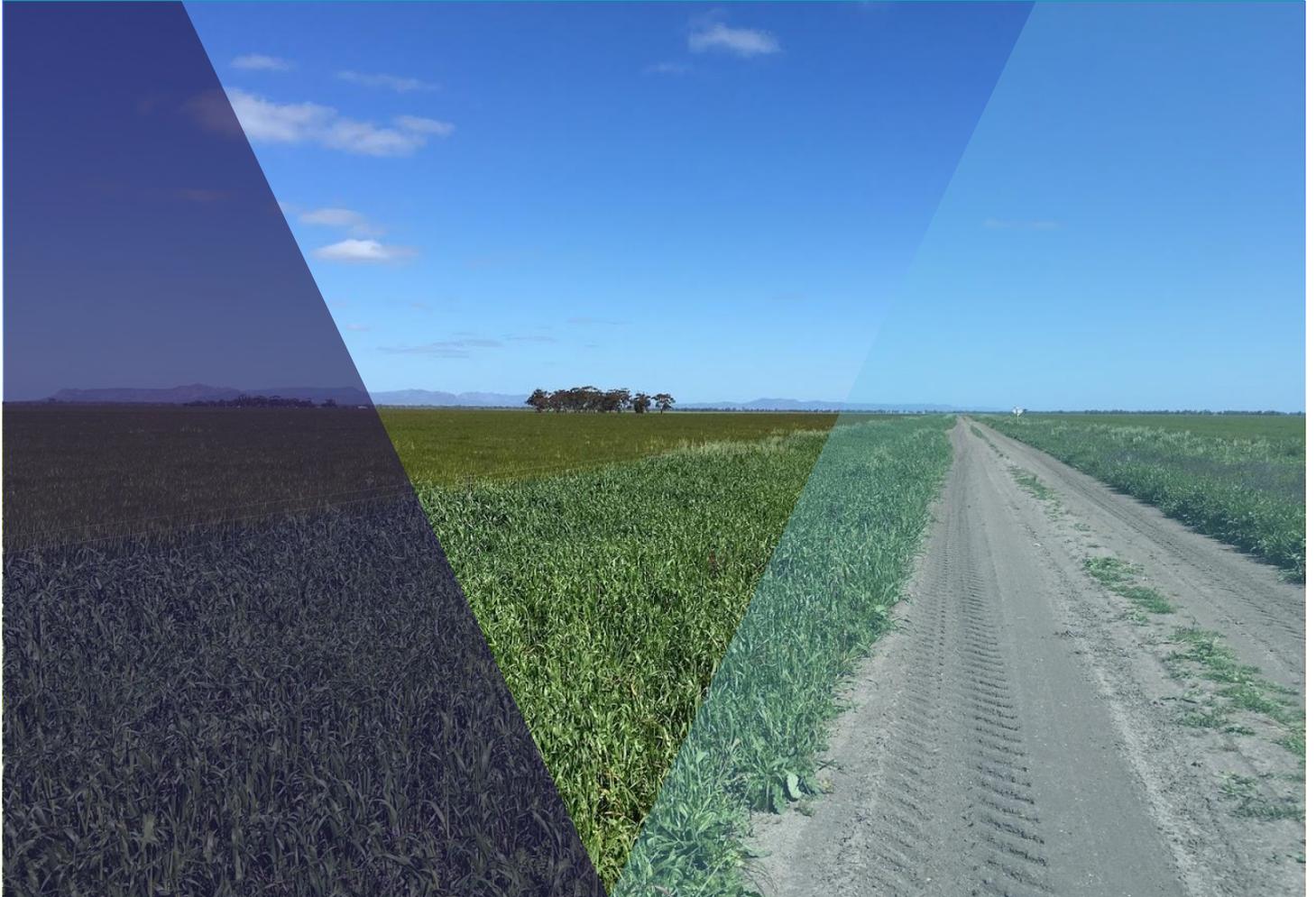


# Wimmera-Mallee Water Resource Plan Model



Version 1.0

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# 1. Purpose

The purpose of this report is to provide details of the Wimmera – Mallee model that Victoria proposes to use to determine the annual permitted take for the Wimmera-Mallee (surface water) water resource plan area. The report includes technical information about modelling to quantify the following components of take:

- (a) take from regulated rivers, other than under basic rights ; and
- (b) take from unregulated watercourses (partial).

## 2. Introduction

The Basin Plan was prepared by the Murray-Darling Basin Authority and signed into law by the Commonwealth Minister for Water on 22 November 2012 under the *Water Act 2007* (Cth). A key requirement is the preparation of water resource plans (WRPs), in accordance with Chapter 10 of the Basin Plan.

For the purpose of assessing compliance with the Sustainable Diversion Limit (SDL), the Basin Plan (Section 10.10) states that the water resource plan must set out the method for determining the maximum quantity of water permitted to be taken for consumptive use during a water accounting period.

During the development of the WRP, two options for the method for determining annual permitted take were considered. These are the Wimmera-Mallee SDL model (DELWP, 2017) and a new model that reflects the current system configuration and rules based on best available information at the time of development of the model, and the levels of demand scaled to produce a long-term annual diversion limit matching the SDL. The new model is referred as modified WRP model.

## 3. Background

### 3.1 Wimmera-Mallee System

The Wimmera-Mallee region is located in north-west Victoria. The region is bounded by the Grampians in the south and by the River Murray in the north. The Wimmera-Mallee region falls within the Murray-Darling Basin. Consequently, the region is defined as a:

1. Designated River Valley in the Murray-Darling Basin Agreement; and
2. Sustainable Diversion Limit (SDL) resource unit (SS9), only SDL unit in the Wimmera-Mallee (surface water) water resource plan area (SW4) under the Basin Plan.

Figure 1 shows the extent of the Wimmera-Mallee (surface water) SDL resource unit. The Wimmera-Mallee SDL resource unit encompasses the Wimmera, Mallee, Avon-Richardson and Avoca Basins. The Wimmera River is the major river system in the Wimmera-Mallee region. It rises in the eastern end of the Grampians and flows northwest, receiving water from various tributaries flowing out of the range system. It then turns north flowing to the terminal lake system of Lake Hindmarsh and Lake Albacutya.

The Wimmera-Mallee region has a semi-arid climate with average annual rainfall varying from 890 mm in the Grampians in the south to 300 mm in the arid north. The dams and storages located in the Grampians are the primary sources of water for the region. Substantial volumes of water are transferred from the Glenelg River Basin to supply the Wimmera-Mallee region.



Figure 1 Map of Wimmera (surface water) SDL resource unit

The infrastructure and operation of the Wimmera-Mallee region’s water supply system has undergone fundamental changes over the last two decades. A brief timeline of major changes is provided below in Figure 2.

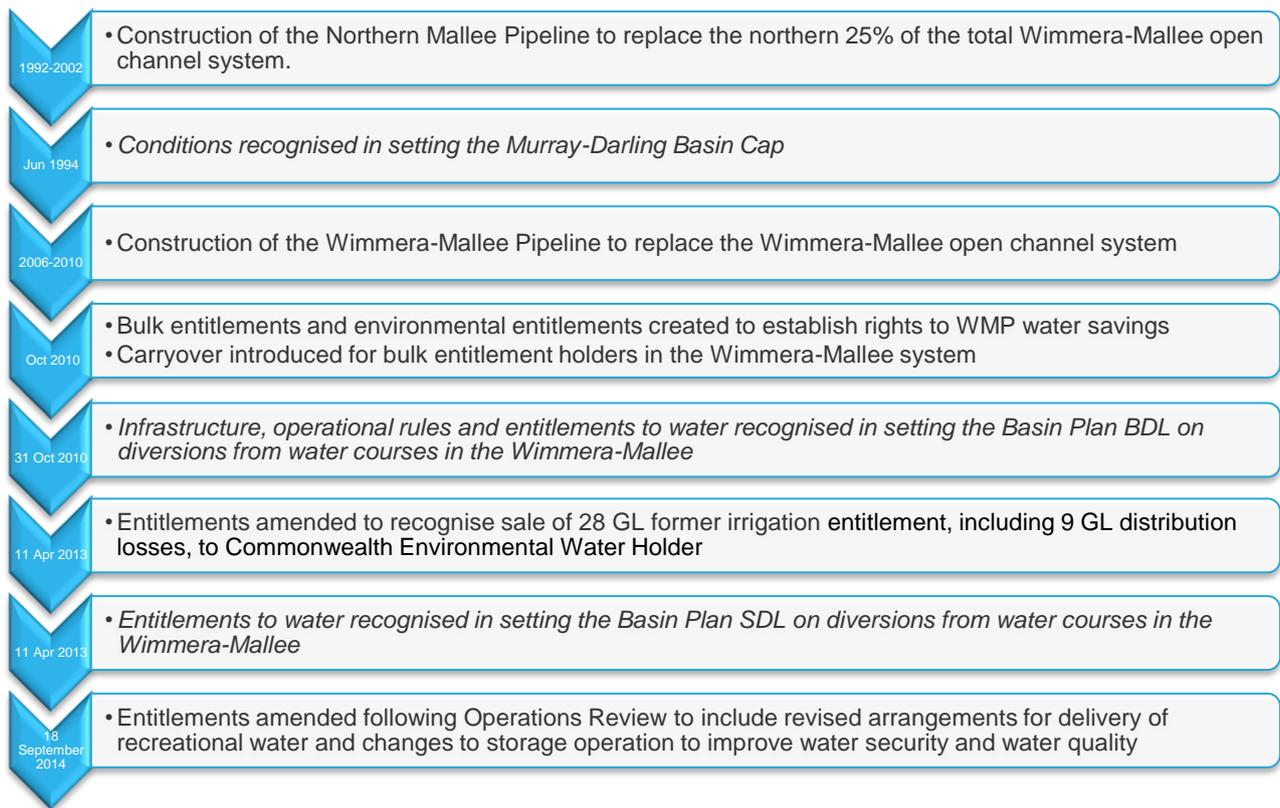


Figure 2 Timeline of major changes and important dates relevant to the Wimmera-Mallee region's water supply

## 4. The Modified Wimmera-Mallee WRP Model

The modified Wimmera-Mallee WRP model was developed to reflect current system configuration and management rules (based on best available information at the time of development of the model), and the levels of demand scaled to produce a long-term annual diversion limit that matches the SDL. It was developed by modifying the Wimmera-Mallee SDL model (DELWP, 2017) to reflect current entitlements and operational practice, and more accurate information on the current system.

### 4.1 Wimmera-Mallee SDL Model

The Wimmera SDL model was developed by modifying the Wimmera-Mallee Post Irrigation (WMPI) Cap model (DSE, 2012b) to better reflect the conditions as at 31 October 2010 (when the bulk entitlements came into effect), implement improved water accounting including carryover and include updated model input datasets.

The WMPI model (DSE 2012b) was developed by modifying the Wimmera-Mallee Post Pipeline (WMPP) cap model (DSE, 2012a) to represent the system with Wimmera Irrigation Area (WMI) decommissioned and irrigation entitlements, including the loss allowance, transferred to the environment. The WMPP model (DSE, 2012a) was developed as a replacement to the Wimmera-Mallee Pre Pipeline Cap model (W&D Engineering and Legal Services, 2009) for the pipelined Wimmera-Mallee system.

### 4.2 Improvements for the Modified Wimmera- Mallee WRP Model

#### 4.2.1 System Configuration

A number of changes to the representation of system infrastructure were made to reflect more accurate information (GWMWater 2016) that has become available since the model was developed. Changes included:

- increased dead storage for Lake Lonsdale, Lake Wartook and Toolondo Reservoir,

- small changes to storage volume at full supply level for Moora Moora Reservoir, Lake Wartook and Lake Lonsdale,
- small changes to storage volume at full supply level for Mt Cole Reservoir, Langhi Ghiran Reservoir and Panrock Reservoir,
- Update of the stage-storage volume-surface area relationship for Toolondo Reservoir,
- Reduction of the Taylors Lake inlet channel capacity, and
- Change to system configuration to reincorporate Green Lake into the headworks system, primarily to manage water quality.

#### **4.2.2 Operating Rules**

The operating rules were updated to match to the latest storage management rules (GMMWater 2016), changes included:

- Increased maximum operating level and corresponding storage volume for Rocklands Reservoir,
- Adjustment of the rule that controls transfer of water from Rocklands Reservoir to Toolondo Reservoir, and
- Rules to divert poor quality (assumed that first flush channel flows are poor quality) water from Burnt Channel and spills from McKenzie River into Green Lake to manage water quality in Taylors Lake.

#### **4.2.3 Entitlements and Demands**

The configuration of entitlement volumes was modified to represent the latest Wimmera and Glenelg Rivers Bulk and Environmental Entitlements granted in September 2014. This included:

- Increase (of 500 ML) in recreational water entitlement within GMMWater's bulk entitlement and increase in the recreational water demands to use this full entitlement volume,
- All other demands maintained at the full entitlement level of demand as per the SDL model, and
- Removal of the obligation to supply of water to Lake Batyo Catyo from the Wimmera and Glenelg Rivers Environmental Entitlement

#### **4.2.4 Climate and Streamflow Inputs**

The climate and streamflow inputs to the modified Wimmera-Mallee WRP model are identical to those in the SDL model.

#### **4.2.5 Water Allocation**

The configuration of water allocation rules was modified to represent the latest storage management rules (GMMWater 2016). This included:

- Increase in the forecast inflow assumed to occur when determining water available for allocation,
- Reduction (up to 500 ML) in reserve adopted in determining water available for allocation, and
- Adjustment of method for determining risk of spill to match the latest storage management rules and operational practice - water that has been carried over from a previous year can only be accessed when a low risk of spill is declared.

## 4.3 Model Results

A brief summary of key model run information is provided below:

**Table 1: Summary of Modified Wimmera-Mallee WRP Model Run**

Key Information	Comments
Run Date	17 May 2018
Software used	REALM (Version 6.33)
Simulation period	July 1891 to June 2017 (126 years)
Model time step	Monthly
Relevant file names	WP01.log, WP01.scn, WP01.sys

### 4.3.1 Diversion Off-take Points

The models calculate consumptive take in accordance with Schedules 4 and 5 of Bulk Entitlements 2014 which are consistent with the Murray-Darling Basin Authority's Diversion Formula Register for the Murray-Darling Basin (MDBA 2011), updated to take account of decommissioning of channels. Victoria proposes to continue to use these diversion definitions for Basin Plan purposes. Table 2 provides details of the diversion off-takes used to calculate the modelled consumptive take.

It is noted that Green Lake inlet channel is not considered an offtake point as any flows into the lake are considered system operating water required to manage water quality. Similarly, Lake Batyo Catyo inlet channel was not considered an offtake point as diversion were considered environmental water deliveries under the environmental entitlement.

### 4.3.2 Long-term Diversion Limit

Table 2 compares the long-term average annual diversion for the Basin Plan historic climate period — July 1895 to June 2009 — for three model runs:

1. Modified Wimmera-Mallee WRP model (run WP01);
2. Wimmera-Mallee SDL model (run SDL2);
3. Wimmera-Mallee BDL model (run BDL2);

The long-term diversion limit estimated by the modified Wimmera-Mallee WRP model (43,835 ML/year) is very close to that estimated by the SDL model (43,842 ML/year). The very minor differences in the diversion limits result from changes in model configuration. This includes reduction in diversions in the driest years mainly due to the more accurate representation of dead storage.

The BDL model estimated long-term diversion limit (66,874 ML/year) is consistent with the estimate of 66 GL per year reported in Schedule 3 of the Basin Plan.

**Table 2: Long-term average annual diversion limit July 1895 to June 2009 for (i) modified WRP model, (ii) SDL model, (iii) BDL model**

Off-take Site	Areas Supplied	Remarks	Diversion Limit (ML/year) run WP01	Diversion Limit (ML/year) run SDL2	Diversion Limit (ML/year) run BDL2
Pine Lake (outlet)	Disconnected				
Bunganally channel	Gross supply to Horsham Irrigation and Quantong Irrigation		0	0	3,734
Brimpaen storages *	GWMWater's gross supply to Wimmera-Mallee Pipeline customers (urban, D&S and future growth) on supply system 6		2,244	2,253	2,233
Rocklands-Lubeck offtake regulator	Disconnected				
Glenorchy Weir	Disconnected				
Dad and Dave Weir	GWMWater's gross supply via Mt Zero channel to Horsham and Natimuk		4,685	4,757	4,654
Taylor's Lake Outlet	GWMWater's gross supply from Taylor's Lake to: (1) irrigators, (2) recreation lakes, (3) wetlands, (4) Wimmera-Mallee Pipeline customers (urban, D&S, Supply-by-Agreement, and future growth) on supply systems 1, 2, 3 and 4, (4) Coliban Water Customers	Releases for environment and wetlands not included. Note that supplied demands to 1&2 WETLAND and 3&4 WETLAND	24,906	22,510	37,691
Rocklands offtake	Supply to supply by agreement direct from Rocklands Reservoir	Not to be included			
Multiple independent diverters as listed on GWMWater's licence register	Supply to supply by agreement from the Wimmera River basin **	Refer to footnote			
	Supply to new developments from the Wimmera River basin **	Refer to footnote			
	Supply to new developments direct from Rocklands Reservoir	Not to be included			
Rich Avon Weir	Disconnected				
Lake Bellfield outlet or tail gauge	GWMWater's gross supply from Lake Bellfield to: (1) recreation lakes, (2) wetlands, (3) Wimmera-Mallee Pipeline customers (urban, D&S, Supply-by-Agreement, and future growth) on supply systems 1, 2, 3, 4 and 7.		8,007	10,275	14,494
Lake Bellfield (pump station)	GWMWater's gross supply from Lake Bellfield to towns direct off Wimmera-Mallee system headworks (Halls Gap and Pomonal)		246	252	254
Lake Fyans outlet (pump station)	GWMWater's gross supply to Stawell, Ararat, Great Western and Supply-by-Agreement customers.		3,748	3,795	3,813
Fyans Creek (Stawell) Diversion Weirs (2 Nos.)					
Mt Cole Reservoir					
Langhi Ghiran Reservoir					
Panrock Reservoir					
Multiple independent diverters as listed on GWMWater's licence register	Gross diversions to irrigation, stock & domestic, commercial & industrial unregulated licensed diversions in the Avoca, Wimmera and Mallee basins, including unregulated licences on the Wimmera River downstream of Glenorchy weir, referred as "out-of-model" diversions		Not in the model	Not in the model	Not in the model
<b>TOTAL</b>			<b>43,835</b>	<b>43,842</b>	<b>66,874</b>

\* - Can also be supplied from Lake Wartook and the Mackenzie River via Distribution Heads;

\*\* - Included in different supply systems

## 4.4 Assessing Annual Compliance

In accordance with the Basin Plan (s. 10.10), from 1 July 2019, Victoria proposes to use the Wimmera-Mallee modified WRP Model at the end of each year to determine the maximum quantity of water permitted to be taken in that year for consumptive use from the Wimmera-Mallee (surface water) water resource plan area for the following:

- take from regulated rivers, and
- some of take from watercourses that are not regulated rivers for supply of urban commitments under the bulk entitlement.

The proposed method for assessing annual compliance in the Wimmera-Mallee (surface water) water resource plan area is as follows:

4. Extend the modified Wimmera-Mallee WRP model input data (inflows, rainfall, evaporation, demands) to 30 June, being the end of the last water accounting year.
5. Run the model from 1 July 2019 to end of the last water accounting year by initialising the simulation with recorded storage volumes at the end of June 2019.
6. Determine the annual permitted take using the consumptive diversions calculated by the model.
7. Determine the difference between the annual actual take and the annual permitted take.
8. Determine the new cumulative balance of the difference between annual permitted take and the annual actual take for the water accounting years commencing 1 July 2019.
9. Assess the compliance with the annual SDL by comparing the new cumulative balance with the agreed non-compliance trigger volume.

The determination of total annual permitted take and total annual actual take must take account of all forms of take from the SDL resource unit and all classes of water access right. Fit-for-purpose methods for determining permitted and actual takes will be used for forms of take not represented by the model (e.g. catchment dams), as described in the Wimmera-Mallee WRP.

The Basin Plan (s. 6.12) defines non-compliance with a long-term annual diversion limit for an SDL resource unit in a water accounting period if:

- a. the cumulative balance for an SDL resource unit is a debit amount equal to or greater than 20% of the SDL; and
- b. there is no reasonable excuse for the excess.

The compliance trigger (20% of SDL) is to recognise the errors in compliance accounting as models and/or estimation methods for diversion limits contain uncertainties and diversion data cannot be measured perfectly. In the case of Wimmera-Mallee WRP area, significant changes have occurred in the system (Figure 2) and the long term average diversion limits have significantly reduced by 57% under post-pipeline conditions compared with pre-pipeline conditions. While it could be argued that measurement error associated with diversion would reduce with pipelining, model uncertainty, which forms the biggest component of the error term, will certainly not have halved. Therefore, Victoria recommended that the compliance trigger be changed from 20% to 35% of long term average diversion limit (DSE 2012a and 2012b) as part of Cap compliance. Given the Wimmera-Mallee BDL and SDL models are based on the Wimmera-Mallee post-pipeline and post-irrigation Cap models, Victoria recommends this proposed change in compliance trigger from 20% to 35% of long term average diversion limit for SDL compliance in Wimmera-Mallee WRP area.

## 4.5 Future Direction

The REALM monthly model is fit for purpose tool for Wimmera-Mallee WRP requirements. Victoria is working towards developing a daily time-step model of the Wimmera-Mallee system using Source software. This is a longer-term, multi-year project. Post 2020, Victoria plans to transition to the daily Source model for

SDL compliance reporting. The approach to compliance reporting would remain unchanged until the transition.

## 5. Conclusions and Recommendations

The modified Wimmera-Mallee WRP model was developed to represent current infrastructure, operational rules and entitlements to water (based on best available information at the time of development of the model), and the levels of demand scaled to produce a long-term annual diversion limit that matches the SDL.

This model meets the Basin Plan requirements. Therefore, it is recommended that the modified Wimmera-Mallee WRP model be used from 1 July 2019 to determine the annual permitted take for consumptive use for the form of take from regulated rivers within the Wimmera-Mallee (surface water) SDL resource unit that are represented in the model.

## 6. References

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MDBA (2011), Diversion Formula Register for the Murray-Darling basin, Version 5, Approved by MDBA decision D11/32219 – 8 November 2011.

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