SINCLAIR KNIGHT MERZ

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Melbourne Water

Woori Yallock Creek Catchment

REVIEW AND UPDATE OF REALM MODEL AND SCENARIO MODELLING

- FINAL
- 19 January 2010

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Executive Summary

Melbourne Water is responsible for developing Streamflow Management Plans (SFMPs) under the State Environment Protection Policy Waters of Victoria, Schedule F7, Waters of the Yarra catchment. SFMPs provide a framework by which water can be shared sustainably between the environment and consumptive users of water.

Improvements to the previous (SKM 2005c) model were made to give a more accurate representation of current and future water use utilising comments and feedback from Melbourne Water and the advisory committee. Subsequently the model was extended to include streamflow and diverter data to the 2006/07 irrigation year. Additional diversion data from Melbourne Water's 2006 Diverter survey in addition to diversion data made available through the previous project (2005c) has been utilised for this project. Two streamflow scenarios were simulated for this project based on two climate scenarios: Natural historic streamflows and climate change streamflows. In combination with these streamflow scenarios, a number of demand scenarios including historic, current and full level of development (LOD) were derived for this project. This combination of streamflows, LOD and operating rules led to the following scenarios being developed for the project:

- **Woori Yallock River REALM Scenarios**

Flow Series	Level of Development	Current Environmental Flow Scenario (MW Drought Response Plan Restriction Policy)	Environmental Flow Recommendations
Historic Natural Inflows	Historic LOD	Calibration	Not modelled
	Current LOD	Scenario 1 (CNR1.log)	Scenario 5 (CNE1.log)
	Full LOD	Scenario 2 (FNR1.log)	Scenario 6 (FNE1.log)
Step-climate Change Inflows	Historic LOD	Not modelled	Not modelled
	Current LOD	Scenario 3 (CCR1.log)	Scenario 7 (CCE1.log)
	Full LOD	Scenario 4 (FCR1.log)	Scenario 8 (FCE1.log)

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For each of the eight scenarios, the following results have been presented:

- Flow duration curves of annual, high flow season and low flow seasons,
- Days on Restriction/Ban in representative wet, average and dry years,
- Hydrographs of average daily flows in representative wet, average and dry years, and
- Reliability of supply.

The results show the varying impact of the different levels of demand, climate scenarios and operating rules upon both the flow of the Woori Yallock Creek and the private diverters.

The tables below compare the current and full LOD supplied demand and demand not supplied (shortfall) in each sub-catchment under all scenarios. In all scenarios, whether as a result of restrictions or implementation of the cease to divert environmental flow recommendations, the unrestricted licensed diverter demand cannot be met in all years in the Woori Yallock sub-catchments (i.e. there is a shortfall in licensed diverter demand). It should be noted that whilst the average annual volume supplied increases between current and full LOD scenarios, the proportion of the total unrestricted licence allocation that isn't supplied also increases.

- **Average annual volume supplied to licenced diverters under all scenarios**

		Average Annual Volume Supplied	
Flow Series	**Level of Development**	**Current Environmental Flow Scenario (MW Drought Response Plan Restriction Policy)**	**Environmental Flow Recommendations**
Historic Natural Inflows	Current LOD	4,184 ML	2,235 ML
	Full LOD	4,902 ML	3,098 ML
Step-climate Change Inflows	Current LOD	3,163 ML	859 ML
	Full LOD	3,239 ML	1,567 ML

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- **Average annual volume not supplied (shortfall) to licenced diverters under all scenarios**

		Average Annual Volume Not Supplied (Shortfall)	
Flow Series	**Level of Development**	**Current Environmental Flow Scenario (MW Drought Response Plan Restriction Policy)**	**Environmental Flow Recommendations**
Historic Natural Inflows	Current LOD	324 ML	2,272 ML
	Full LOD	755 ML	2,563 ML
Step-climate Change Inflows	Current LOD	1,344 ML	3,649 ML
	Full LOD	2,418 ML	4,090 ML

The results of the scenario modelling suggest that the impact of the transition between current and full LOD is small compared to the impact of transitioning between natural historic and climate change scenarios. The results also show that reliability of supply to diverters is less for the scenarios using the environmental flow operating rules. It is important to note that these environmental flow rules have been implemented in an idealised fashion that is not representative of a realistic operational system. In practice there are many potential operational issues associated with managing the delivery of idealised environmental flow recommendations in an unregulated catchment such as Woori Yallock and Wandin Yallock. These have not been attempted to be included in the modelling for this report.

Contents

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1. Introduction

1.1. Background

Melbourne Water is responsible for developing Streamflow Management Plans (SFMPs) under the State Environment Protection Policy Waters of Victoria, Schedule F7, Waters of the Yarra catchment. SFMPs provide a framework by which water can be shared sustainably between the environment and consumptive users of water.

To help the consultative committee to develop the SFMPs, a water resource model for the Woori Yallock catchment was developed using REALM (Resource Allocation Model) by Sinclair Knight Merz (SKM) in December 2005. The model simulates daily streamflows and water use throughout the catchments over the period January 1975 to December 2004. This model was used to assess the reliability of water supply to licensed water users and the impact on natural streamflow in the Woori Yallock Creek under a number of different demand scenarios.

As part of this current project, the model simulation period was extended to 2007. Improvements to the model were also made to give a more accurate representation of current and future water use utilising comments and feedback from Melbourne Water and the advisory committee on the previous project prepared by SKM (2005C). Two streamflow scenarios were simulated for this project based on two climate scenarios: Natural historic streamflows and climate change streamflows. In combination with these streamflow scenarios, different level of development demand scenarios including historic, current and full level of development were derived for this project. In order to provide greater insight into water use in the Woori Yallock Catchment, SKM has utilised metered diversion data made available through Melbourne Water's 2006 Diverter survey in addition to diversion data made available through the previous project (2005c).

1.2. Purpose

The purpose of this project is to:

1) Review and update the Woori Yallock REALM model and its inputs taking into account Melbourne Water's updated licensed diverter database and additional data from the metering program;
2) Extend the model inputs (historic, current and full level of development (LOD) demands and natural inflow) to 31 December 2007;
3) Derive climate change inflow series; and
4) Assess the reliability of water supply to licensed water users and the impact on natural streamflow in the Woori Yallock Creek under a number of different scenarios, including climate change.

1.3. Report Structure

This report documents the methods used to create the model inputs for the Woori Yallock Creek catchment. As such, the sections in this report have been arranged into two parts to cater for various audiences:

- the main body of the report (Sections 2 to 5) present findings in a non-technical format for stakeholder review; and
- the appendices contain a technical description of the methodology used. They provide a transparent and defensible description of how the outcomes were derived.

1.4. Terms Used

A brief explanation of the terms used in this report is provided below:

Term	Definition
Unregulated catchment	Unregulated systems are those where users rely on run of river flows for either winterfill or direct extraction. There is no bulk water storage. Note that users downstream of a storage may still be classified as unregulated if they do not have access to the stored water (e.g. private diverters in the lower Moorabool River).
Demands	A demand is a term for any use of flow. This be in the form of water pumped directly from a river to irrigate crops, or water captured in small catchment dams in the upper reaches of a catchment.
Unrestricted demand	The demand that would be met given an unlimited supply of water, for direct irrigation purposes it is equivalent to the crop water requirement.
Supplied demand	The volume of water actually supplied to any demand. This accounts for demand that may not be supplied due to implementation of restrictions, bans or environmental flow requirements.
Shortfalls	The volume of water not supplied to a demand as a result of restrictions or environmental flow requirements.
Historic level of development demands	The demands for water that have occurred over time in a catchment. Changes in the level of demand occur as different crops may be planted that have different water requirements, new areas may become irrigated or additional licences are added.
Current level of development demands	The demands for water that are being seen at present in a catchment and are based on the current level of development, i.e. the current types and licensed volume of water use, such as the current number of small catchment dams harvesting water, the current area of irrigated crops or the current types of crops being irrigated. These demands are generated using historic climate data.
Full level of development demands	The demands for water that will be seen when the catchment's water resources are being used at the limit established in a bulk entitlement (for regulated systems) or at licensed volume for private diverters.
Observed flows	Observed flows are those that exist in the catchment under existing conditions that is after diversions, dams or other forms of regulation. Observed flows are recorded at streamflow gauges.
Partial natural/adjusted	Partial natural flows are those current level of development flows that have been partially adjusted for some diversions or discharges so that they

Term	Definition
gauged flow	represent the flow in a catchment that would have occurred if those impacts did not exist. Partial natural flows are commonly calculated to estimate small catchment dam impacts.
Natural flow	Natural flows are those that would have occurred in a catchment under natural conditions that is before diversions, dams or other forms of regulation (those operations that affect the natural stream flow) were implemented. Note however that this includes current level of land development (urbanisation, vegetation cover etc). Flows that are adjusted to take into account the impact of land clearing and the like are said to be "pre-European".
Impacted flow	Impacted flow is considered to be the difference between the flows that would have existed under natural conditions and the flows that exist under particular conditions.
Environmental or passing flow requirement	The flow rate at a certain point in a river system (usually a stream flow gauge) that must be maintained or exceeded before demands are restricted.
Unregulated catchment	Unregulated systems are those where users rely on run of river flows for either winterfill or direct extraction. There is no bulk water storage. Note that users downstream of a storage may still be classified as unregulated if they do not have access to the stored water (e.g. private diverters in the lower Moorabool River).

A brief explanation of the types of graphs used in this report is provided below:

Term	Definition
Flow duration curve	A flow duration curve presents streamflows that have been ranked from the largest to the smallest over the period of record examined and assigned a percentage based on the relative position of the flow against all other flows at the site. The percentage represents the proportion of time that a flow of a certain magnitude is exceeded. Flow duration curves are useful to compare flows between sites or modelling scenarios as they show how often cease to flow conditions occur, and what proportion of the time high or low flows are exceeded. The flow scale on the curves is presented on a logarithmic scale so as to enable easy distinction between flows in the low flow range.
Time series plot	Time series plots illustrate how flows change over time. They are useful to compare when the timing of high flow or low flows occur between different sites or different modelling scenarios. The flow scale on these plots is sometimes shown on a logarithmic scale to enable low flows to be shown more clearly.
Column plot	Column plots show a cumulative value for a certain variable over a certain time period, for example the total volume of water that was diverted over the course of one year. These types of plots are useful as they can be used to demonstrate pictorially the proportion of say the total annual demand that was actually met in each year, i.e. one column shows the total demand and the overlying column shows the supplied demand.