MODELLING BOUNCE-BACK IN WATER CONSUMPTION POST-DROUGHT

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ABSTRACT

Focussed on a case study of Geelong, Victoria, this paper presents the results of a unique comparison of (i) a custom-built regression model for forecasting total customer water demand and (ii) end-use based water projections using the integrated Supply Demand Planning model (iSDP) model. The regression model used historical data for calibration based on level of restrictions, evapotranspiration, temperature, and rainfall. By selecting a future climate scenario (and any anticipated restriction periods) for the next 10 year period, demand can be projected by the model. By contrast, the end use model was calibrated to consumption data during drought (rather than long term averages) to determine the extent to which end use consumption was suppressed and how much each end use may be expected to rebound under a range of scenarios. Results from both approaches are contrasted and reflections of the relative strengths of each approach are discussed.

INTRODUCTION

Major population centres in Australia have been in drought over the last decade. As a result restrictions regimes were put in place which resulted in significant water savings. In the case of Geelong with a population of over 250,000 people – level 3 and 4 restrictions were in place from late 2006 to early 2010 and were progressively lifted as as the drought eased .

Determining the effect of restriction periods on urban water consumption is an important modeling exercise which can be used to more effectively manage scarce water resources. Not only is it important to determine the reduction of water consumption during periods of restrictions, it is also important to determine the longevity of reductions after the stages of restrictions are lifted. This has given rise to a term known as *bounce-back*, which is the extent to which water consumption levels will rise to pre-restrictions levels following the uplifting of restrictions. To date, limited research has been published on bounce-back in Australia.

This paper contrasts two approaches to modelling future water demand following the lifting of restrictions – a regression based model and an end use model. Each has strengths and weaknesses and the combination of tecniques offers complementary insights.

The paper is structureed in three main sections. The first introduces the regression model for estimating the effect of historical restrictions and future water demand proejctions based on different *climate scenarios*. The second introduces results from the the end-use model / integrated supply-demand planning (iSDP) model and explores future water demand projections based on different *customer behaviour scenarios*. This model also has the capacity to run scenarios of low or high uptake of water efficient technologies. Finally, in the third section, results and modelling approaches are contrasted.

REGRESSION MODEL

In the literature, regression modelling has been used to determine water savings associated with periods of water restrictions. Such models may be fitted on pre-restrictions data and used to derive estimates of water consumption during restrictions periods, which are subsequently compared with observed consumption in order to generate estimates of water savings (Beaty et al. 2008; Hansen and Narayanan 1981; Kenney et al. 2004; Kidson et al. 2006; Neal et al. 2010; Spaninks 2010). The effect of restrictions may also be determined by incorporating one or more additional variables into the regression model to reflect the implementation of restrictions (Anderson et al. 1980; Roberts 2008). Simple dummy variables reflecting when a given stage of restrictions is in force are often used (Anderson et al. 1980; Roberts 2008), although more complex specifications can be applied. In a similar manner, the long lasting effects of restrictions may also be determined, using a simple dummy variable which defines the post-restrictions period.

For Geelong, a 10 year forecast model was built and forecasts bulk water demand under user-specified climate scenarios and bounce-back from the 2007-2010/11 water restrictions.

The model is a linear regression model fitted to historical data between 2001 and 2011. It predicts bulk water demand based on temperature and rainfall under varying degrees of restrictions (to allow for climate variability).

Future forecasts can then be made for ‘wet’ or ‘dry’ climate years under varying degrees of anticipated future restrictions or bounceback.