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Urban Water Restrictions: Unbundling Motivations, Compliance and Policy Viability

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Abstract

The welfare costs of urban water restrictions are now well recognised, even if not yet quantified with precision (see, for example, Edwards 2008). Notwithstanding the costs that attend this form of intervention, governments have proven reluctant to abandon them, at least until additional infrastructure is in place. Accordingly, some form of behavioural constraint over the use of water is now applied in almost every major urban centre in Australia. Against this background there is value in understanding the motivations for individuals to comply with water restrictions. There is also much to be gained from developing an appreciation of the preferences for different restriction regimes. There is also scope to address wider politico-economic considerations as part of this analysis. This paper considers some of these issues by presenting the results of a choice modelling and contingent valuation study drawing data from New South Wales and Victoria. The study also embodies data from water-rich and water-poor communities in metropolitan and regional settings.

1.0 Introduction

The welfare costs of urban water restrictions are now well recognised, even if not yet quantified with precision (see, for example, Edwards 2008). Notwithstanding the costs that attend this form of intervention, governments have proven reluctant to abandon them, at least until additional infrastructure is in place. Accordingly, some form of behavioural constraint over the use of water is now applied in almost every major urban centre in Australia.

Conventional economic theory provides compelling evidence that any restriction regime is welfare constraining. However, the reality of water restriction is somewhat different with many political players citing the wider benefits of having the community collectively rally to deal with the problem of water scarcity (see, for instance, Australian Capital Territory Government 2004). Thus, on the one hand restrictions are economically inefficient and arbitrarily impose inconvenience on individuals and yet on the other hand there is some evidence that compliance with restrictions builds social cohesions and *esprit de corps.*

Against this background there is value in understanding the motivations for individuals to comply with water restrictions. There is also much to be gained from developing an appreciation of the preferences for different restriction regimes. After all, restrictions (although not economically ideal) seem likely to remain part of the urban water management landscape for some time and a more preferred restriction regime will be attended by lower social and political costs than one which is less preferred. There is also scope to address wider politico-economic considerations as part of this analysis. For example, it may be plausible to identify individuals' willingness to pay (WTP) to avoid restrictions and examine how this interacts with restrictions and information about water management generally.

This paper considers some of these issues by presenting the results of a choice modelling (CM) and contingent valuation (CV) study drawing data from New South Wales and

Victoria. The study also embodies data from water-rich and water-poor communities in metropolitan and regional settings.

The paper itself is divided into five parts. Section two provides an overview of the literature pertaining to the motivations and incentives underlying individuals' compliance behaviour, which will act as a foundation for considering those factors that may affect individuals' preferences in relation to water restrictions. In section three, we present the design and results of this particular choice experiment. More specifically, we report the empirical estimates of respondents' WTP for identified attributes of a compliance regime. An illustration of the application of the CV methodology to the challenge of determining a welfare estimate associated with avoiding water restrictions is presented in section four. The final section discusses the findings obtained in sections three and four before offering some brief concluding remarks.

2.0 Underpinnings of Compliance Behaviour

Stipulating compliance policy and institutional design requires a comprehensive understanding of compliance behaviour. The most prominent theorising regarding regulatory compliance stems from calculated motivations for compliance. The seminal work by Becker (1968; see also Ehrlich 1972; Stigler 1970) proposed that those regulated will comply with a particular regulation regime when they perceive that the benefits of compliance, including avoidance of fines and penalties, surpass the costs of compliance. Although the individual approach to this calculation may vary, depending on how one evaluates benefits and costs, the process of selecting between complying or not complying is based on the expected utility in terms of net return.

Thus, it appears that the establishment of a compliance system is, hypothetically at least, a key factor associated with calculations of expected utility. A succession of studies on the economics of crime stemmed from Becker's model (1969) (see, for example, Heineke 1978; Pyle 1983; Sutinen & Andersen 1985; Anderson & Lee 1986; Milliman 1986). These studies employed the basic deterrence framework, which supposes that the threat

of sanctions is the single policy mechanism offered to increase compliance with regulations.

Subsequently, various forms of enforcement have been implemented as an economic mechanism to impose restrictions on interests and values-for example water restrictions- in an attempt to achieve desired situations, such as reduced urban water demand (Pannell 2001). Economic mechanisms are largely grounded in the neo-classical assumptions of rational economic man where profit and utility maximisation are assumed paramount. One of the problems with this approach is that it can be relatively imprecise as it tends to regard individuals as largely homogenous and relies heavily on specific assumptions about the motivations that drive behaviour. These assumptions can, in turn manifest themselves in policy intervention that is less than effective. At a theoretical level at least, these limitations are evident in the growing literature that emphasises the role of social rules and personal morals and their impact on individuals as behavioural constraints (James et al. 2001; Tyler 1990).

Therefore, economic incentives alone, may not prove effective in all contexts and revealing the intricacies of the individual's decision-making process has the potential to improve the confidence with which such incentives might be recommended. Moreover, this constrained approach assumes that consumers are relatively homogenous and will respond similarly to any given motivational triggers. The following section is used to explore the different dimensions associated with the concept of incentives.

2.1 Incentives

The study of incentives is fundamental to economics. The conventional economist is of the view that all problems can be solved if given a free hand to develop the proper incentive scheme (Levitt & Dubner 2005). Notably, the economist's solution may not necessarily be compliant with civil liberties and it may involve exorbitant penalties, but the initial problem will be overcome. Levitt and Dubner (2005, p.21) define an incentive as "a means of urging people to do more of a good thing and less of a bad thing". All individuals learn to respond to incentives, both positive and negative, thus incentives

have the potential to change a situation. However, an incentive usually has to be created by someone, whether it is a politician or a parent. The concept of an incentive can be classified into three dimensions; economic, social and moral (Levitt & Dubner 2005). It is common practice for an incentive scheme to include all three dimensions.

Some of the most compelling incentives developed have been established to discourage crime. As previously discussed, the possibility of getting caught, fined or going to gaol, which are essentially economic penalties, act as sound incentives to comply with the law. However, in the context of crime, individuals also respond to social incentives (d'Astous 2005; Evans & Norman 2003) i.e. they do not want to be seen by others as behaving 'inappropriately', and moral incentives (Connor & Armitage 1998; Evans & Norman 2003) i.e. they do not want to behave in a way they consider to be wrong. For particular forms of misconduct, particularly conspicuous acts such as violating water restrictions, social incentives are extremely influential. In light of this, modern society employs economic, social and moral incentives in an attempt to mitigate crime.

Notably, with every incentive there is an inherent trade-off. That is, the incentive may be relatively harsh which means that it is likely to deter misbehaviour, however this may engender animosity. Alternatively, a relatively mild penalty may be more acceptable, but is not likely to be effective in deterring misbehaviour. Accordingly, a high presence of water patrol officers within a city may be just as undesirable as a low presence. Similarly, a high degree of education and media exposure regarding 'appropriate' behaviour consistent with society's regulations may also be as unfavourable as a low degree. Levitt and Dubner (2005) have observed that the key is to balance the extremes.

A useful contribution at this point is the concept of efficient crime (Winter 2008), which suggests that if the benefit of a crime outweighs its cost it may be in society's best interest to encourage that crime. Therefore, Winter (2008) argues that it may not be desirable to deter all crime because of the resource costs that would be needed to achieve this. In addition, Winter (2008, p.5) proposes that it may be efficient for some crimes to occur (i.e. if the benefit gained by the criminal exceeds the cost it imposes on society)

"even if it is costless to deter those crimes". Alternatively, Friedman (2000) claims that benefits to 'bad' people do not count therefore, rules against 'bad' people are inevitably efficient. Therefore, in the current context, it would appear that there is value in management and regulation strategies, given that it is lawful to comply with water restrictions and breaching them may be regarded as delinquent behaviour.

2.2 Beyond Economic Drivers

From a converse perspective, research shows that a large degree of variance in domestic water consumption can be explained by relatively uncontrollable factors such as the number of persons per household (Aitken et al. 1994). Stern (2000) has developed an outline of causal variables associated with behaviour that are essentially, uncontrollable. These include attitudinal factors, external or contextual forces, personal capabilities, and habit or routines. Firstly, attitudinal factors include values, norms, beliefs, and attitudes and can potentially assist in clarifying understanding of consumers' motivations. Put differently, they may point to the underlying 'rationality' or 'psycho-logic' of ostensibly illogical processes (Seligman et al. 1996). There are a number of theories that underpin behavioural variance. Namely, the cognitive dissonance theory of Festinger (1957), the norm-activation theory of Schwartz (1977), the new environmental paradigm (NEP) scale of Dunlop and Van Liere (1978), and the theory of planned behaviour[1].

Secondly, the external or contextual forces are variables that are exogenous to individuals. For instance, financial constraints, legal structures, regulations, a constrained physical environment, and community expectations are all influencing factors that are exogenous to the individual. Notably, the way in which these factors impact on individuals' behaviour is dependent on their beliefs and attitudes (Stern 2000). Therefore, it appears that the way in which individuals respond to water restrictions will be, in part, dependent on their beliefs and attitudes.

[1] Armitage and Conner (2001) regard the theory of planned behaviour (TPB) of Ajzen (1991) and the theory of reasoned action (TRA) of Fishbein and Ajzen (1975) as the most widely researched model of the relationship between attitudes and behaviour.

Thirdly, personal capabilities refer to the knowledge and skills that are required for certain behaviours. A number of authors have suggested that the explanatory power of socio-demographic variables is relatively limited in the context of environmental behaviours (see, for instance, Dietz et al. 1998; McFarlane & Boxall 2003). However, Stern (2000) claimed that variables such as income, gender, age and educational level may be proxies for personal capacities.

Finally, habits or routines also provide a set of variables that influence behaviour. Stern (2000) has acknowledged that habits and routines may need to be altered in order for behaviour to change. However, this particular set of variables does not require substantial analysis in the current context as the focus of this study centres on rational, conscious choice behaviour.

Numerous studies have revealed that deterrence alone cannot explain the generally large extent of compliance (see, for instance, Alm, McClelland & Schulze 1992). Moreover, it appears that social motivations, such as social norms and ethical concerns, perceptions of legitimacy and fairness as opposed to mere selfishness, influence individuals' behaviour (James et al. 2001; Tyler 1990). Put differently, consumers may not just be motivated by extrinsic incentives, but there may also be intrinsic motivations that play a prominent part in compliance behaviour (see, for instance, Carroll 1987). A useful contribution, in the current context would be to expand our understanding of the economic drivers that affect the behaviour of consumers in regards to water restrictions and also those drivers beyond economics, such as attitudinal and exogenous variables, in order to develop more effective compliance systems. This approach would also allow us to construct welfare estimates associated with water restrictions within and across groups in society.

3.0 Choice Modelling (CM)

In order to shed light on the preferences for a water restriction regime and likely compliance we turn to the CM technique. CM is a type of multivariate technique which is employed to comprehend the manner in which respondents form preferences for the attributes of products, services, or ideas (Hair et al. 1998). This technique allows

estimation of separate marginal values for each attribute or total values for any particular collection of attribute levels and it can also estimate the marginal rates of substitution between any two attributes. The theoretical underpinning of CM is random utility model (RUM) (McFadden 1974). In this case, an advanced RUM model is employed, where we relax the assumption that the coefficients are the same for all individuals. We will refer to the models within this approach as Mixed Logit (ML) models[2]. ML is increasingly used to estimate choice models (see, for example, Train 2003; Hensher & Greene 2003; Hensher et al. 2005). Notably, this approach relaxes the Independent of Irrelevant Alternative (IIA) assumption making it a less restrictive model specification than the Multinomial Logit (MNL) and Nested Logit (NL) models. Hensher et al. (2005) has suggested that as discrete choice models become less restrictive in their behavioural assumptions, the likelihood of the model revealing sources of preference heterogeneity associated with the mean and variance of systematic and random components increases. Therefore, this extended framework is able to capture a superior level of true behavioural variability in choice making (Hensher et al. 2005).

3.1 Data Collection

This research generally followed the experimental design process used by Lockwood and Carberry (1998), involving focus interviews, focus groups and survey pre-testing. It was anticipated that this process would reveal the attributes of the 'product', an urban water restrictions compliance regime and relevant attribute levels. Six cities were selected to draw the sample for conducting the main survey, which was distributed on-line to a random sample of households. These cities provided scope for analysis on several dimensions, including comparisons between water rich and water poor cities; Victorian and NSW cities; and regional and metropolitan cities.

Complete and valid information was gathered from 512 respondents (Wodonga: 54; Albury: 94; Melbourne: 106; Sydney:102; Goulburn: 51; Bendigo:105). Notably, the surveys were framed differently where half included information outlining the percentage

[2] Numerous names have been employed in the literature, i.e. random coefficient logit, random parameters logit, mixed multinomial logit, error components logit, probit with a logit kernel, and mixed logit. These names describe the same underlying model.

of national water usage per sector and the remaining did not[3]. The questionnaire consisted of four parts. The first part contained questions regarding respondents' attitude toward water restrictions. The choice-experiment was presented in the second section and questions regarding the respondents' socio-economic status were presented in part three. The final section was used to probe respondents about their WTP to avoid water restrictions[4].

3.2 CM Design

From a statistical perspective, experimental designs governing stated preference tasks should impart the maximum amount of information about the parameters of the attributes relevant to each specific choice task (Sandor & Wedel 2001). Concurrent with a move within the literature toward the use of efficient (and often non-orthogonal) designs, this study employs a D-effiecient design[5], where parameter estimates were obtained from a pilot study (see, for instance, Hensher & Greene 2003; Hensher 2005). More specifically, a Bayesian D-efficient design was employed, which generated 24 choice situations[6] (see, Sandor & Wedel 2001 for a review of Bayesian efficient designs). Each sampled respondent evaluated 12 stated choice sets, where each choice set comprised three alternatives and the third alternative was always the status quo[7]. Whilst the specified attributes were common across all options, the levels differed from one option to another, according to the experimental design.

In this case, the product was identified as a 'compliance regime' for urban water restrictions[8], which was comprised of the following four generic attributes: the price

[3] The significance of this is investigated later in the paper by including the variable FACTS into the models.
[4] See section 4 for a review of the CV analysis conducted with this data.
[5]The generation of statistically efficient designs has been addressed by numerous authors (see, for instance, Kuhfeld et al. 1994; Lazari & Anderson 1994; Huber & Zwerina 1996; Bunch et al. 1996; Sandor & Wedel 2001; Kanninen 2002).

[6] The efficiency of a Bayesian D-efficient design is less sensitive to misspecification of the priors, and therefore considered to be more robust (Rose & Bliemer 2005).
[7] See Appendix A for a sample of the choice sets presented to respondents.
[8] In an attempt to address the potential challenge of adverse behaviour, that is, respondents who breach water restrictions deliberately selecting compliance regime alternatives that will minimize the likelihood that they will get caught, a series of statements were included before the choice experiment. These

respondents were WTP per annum to have the compliance regime invoked in their city; the number of water inspectors per household to patrol householders outdoor water usage; an attribute to act as a proxy for the educating and informing aspect of a compliance regime was included in the form of 'frequency of exposure' to informative media advertisements regarding water restrictions; the ability to report neighbours via a hotline to a team who would process the complaint. This final attribute was developed in response to the evident increase in management conflicts between water users and decision-makers around the daily management of the water resource. For instance, in many cases, individuals have expressed concerns that their reports of water abuse are not being taken seriously (Geelong Advertiser 2006).

3.3 Results

3.3.1 Coding of Variables and the Status Quo

To develop models of buyer behaviour in the current context, choice attributes and socio-economic variables were coded for regression[9]. In this instance, the status quo or base option implied that the respondent would prefer the present situation to either of the alternatives. Obviously, if the respondent chose neither option, they make no additional payments, but do not receive the 'benefits' of the compliance regime; say by being able to report their neighbours' breach to authorities. In terms of the 'inspector' attribute, the status quo indicated a ratio of 1 water patrol officer per 10,000 households[10] and the 'informing' attribute status quo implied that the frequency of being informed about water restrictions will be once every 90 days[11].

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statements highlighted the possible and generally undesirable outcomes of people not complying with water restrictions (e.g. reduced water reliability in the immediate term, more severe water restrictions in the future, an increase in the need to source alternative water supplies).

[9] Refer to the Appendix B: Table 1 & 2 for a complete report of attribute and variable coding.

[10] This ratio was established by estimating the average number of households per water inspector based on the number of water inspectors across the six cities used for this study during 2008.

[11] As a minimum, water authorities are required to notify residents at least once when a water restriction stage is changed. Therefore, if a city was to stay on the same water restrictions stage for the entire summer it would only be mandatory for the water authority to inform its residents once during this period. Any additional activities aimed at informing and reminding customers is at the discretion of each water authority or city council.

3.3.2 The Mixed Logit Model (ML)

All four attributes were initially included as random variables and different distributions were used to estimate the models. A number of distributions were imposed upon the REPORT attribute (i.e. normal, lognormal, uniform, triangular) and all collapsed to a single point represented by its mean. In this case, all individuals within the sample may be (statistically) represented by a REPORT parameter of 0.886, and hence the REPORT parameter is treated as a non-random parameter in Model 1. Conversely, dispersion of the PRICE, INSPECTOR and INFORMING parameters is statistically significant at the 1 percent level, as suggested by a Wald statistic of -11.15, -7.08 and 6.63 respectively and a p-value of 0.000 for all three parameters. This suggests the presence of heterogeneity over the sampled population with regards to individual-level PRICE, INSPECTOR and INFORMING parameter estimates. Therefore, these attributes are treated as random parameters (see Model 1, Table 1). Moreover, a triangular distribution for the PRICE parameter and a normal distribution for the INSPECTOR and INFORMING parameters was employed for Model 1 based on statistical grounds (Hensher et al. 2005).

The Chi-square value of Model 1 suggests that the overall model is statistically significant[12] and a pseudo-R^2 of 0.19 is considered adequate (Hensher et al. 2005). This model implies that respondents were more likely to select a compliance regime option as opposed to the status quo when it: embodied a lower price, offered less households per water inspector (i.e. a more vigilant inspection regime), provided a lower level frequency of information exposure and offered a means of reporting others for breaching water restrictions. Accordingly, it would appear that respondents prefer the alternatives that provide more patrol officers in their city, less frequent information prompts about water restrictions in the media and being able to report residents if they are observed flouting water restrictions.

[12] Chi-square value of 2530.37 compared against a critical Chi-square value of 30.144 with 19 degrees of freedom taken at alpha equal to 0.05.

The ML model was also estimated with each of the attributes interacted with socio-economic variables. A number of the interactions that proved to be significant are reported in Model 1.

Inspectors

The significant interactions between INSPECTOR and HOME; INSPECTOR and INTENT; INSPECTOR and NEWSPAPER imply that differences in the INSPECTOR attribute may be partially explained by differences in respondents intentions to comply with water restrictions, whether or not they own their own home and whether they believe that a resident's name should be published in the newspaper if they have breached water restrictions. More specifically, the parameters of these interactions indicate that the average respondent has a preference for more inspectors and this preference is stronger for respondents who own their home, are intent on complying with water restrictions and who strongly disagree with publishing offenders' names in the newspaper.

Informing

The interaction terms between INFORMING and AGE; INFORMING and HOME; INFORMING and GENDER; INFORMING and REGION; INFORMING and WATER; INFORMING and DOB are significant at the 1 percent level. This suggests that these variables, in part, explain the differences in the INFORMING attribute. The interactions imply that the average respondent has a preference for a decrease in the frequency of information regarding water restrictions[13] and the strength of this preference is greatest for respondents who are younger, males, disinclined toward 'dobbing in' neighbours, own their home, live in a metropolitan city and have been on more severe water restrictions for a longer period of time relative to other respondents in the sample.

Price

The interactions between PRICE and NEWSPAPER and PRICE and DOB are positive and significant. Therefore, these attitudes shed some light on the heterogeneity around

[13] This is true for the average respondent, however, the standard deviation for the INFORMATION parameter is relatively wide (0.0389), which implies that the distribution of parameters in INFROMATION will be both positive and negative.

the mean of the PRICE attribute. More specifically, these data support the view that respondents have a preference for a lower price and this preference is stronger for people who disagree with publishing offenders names in the newspaper and disagree with 'dobbing in' their neighbours relative to other respondents in the sample.

Table 1: Mixed Logit Model: Socio-economic Characteristics Interacted with Attributes

Model 1		
	Coefficient	Std error
Random Parameters in Utility Functions		
PRICE	-0.0612***	0.0998
INSPECTOR	-0.1563D-04***	0.22D-04
INFORMING	0.0389***	0.0257
Non Random Parameters in Utility Functions		
C1	2.0082***	0.2971
REPORT	0.8863***	0.0675
Heterogeneity around the mean		
PRICE:NEWSPAPER	0.0018**	0.0007
PRICE:DOB	0.0075***	0.0011
INSPECTOR:HOME	-0.37D-05***	0.89D-06
INSPECTOR:NEWSPAPER	0.17D-05***	0.44D-06
INSPECTOR:INTENTION	-0.14D-05*	0.83D-06
INFORMING:AGE	-0.0042***	0.0011
INFORMING:HOME	0.0035***	0.0007
INFORMING:GENDER	-0.0090***	0.0015
INFORMING:REGION	0.0073***	0.0017
INFORMING:WATER	0.0062***	0.0018
INFORMING: DOB	-0.0063***	0.0007
Standard deviations of random parameters		
PRICE	0.0998***	0.0122
INSPECTOR	0.22D-04***	0.38D-05
INFORMING	0.0257***	0.0041
Model statistics		
Log L	-5484.68	
Pseudo R^2	0.19	

*** indicates significance at the 1 percent level. ** indicates significance at the 5 percent level. *indicates significance at the 10 percent level.

3.3.3 Estimation of Implicit Prices

In addition to the generalizations formed above, the parameter estimates from the ML model can be employed to generate empirical estimates regarding specific welfare measures. In economic theory, the marginal rate of substitution between the price attribute (generic cost parameter) and the other three attributes defines the householder's

WTP or implicit prices for a modification to the compliance regime. That is, the WTP for an attribute is the ratio of that attribute's parameter estimate to the parameter estimate of the cost parameter. The WTP measures may be derived employing either the unconditional parameter estimates or conditional parameter estimates, which may be constrained or unconstrained (Hensher et al. 2005). In this case, unconditional parameter estimates are used. Estimates of marginal WTP constructed from Model 1 are reported in Table 2 and notably represent a householder's marginal WTP per annum for a change in the compliance regime for water restrictions, *ceteris paribus*.

Table 2: Implicit Price-Model 1

		95% CI for Mean	
	Mean WTP	Lower Bound	Upper Bound
INSPECTOR	0.00092*	-0.00043	0.00227
INFORMING	1.476*	-2.7137	5.666
REPORT	38.08*	-43.66	119.82

*The mean WTP were calculated using the unconditional parameter estimates.

The implicit price estimates obtained from Model 1 imply that respondents are WTP to bring about changes in the compliance regime associated with water restrictions. More specifically, the estimates reveal that, on average, respondents are WTP $38.08 per annum to have a service provided that takes and processes complaints about a neighbouring non-compliance. In terms of frequency of exposure to information regarding water restrictions, on average respondents are WTP about $1.50 per annum to have one less day that they are exposed to information about water restrictions[14]. The WTP estimate for the inspector attribute implies that, on average, respondents are WTP $0.00092 to have one less household per water patrol inspector, that is an increase in the presence of inspectors. Hypothetically, at least, we can use these values to construct more meaningful scenarios, particularly regarding the WTP estimates associated with the inspector attribute (see Table 3). For instance, on average respondents are WTP $9.20 per annum to increase the presence of inspectors from 1 per 20,000 households to 1 per 10,000 households and $82.80 to increase the presence of inspectors from 1 per 100,000 household to 1 per 10,000 households.

[14] Put differently, this implies that the average respondent is WTP about $1.50 per annum to have one more day between reminders.

Table 3: Inspector Attribute WTP- Hypothetical Scenarios

Scenario (Inspector:Houshold)	Mean WTP
1:20,000 to 1:10,000	$9.20
1:100,000 to 1:10,000	$82.80

4.0 Contingent Valuation

In addition to investigating householders' preferences for a water restriction regime, data were collected to uncover the preference for avoiding restrictions entirely. These data are considered in the context of the CV methodology.

4.1 Bid Design

Amongst the stated preference techniques the most extensively used approach is the contingent valuation (CV) method, which has been commonly employed to value preferences for environmental goods across numerous countries (Carson et al. 1995; Carson 2001). In a CV method study, respondents are asked questions to elicit their maximum WTP or minimum willingness to accept compensation for a predetermined change. A number of contingent valuation studies have used the multiple-bounded discrete choice (MBDC) response format as an alternative to the dichotomous choice format (Loomis & Ekstrand 1997; Welsh & Poe 1998; Poe et al. 2001; Cameron et al. 2002; Roach et al. 2002; Alberini et al. 2003; Evans et al. 2003; Vossler et al. 2003). The MBDC approach increases the number of possible intervals to k+1 (where k is the number of bids shown to a respondent). This approach improves the efficiency of the welfare estimate. This research employed a payment card (MBDC) with an exponential response scale design that contained 13 cells. The value given to respondents in the first cell was $0. The values in the second cell through to cell twelve were computed by equation (2),

$$B_n = B_1 (1 + k)^{n-1} \qquad (2)$$

In this case, B_n is the bid amount, where B_1 equals 1 and k is determined by the range selected for the payment card. The value of k is selected so that $(1+k)^{11}$ equals the largest value on the payment card i.e. $(1.86)^{11}= 921$[15]. Appendix C illustrates the bid design used for this study. The bids range from \$0 to \$900 and have a k value of 0.86. For ease of respondent review, the actual values listed on the payment card were rounded. Expressing a value of \$900 instead of \$921, or \$40 instead of \$41, is less distracting to respondents when they review the payment card, rarely has this had a significant effect on WTP summary statistics, and is not likely to be within the reporting precision of respondents (Rowe et al. 1996). In this study, the MBDC format required respondents to indicate their voting certainty on a proposed policy referendum at each of the possible dollar values specified on the payment card (bids) by choosing from "definitely no", "probably no", "not sure", "probably yes", and "definitely yes" response alternatives.

4.2 Ordered Probit Model

There are a number of ways that have been proposed to retrieve the WTP from this form of data. Here we applied an ordered probit model[16] (see, for instance, Cameron et al. 2002; Horna et al. 2007). The central concept of an ordered probit model is that there is a latent continuous metric underlying the ordinal responses observed by the analyst. Thresholds partition the real line into a series of regions corresponding to the various ordinal categories. The latent continuous variable, y^* is a linear combination of some predictors, $\mathbf{x}$, the bid amount plus a disturbance term that has a standard Normal distribution:

$$y^*_i = \mathbf{x}_i \boldsymbol{\beta} + \beta_o \mathbf{Bid} + e_i, \qquad e_i \sim N(0, 1), \forall\, i = 1, \ldots, N.$$

y_i, the observed ordinal variable for individual i, takes on integer values 0 through m according to the method below:

[15] The value k equals the percent increase between adjacent cells before smoothing of the values. Cell 13 includes the text 'More than the above,' which implies more than B_{12}.
[16] The ordered probit model was estimated using the data collected from the main survey instrument, which was described in section 3.

$$y_i = j \quad \Leftrightarrow \quad \mu_{j-1} < y^*_i \leq \mu_j,$$

where j =0,…,m, and $\mu_{-1} = -\infty$, and $\mu_m = +\infty$, and the μj are defined as the 'cut values'.

To determine how changes in the predictors translate into the probability of observing a particular ordinal outcome consider the following:

$$P[y_i = 0] = P[\mu_{-1} < y^*_i \leq \mu_0],$$
$$= P[\infty 1 < y^*_i \leq \mu_0],$$
$$= P[y^*_i \leq \mu_0],$$

substituting from (1),

$$= P[\mathbf{x}_i \boldsymbol{\beta} + \boldsymbol{\beta}_o \mathbf{Bid} + e_i \leq \mu_0],$$
$$= P[e_i \leq \mu_0 - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}],$$
$$= \Phi(\mu_0 - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid});$$

$$P[y_i = 1] = P[\mu_0 < y^*_i \leq \mu_1],$$
$$= P[\mu_0 < \mathbf{x}_i \boldsymbol{\beta} + \boldsymbol{\beta}_o \mathbf{Bid} + e_i \leq \mu_1],$$
$$= P[\mu_0 - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid} < e_i \leq \mu_1 - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}],$$
$$= \Phi (\mu_1 - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}) - \cup(\mu_0 - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}).$$

Therefore, generically:

$$P[y_i = j] = \Phi (\mu_j - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}) - \Phi (\mu_{j-1} - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}).$$

For j = m (the 'highest' category) the generic form reduces to:

$$P[y_i = m] = \Phi (\mu_m - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}) - \Phi (\mu_{m-1} - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}),$$
$$= 1 - \Phi (\mu_{m-1} - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}).$$

A maximum likelihood estimation (MLE) is used to estimate the model, thus initially a log-likelihood function is generated. This is achieved by defining an indicator variable Z_{ij} , which equals 1 if $y_i = j$ and 0 otherwise. The log-likelihood is simply[17]:

[17] The variance parameter was set to equal 1.

$$\ln \mathcal{L} = \sum_{i=1}^{N} \sum_{j=0}^{m} Z_{ij} \ln[\Phi_{ij} - \Phi_{i,j-1}],$$

where $\Phi_{ij} = \Phi [\mu_j - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}]$ and $\Phi_{i,j-1} = \Phi [\mu_{j-1} - \mathbf{x}_i \boldsymbol{\beta} - \boldsymbol{\beta}_o \mathbf{Bid}]$.

(Greene 1990)

In the context of the current study, a further adjustment is required to account for the panel nature of the data: each respondent contributes 12 observations (associated with the 12 bid amounts). This can be dealt with by estimating a random effects ordered probit model, where the error term is modified such that:

$$y^*_{ki} = \mathbf{x}_i \boldsymbol{\beta} + \boldsymbol{\beta}_0 \mathbf{Bid}_\mathbf{k} + \zeta_i + e_{ki}, \qquad e_{ki} \sim N(0, 1) \, , \, \zeta_i \sim N(0, 1)$$

where ζ_i is an individual specific random effect, and k indicates the bid within the panel. The implication is that the responses are correlated for an individual, but are independent across individuals (Alberini et al. 2003).

4.3 Ordered Probit Results

An ordered probit model was estimated for all respondents. Table 4 summarizes the results of model 2, where significant socioeconomic and attitude items have been included in an attempt to improve model fit[18].

[18] Refer to Appendix B: Table 1 & 2 for a description of the interaction variables.

Table 4: Ordered Probit Model

Model 2		
	Coefficient	t-ratio
BID	-0.0046 ***	43.46
FACTS	0.2082 ***	3.29
STATES	0.4147 ***	6.56
WATER	-0.2632 ***	3.51
INCOME	0.0002 ***	4.31
AGE	-0.0094 ***	2.40
EDUCATION	-0.0879 ***	2.75
NUMBER CHILDREN	-0.0972 ***	2.21
POOL	-0.1631 **	2.03
INTENTION	-0.2137 ***	3.68
ATTITUDE	0.3140 ***	3.57
SOCIAL NORMS	0.1669 ***	4.37
VALUES	-0.1294 ***	2.56
PBC	-0.3593 ***	7.19
μ_1	-1.2201 ***	5.07
μ_2	-0.7557 ***	3.15
μ_3	-0.2346	0.98
μ_4	0.4376	1.83
N	6132	
Log Likelihood	-6267.202	

*** indicates significance at the 1 percent level. ** indicates significance at the 5 percent level.

Model 2 indicates that the STATES, FACTS and INCOME parameters are positive and significant, which imply a number of relationships. Firstly, respondents residing in NSW gain a higher utility from avoiding water restrictions than Victorian respondents and therefore have a higher WTP to avoid them. Secondly, those respondents who received facts regarding national water usage on their survey gained a higher utility from avoiding water restrictions than those who did not receive facts. Thirdly, higher income earners have a higher WTP to avoid water restrictions than lower income earners. Conversely, the WATER, AGE, EDUCATION, POOL and NUMBER CHILDREN parameters are

negative and significant. This suggests that participants from cities that have been on severe water restrictions for a long period of time are less WTP to avoid water restrictions compared to those respondents from cities that have a shorter history of water restrictions. In addition, respondents that are younger, have a lower level of education, do not own a pool and have a lower number of children residing in their household gain a higher utility from avoiding water restrictions and are therefore more WTP to avoid water restrictions. These results support Syme and Nancarrow's (1991) observation that concerns surrounding perceptions of water restrictions are likely to be related to socio-economic status, age and household size, which may prompt strong emotions among water users.

Attitude components were also included in the ordered probit model[19] in an attempt to increase our understanding of the cognitive, and perhaps more profound, influences over behaviour. Model 2 indicates that INTENTION, VALUES and PBC have negative and significant coefficients, which has several implications. Firstly, respondents that indicated a low intention to comply with water restrictions appear to be more inclined to pay to avoid water restrictions relative to those with higher intentions to comply. Secondly, respondents that expressed relatively low environmental values are generally more WTP to avoid water restrictions. Thirdly, participants that scored low in terms of perceived behavioural control were also more inclined to use a monetary vehicle to avoid water restrictions. Put differently, those that believe that the actions of their individual household will not influence the overall water situation are generally more WTP to avoid water restrictions. On the other hand, ATTITUDE and SOCIAL NORMS[20] have positive and significant coefficients. Perhaps controversially, respondents with a favourable attitude toward complying with water restrictions appear more WTP to avoid them than those with a less favourable attitude. The SOCIAL NORMS variable attempts to act as a proxy for participants' ranking of social norms i.e. the extent to which the respondent views compliance as 'appropriate behaviour' in a social context. The data thus support

[19] Six attitude components were estimated from 30 scale items included in the survey, where the extraction method employed was principal axis factoring. Refer to Appendix B: Table 2 for a description of these variables.

[20] For a more detailed explanation of the derivation of these items see Cooper (forthcoming).

the view that those who scored higher in terms of SOCIAL NORMS were more inclined to pay to avoid water restrictions.

4.4 WTP to Avoid Water Restrictions

The definition of the median WTP is complicated if the central category is unsure. In such cases one can only say that the median WTP lies within a bound. These are defined in this case as:

$WTP_l = (x_i \beta - \mu_3)/\beta_o$

and

$WTP_u = (x_i \beta - \mu_2)/\beta_o$

where l and u indicate lower and upper bounds respectively. Given the inclusion of the respondent-specific exogenous variables x_j, the WTP values can be evaluated either at the means, or at specific values. One view of these bounds is that they represent alternative interpretations of the value needed to achieve a majority in a referendum: the lower assumes that the majority can include only those who say "definitely yes" and "probably yes", while the upper bound considers those who respond both "yes" and "uncertain".

The median WTP for all respondents was estimated from the sample data and the estimated coefficients from Model 2. This range is not a statistical significance concern, rather the WTP of -$4.86 represents the conservative estimate and the WTP of $107 represents a liberal estimate (see Table 5).

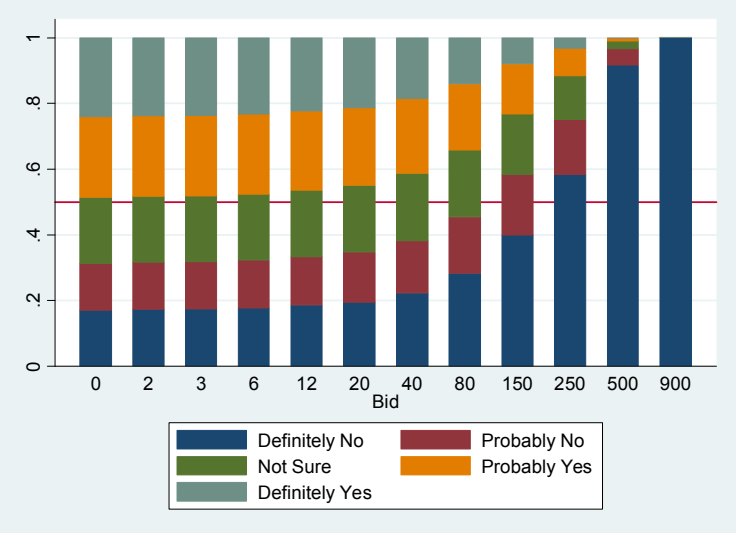
Table 5: WTP per annum All Respondents

	WTP	t-ratio
Lower bound (Conservative)	-$4.86	-0.64
Upper bound (Liberal)	$107.06	14.55***

*** indicates significance at the 1 percent level.

In addition, Graph 1 is derived from the estimated coefficients from Model 2 and illustrates the predicted probabilities for each class (definitely no; probably no; unsure; probably yes; definitely yes) of the latent variable for each of the bid amounts. Framing this information as a referendum, we can also determine the range where the WTP will fall for the median respondent.

Graph 1: Predicted Probabilities



A number of unconditional median WTP values were estimated along situational dimensions in order to make meaningful comparisons within the sample data. Table 6 below presents the range for the unconditional Median WTP across three dimensions. Firstly, the WTP range is presented for NSW respondents compared to Victorian respondents. As observed earlier, NSW participants are generally more WTP to avoid water restrictions than Victorians, where, even from the conservative perspective, NSW respondents are WTP $45. Notably, this may, in part, be explained by the vastly different enforcement regimes associated with water restrictions across the two states. For instance, Victoria has a less stringent regime and therefore Victorian respondents may not perceive there to be as much value in paying to avoid water restrictions as they are not as heavily enforced as those in NSW.

Secondly, Table 6 enables us to compare the WTP range for water rich cities with water poor cities. That is, those cities that have a history of severe water restrictions compared to those that have been faced with less severe restrictions or restrictions more recently. Respondents from water poor cities have a lower WTP range. This may, in part, be explained by the notion that consumers adapt to changing circumstances (Seligman et al. 1996). Thus, residents in water poor cities may have invested in water efficient gardens or alternative water supplies, and hence might be expected to gain a lower utility from avoiding water restrictions. Moreover, Krannich et al. (1995) suggests that severe and long-term scarcity can seriously strain the response capabilities of individuals. Therefore, the notion of 'water restriction fatigue' may also contribute to the explanation of this result[21] where, in some instances, consumers in water poor cities have developed an indifferent attitude toward water restrictions altogether.

Finally, the WTP range is presented for those respondents who received information pertaining to national water use compared to those who did not. The data reveals that those who received this information had a higher WTP. Notably, participants that received this information indicate a WTP value of $21 from the conservative perspective, with the upper bound estimating a WTP of $133. This suggests that there may be merit in further investigating whether differing amounts of information will alter people's preferences to tolerate water restrictions. For instance, 'to what extent are the people who generally support water restrictions decisions subject to information regarding the national distribution of the resource?'

[21] This concept became apparent during interviewing residents from cities that had been on severe water restrictions for a long period of time (i.e. Bendigo, Goulburn). A number of interview participants revealed a diminishing enthusiasm for water restrictions due to the extensive length of time they had been inflicted upon them.

Table 6: Unconditional Median WTP Ranges

	States			
	NSW	t-ratio	Vic	t-ratio
Lower bound	$45.09	4.84***	-$55.80	-5.10***
Upper bound	$157.02	16.78***	$56.13	5.35***
	Water			
	Water Rich	t-ratio	Water Poor	t-ratio
Lower bound	$19.76	2.39**	-$63.22	-4.35***
Upper bound	$131.69	16.12***	$48.71	3.45***
	Facts			
	No	t-ratio	Yes	t-ratio
Lower bound	-$8.29	0.76	$21.17	2.11**
Upper bound	$103.63	9.69***	$133.11	13.47***

*** indicates significance at the 1 percent level. ** indicates significance at the 5 percent level. All other exogenous variables held constant at mean levels.

5.0 Discussion and Concluding Remarks

People's sensitivity to water restrictions and preferences for a compliance regime appear to differ between groups within the population. Being able to identify the segments within the population who are most likely to be adversely affected by water restrictions and establishing people's preferences for compliance regimes is an important element to developing effective policy.

Analysis in section three reveals that the average survey respondent values modifying the compliance regime surrounding water restrictions. More specifically, the notion that respondents, on average, are WTP to have a service that enables them to report others for what they might perceive as 'water abuse' and are also WTP to increase the presence of water inspectors suggests that they value economic incentives in relation to regulating

water restrictions. Notably, this type of incentive may have a negative impact on social cohesion and thus, undermine moral and social incentives. The estimates also reveal that respondents, on average, are WTP to decrease the frequency of information appearing in the media regarding water restrictions. Paying to receive less of a product's attribute may, in the first instance, appear to be behaviourally implausible. However, given the nature of this attribute it is reasonable to suggest that respondent's utility may, in fact, be increased when they are not inundated with information. Consistent with this notion is the consumer behaviour concepts of 'habituation' and 'advertising wear-out', which occur when consumers are overexposed to particular stimuli (see, for instance, Blackwell et al. 2006).

The CM results also imply that attitude and socio-demographic variables can, in part, explain the variance in preferences surrounding the attributes comprising the compliance regime. Accordingly, different segments within society will have varied preferences regarding an optimum compliance regime for water restrictions.

Contrary to the implied value of 'saving water' that dominates popular thinking, analysis in section four suggests that particular segments within society actually value not being subject to water restrictions. More specifically, attitudinal variables (e.g. attitudes toward social norms) and particular value sets (e.g. environmental values) were prove to play some part in influencing an individual's WTP to avoid water restrictions. Similarly, respondents that differ across socio-demographic variables such as age, income and education also appear to receive differing levels of utility from avoiding water restrictions. In addition, exogenous factors such as a respondents' state jurisdiction, the severity and duration of water restrictions imposed within their city and whether the respondent received information about overall national water usage were shown to have an influence on the respondent's WTP to avoid water restrictions. Interestingly, across some of these situational dimensions it appears that respondents do not *prima facie* gain utility from avoiding water restrictions and across others the impact of water restrictions on human welfare is self evident.

The policy implications of this analysis are significant. Presently, state jurisdictions impose a range of constraints to limit household water use. Clearly, this approach is not unanimously supported by the population, although many would appear to be in favour of more rigorous application across the populous. By way of contrast, the CV data also show that more rigorous enforcement- such as that applied in NSW- is also linked to a greater inclination to pay to avoid restrictions. Moreover, when individuals have access to information about national water consumption trends they are more inclined to seek to 'buy their way out' of the restriction regime. All of these topics are worthy of greater scrutiny in a policy context and provide a useful basis for future research.

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Appendix A: Choice Set Example

Which enforcement & education package would you choose?		Price of the Enforcement Package 	Number of Inspectors 	Information 	Able to report your neighbour 
Package 1		$5 per year	1 per 8, 000 households	Every 14 days	Yes
Package 2		$50 per year	1 per 5,000 households	Every 7 days	No
Neither		$0 per year	1 per 10,000 households	Every 90 days	No

Appendix B: Table 1 and 2- Coding of Attributes and Variables

Table 1: Coding and Description of Attributes and Socio-Economics Variables

ATTRIBUTES/ VARIABLES	DESCRIPTOR	STATUS QUO	LEVELS/CODING
NUMBER OF INSPECTORS	ratio: inspector per household	1: 10,000=10,000	1: 1,000= 1,000 1; 2,000= 2,000 1: 5,000=5,000 1:8,000= 8,000 1: 50,000= 50,000 1: 200,000=200,000
INFORMATION	Frequency of household exposure (days)	Every 90 days=90	Everyday= 1 Every 7 days= 7 Every 14 days= 14 Every 31 days= 31
INCREASE IN WATER BILL (WTP)	$ Per annum	$0 per annum=0	$2=2 $5 =5 $10=10 $20=20 $50=50 $100=100
ABLE TO REPORT YOUR NEIGHBOUR	Yes; No	No=0	Yes=1 No=0
AGE	4 stage scale		18 to 24=1 25 to 54=2 55 to 64=3 65+ =4
GENDER	2 stage scale		Male=1 Female=2
REGION	Do respondents live in a regional or metropolitan city		Regional=0 Metropolitan=1
WATER	Do respondents live in a water poor or water rich city		Water rich=0 Water poor=1
HOME	Do respondents own their own home or currently paying if off		Yes=1 No= -1
DOB	7 stage Likert scale		1 (strongly disagree)=-3 2=-2 3=-1 4=0 5=1 6=2 7 (strongly agree)=3

Table 1 Cont'd

ATTRIBUTES/ VARIABLES	DESCRIPTOR	STATUS QUO	LEVELS/CODING
NEWSPAPER	7 stage Likert scale		1 (strongly disagree)=-3 2=-2 3=-1 4=0 5=1 6=2 7 (strongly agree)=3
FACTS	Did respondents receive facts outlining national water usage on their survey		Yes=1 No=0
STATES	Which state do respondents live in		NSW=1 Victoria=0
INCOME	Total household income per week		<$200=1 $200-$299=2 $300-$399=3 $400-$499=4 $500-$599=5 $600-$699=6 $700-$799=7 $800-$999=8 $1,000-$1,499=9 $1,500+ =10
EDUCATION	Highest level of education completed		Year 10 at secondary college=1 Year 12 at secondary college=2 Diploma or certificate=3 Tertiary degree=4
NUMBER OF CHILDREN	The number of children in their household		None=0 1 or 2=1 3 or 4=2 5+ =3
POOL	Do respondents have a pool		Yes=1 No= -1

Table 2: Coding and Description of Attitude Variables

ATTITUDE VARIABLE	DESCRIPTOR	EXAMPLE QUESTION	CODING
INTENTION	Intention to comply with water restrictions: where increased intention implies greater intention to comply with water restrictions.	"I intend to follow water restrictions in the future"	Factor Score: 4 intention questions (5 stage Likert scale) were reduced to a single INTENTION variable.
ATTITUDE	Attitude toward water restrictions: where an increase in this variable implies a more favourable attitude toward complying with water restrictions.	"I think it is a good idea to comply with water restrictions"	Factor score: 11 Attitude questions (5 stage Likert scale) were reduced to 2 variables- ATTITUDE and SOCIAL NORMS Factor score (5 scale items).
SOCIAL NORMS	Respondents attitude toward social norms: where increased social norms implies a greater concern for behaving 'appropriately' according to society's norms.	"Most members of my family think I should comply with water restrictions" x "Generally speaking, I want to do what most members of my family think I should do"	
VALUES	Environmental values: where increased environmental values implies stronger values for the environment.	"It makes me sad to see natural environments destroyed"	Factor score: 8 Attitude questions (5 stage Likert scale) were reduced to 2 variables- VALUES and COMPLIANCE VALUES 3 items
COMPLIANCE VALUES*	Compliance Values in general: where increased compliance values implies stronger values for complying with the law in general.	"Generally, I feel that I have a duty to comply with the law"	
PBC	Perceived behavioural control over the national water situation: where higher PBC implies higher perceived control.	"It won't make any difference if my household does not comply with water restrictions"	Factor Score: 7 intention questions (5 stage Likert scale) were reduced to a single PBC variable.

*****This variable (component) did not prove to be statistically significant and was therefore not included in Model 2.

Appendix C: Contingent Valuation Bid Design

Given your household's income and other expenses, we would like you to think about whether or not you would be willing to make an annual payment so your household would not be subject to water restrictions. This amount would be listed as a separate item on one of your water bills for the year.

For each of the amounts below, please indicate your willingness to pay to avoid water restrictions.

	Willingness to Pay?				
Amount (each year)	**Definitely No**	**Probably No**	**Not Sure**	**Probably Yes**	**Definitely Yes**
0	A	B	C	D	E
$2	A	B	C	D	E
$3	A	B	C	D	E
$6	A	B	C	D	E
$12	A	B	C	D	E
$20	A	B	C	D	E
$40	A	B	C	D	E
$80	A	B	C	D	E
$150	A	B	C	D	E
$250	A	B	C	D	E
$500	A	B	C	D	E
$900	A	B	C	D	E
More than the above	A	B	C	D	E