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POLICY PAPER

Willingness to Pay For Achieving Good Status Across Rivers in the Republic of Ireland

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Abstract: The Water Framework Directive mandates EU Member States to achieve good status across all surface waters. Derogations from this have to be proven based on infeasibility or disproportionate cost. This study explores public preference for water quality objectives and assesses willingness to pay (WTP) for achieving good status across all rivers in the Republic of Ireland using contingent valuation. Mean WTP for achieving full good status across rivers was estimated at €19 per respondent per annum. WTP was influenced by social class, subjective perceptions relating to household financial status, education, recreational use, environmental values and river basin district.

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I INTRODUCTION

The Water Framework Directive (WFD), introduced in 2000 (European Parliament and Council, 2000), is a framework developed by the European Union (EU) to protect inland surface waters, groundwater, transitional and coastal waters (Europa, 2012). The WFD has a number of overarching objectives such as "preventing and reducing pollution, promoting sustainable water usage, environmental protection, improving aquatic ecosystems and mitigating the effects of floods and droughts" (Europa, 2012). One of the principle objectives of the WFD, in relation to surface waters, is to achieve good status by 2015 (or subsequent cycle) if not at this level already. The WFD mandates that there can be no deterioration in quality standards; hence if a water body is already achieving "good status" or "high status" then this must be maintained.

The WFD is demanding (OECD, 2012), as it covers the total water system (both quality and quantity); sets timelines for achieving relevant objectives; requires compliance with the polluter pays principle; stipulates that economic criteria are necessary to ensure WFD goals are achieved at least cost; has definitive targets for the chemical and ecological status of water bodies; requires full evaluation and monitoring of programmes; and comprises stakeholder consultation and participation through the river basin management planning process. Article 4 of the WFD stipulates that Member States may aim for less stringent objectives if the condition of a surface water body is so affected by human activity or the national condition is such that it would be technically infeasible or disproportionately expensive to achieve the primary objectives of the Directive, i.e. good status by 2015 or subsequent cycles. Consequently assessment of the "proportionality" of costs is an important element in the implementation of the WFD. The concept of disproportionate costs is not defined under the WFD. A commonly held view is that a measure could be regarded as disproportionately expensive where, in aggregate, the costs of the measure(s) to achieve good status exceed its benefit(s) (Goodbody Economic Consultants, 2008). In this context, assessing whether the achievement of good status is disproportionately expensive requires a comparison of the costs of putting in place a plan to achieve good status versus the benefits that might accrue as a result of the water body achieving good status (Norton *et al.*, 2012).

The benefits of an environmental public good like achieving good surface water status are difficult to quantify because they are not traded in the marketplace. Bateman *et al.* (2006a) outline how "the economic benefits (of implementing the WFD) are likely to be many although only a minority are likely to be easily amendable to quantification, for example, reduced water treatment costs. One important motivation for the WFD appears to be the creation of non-market environmental benefits, such as open-access recreation".

In situations where no market exists for the good or service alternative, non-valuation methods are required to estimate economic values placed on environmental public good provision. Non-market valuation methods applicable to estimation of the value of achieving good status can be separated into two typologies; revealed and stated preference methodologies (Bateman *et al.* 2006b; Hanley *et al.* 2006). Stated preference methodologies are advantageous as they allow for the estimation on a new level of a natural resource amenity that have not yet been experienced or provided such as achievement of good status under the WFD. The two major classes of stated preference elicitation techniques associated with provision of environmental public goods are contingent valuation and choice experiments. Choice experiments (CE) tend to deal more explicitly with how societal values relate to individual attributes, and combinations of attributes that make up the environmental good or policy under investigation whereas the contingent valuation (CV) method takes a more holistic approach by focusing on the value of (inter alia) moving from the status quo to an alternative status of the good or service (Hynes *et al.*, 2011). Hanley *et al.* (1998) used both CV and CE methodologies and compared the valuations of conservation benefits of Environmental Sensitive Areas in Scotland and concluded that CV seems best suited in valuing the overall policy package and CE in valuing the individual characteristics that make up this policy. Very few studies have looked at the benefit side of the equation in the Republic of Ireland and in this context this research seeks to address this gap by undertaking a survey of the general population using non-market valuation to explore willingness to pay (WTP) to achieve good status across all rivers in the Republic of Ireland. The paper proceeds as follows, firstly some background on WFD objectives is outlined. Then the methodology for the study is set out, results are then presented and some conclusions and discussion is offered.

II BACKGROUND

Under the WFD the status of a surface water body is determined based on the assessment of both ecological and chemical parameters (EPA, 2008). The ecological status of a surface water body is an expression of the quality, structure and functioning of aquatic ecosystems (EPA, 2010). Assessment is based on measurement across a cross-section of biological and physico-chemical parameters as well as supporting hydrology and morphology conditions. The biological parameters measurement assessment includes the abundance and composition of aquatic flora (diatoms, phytoplankton, macrophytes) and aquatic fauna (benthic invertebrates, fish). The physico-chemical parameters include oxygen, nutrients, temperature, water clarity, acid status and salinity. The

hydrology and morphology parameters include depth, flow, water level and bankside conditions (EPA, 2010). The chemical status of surface water is based on priority substances and certain other pollutants (European Parliament and Council, 2000) being below certain threshold values. Failures of surface water to either meet chemical or ecological standards will mean failure to achieve good status (EPA, 2008).

The WFD mandates that the achievement of objectives is to be coordinated at the level of the River Basin District (RBD). The Directive requires that management plans be prepared, including a programme of measures to achieve WFD objectives if required. River Basin Management Plans are prepared and renewed in a six-year cycle. The second six-year cycle covers the 2015 to 2021 period and policymakers are developing management plans for this phase. River Basin Districts were established based on the planning at the natural hydrologic units instead of administrative or political demarcations. These correspond to large catchment basins incorporating smaller sub-basins or hydrometric areas. Ireland is divided into 40 hydrometric areas, each of which comprises a single large river catchment or a group of smaller catchments. There are four River RBDs contained wholly within the Republic of Ireland namely the Eastern, South Eastern, Western and South Western RBDs. Three others, the North Western, Shannon and Neagh-Bann are shared with Northern Ireland and as such are classified as International River Basin Districts.

Table 1 below outlined the percentage river channel of good or high status by RBD (EPA, 2010). The South Western RBD (92 per cent) and the Western RBD (83 per cent) have considerably higher levels of river channel at good status compared to the other RBDs.

Rivers provide a range of ecosystem services. Humans can derive benefit from consumptive and non-consumptive use of rivers. These range from provision of drinking water, to various form of direct recreational use such as water sports or fishing, to indirect use such as walking or jogging along a river bank. This can influence the value individuals place on good water quality across rivers. The Republic of Ireland has an extensive network of rivers and streams. A European Commission study indicated that 43 per cent of Irish respondents indicated water pollution as one of the top issues they have concerns about (European Commission, 2011). Additionally, the European Commission (2012) carried out a survey looking at the European public's understanding of water-related issues. In relation to the Republic of Ireland the results of the survey showed that 40 per cent of those surveyed felt that they were well informed about problems facing groundwater, rivers and lakes. In terms of people's perceptions of water quality, 67 per cent of respondents felt that water quality issues were a serious problem in Ireland and 42 per cent felt that water quality in Ireland had actually deteriorated over the last ten years.

Table 1: *Percentage of River Channel Achieving At Least Good Status by River Basin District*

River Basin District (RDB)	*% River Channel of Good or High Status*
South Western RBD	92
Western RBD	83
North West RBD	66
Shannon RBD	58
South Eastern RBD	64
Neagh-Bann IRBD	55
Eastern RBD	46

Source: Environmental Protection Agency, 2010.

In this context the objectives of this research was to explore the importance the general public place on water quality-related issues, to assess the WTP of the general public for achieving WFD objectives across all rivers and to examine the factors which influence WTP, especially the role of environmental values.

III METHODOLOGY

3.1 *Data and Survey Design*

The main data source used in this analysis is a survey of the general population across the Republic of Ireland in 2013. A questionnaire instrument was designed to examine preferences regarding importance of water quality objectives, recreational use of watercourses, environmental values and willingness to pay for measures aimed at achieving good status across all rivers in the Republic of Ireland. A total of 650 face-to-face interviews (35 were conducted in the pilot phase and were not included in the final analysis) were conducted over 11 weeks by a team of professional interviewers. The target group for the surveys was the general public, i.e. adults aged 18 years or over. Stratified quota sampling was used to ensure a nationally representative sample of the population. Sampling points were based on 77 electoral divisions (ED), randomly selected around the country. Gender, age and social class quotas were also applied based on census of population data. The sampling methodology ensures that the sample will be nationally representative on gender, age, social class and region. Prior to the launch of the main survey a pilot phase was undertaken where the questionnaire instrument was tested.

Contingent valuation methodology (CVM) is a stated preference technique which asks respondents to directly express their willingness to pay (WTP) for a hypothetical change to a non-market good by means of a survey. The CVM is subject to various criticisms with regard to its reliability and validity. However,

it has emerged as a valid tool for estimating the benefits of non-market goods (Mitchell and Carson 1989, Arrow *et al.* 1993, Carson 2000, Boyle, 2003), expressly where respondents care about the proposed intervention and believe their responses have a positive probability of influencing the final outcome (Carson and Groves, 2007). Similar to Hynes and Hanley (2009) the payment card elicitation method of contingent valuation was used in this instance. The payment card format involves each respondent being shown a card listing various Euro amounts and being asked to indicate the maximum amount they were WTP for all rivers in the Republic of Ireland to achieve good status under the Water Framework Directive. In carrying out the survey each interviewee was provided with a show card outlining in percentage of river channel in the Republic of Ireland currently at high/good, moderate, poor and bad status as reported by the Irish Environmental Protection Agency (2010). This show card detailed the various attributes that contributed to the prevailing status as outlined in Table 2.

Respondents were told that 31.5 per cent of river channels in the Republic of Ireland are failing to achieve good status. Of this total, 21 per cent of river channel is classified as of moderate status, 10 per cent is classified as being of poor status and 0.5 per cent is of bad status. Respondents were informed that under the EU Water Framework Directive introduced by the European Commission all rivers in the EU must reach what is described as "good ecological status" and that if Ireland fails to comply with this standard it is facing reoccurring fines from EU enforcement institutions. Respondents were then told and shown (through show card) that good status in a river means that fish, insects and plants exist in abundance and with wide variety and also that the river is suitable for a variety of recreational activities. The show card also provided details of some of the common problems associated with rivers that are of moderate, poor or bad status. Once respondents had time to examine and consider the show card, they were asked the following question: "Bearing in mind the information presented earlier what is the maximum increase in your annual income tax that you would be willing to pay to get all rivers in Ireland to a point where they are classified as being of a good status?". Respondents were then presented with a payment card and asked to select one price only for a series of 21 bid prices ranging from €0 to more than €350 extra in additional taxation.

3.2 *Regression Analysis*

Modelling Framework – A generalised Tobit model was used to model respondents WTP using maximum likelihood estimation procedures (Hynes and Hanley 2009; Buckley *et al.* 2012). This generalised Tobit interval model employs a log-likelihood function adjusted to allow for point, left-censored,

Table 2: *Show Card Presented to Respondents*

	High / Good Status	*Moderate Status*	*Poor Status*	*Bad Status*
Current % rivers	69	21	10	0.5
Quality	Pristine and unpolluted	Slightly polluted	Moderately polluted	Seriously polluted
Water clarity and composition	Good water clarity	Slightly murky or discoloured water	Moderately murky or discoloured water	Murky or discoloured water. Smell noticeable
	No or trace algae	Some algae present	Excessive algae present	Absence of algae
	No smell	No noticeable smell	Some smell maybe noticeable	Some smell maybe noticeable
Insects	High diversity of insects	Less diversity but more density of certain type	Low diversity	Minimal diversity
Plant life	Diverse range of aquatic plants	Reduced diversity of aquatic plants	Excessive growths of aquatic plants	Aquatic plants are few to absent
Fish	Game (salmon and trout) and coarse (bream, roach) fisheries	Game fish are at risk	Coarse fisheries only	Fish absent
Bank condition	Banks in their natural condition	Evidence of bank alterations/ erosion	Clear evidence of bank alteration/ erosion	Extensive interference/ erosion
	Good cover of native vegetation	Majority of bank covered by native vegetation	Only parts of the banks are covered by native vegetation	Only small traces of vegetation on the banks

right-censored (top WTP category with only a lower bound) and interval data. For respondents, $j \in C$ we observe WTP_j, this is point data where respondents are willingness to pay €0. For individuals who selected the top WTP bid respondents are right censored $j \in R$, we hence know only that the unobserved WTP_j is greater than or equal to WTP_{Rj} the largest value offered in the show card (>€350). Finally where respondents selected a bid above €0 and below >€350 $j \in I$ are intervals. Hence, we know that the unobserved WTP_j falls in the interval $[WTP_{1j}, WTP_{2j}]$.The log-likelihood is hence given by:

$$\ln L = -\frac{1}{2}\sum_{j\in C}\left\{\left(\frac{WTP_j - x\beta}{\sigma}\right) + \log 2\pi\sigma^2\right\} + \sum_{j\in L}\log\phi\left\{\left(\frac{WTP_{Lj} - x\beta}{\sigma}\right)\right\}$$

$$+\sum_{j\in R}\log\left\{1-\Phi\left(\frac{WTP_{Rj} - x\beta}{\sigma}\right)\right\} + \sum_{j\in I}\log\left\{\phi\left(\frac{WTP_{2j} - x\beta}{\sigma}\right) - \phi\left(\frac{WTP_{1j} - x\beta}{\sigma}\right)\right\}$$

where $\Phi(\,)$ is the standard normal cumulative distribution function and $\phi(\,)$ is the probability distribution function. The WTP bid selected is hence specified as: $WTP_j = \mu_j + \varepsilon_j$ where μ_j is the deterministic component and ε_j is the error term. It is assumed that $\varepsilon \sim N(0, \sigma^2 I)$.

Explanatory Variables – A number of variables can be expected to influence WTP values and these are discussed in this section. The questionnaire sought to collect income of the respondent; however, common to surveys of this type, a large number of respondents did not answer the level of income question (35 per cent). Consequentially a social class variable was included to account for likely differences in income levels. This variable divides social class into four categories namely A-B (senior and upper middle management), C1-C2 (junior management; owners of small establishments; and all skilled manual workers and those manual workers with responsibility for other people), D-E (all semi-skilled and unskilled manual workers; all those entirely dependent on the state long-term through sickness, unemployment, old age or other reasons), F1-F2 (farmers).

A variable income perception was included in the model to test whether respondents' own perception of the financial status of their household influenced WTP. Some respondents, even with high incomes, may be under significant financial pressure given the economic recession in the Republic of Ireland since 2008 to the survey year 2013. This variable is based on responses to the question "How would you rate the financial situation of your household". Results compare respondents who report their financial status to be either very

good, good or neither good nor bad with respondents who report their financial status as either fairly bad or very bad.

Recreational use values have been found to influence WTP values (Carson, 2000) and two variables were included in the analysis to capture this effect. Firstly, a trip to river variable reflects the use of rivers for recreational activities and is based on the number of trips to river in the previous 12 months for recreational activity. Additionally a distance travelled to access river reflects the average distance the respondent travels to access a river for recreational purposes. Age, gender and college education demographic based variables were also included in the analysis.

There is a growing evidence that social-psychology variables such as environmental values can influence WTP responses as much if not more than conventional socio-economic variables (Spash and Vatn, 2006; Martín-López *et al.*, 2007; Ojea and Loureiro, 2007; Spash *et al.*, 2009). Environmental values refer to a psychological tendency in which individuals evaluate the natural environment with some degree of favour or disfavour (Hawcroft and Milfont, 2010). This study derives variables reflective of an ecocentric attitude whereby individuals see the intrinsic value of nature and one reflective of a more apathetic environmental attitude whereby individuals don't like to see environmental protection getting in the way of economic progress. A series of statements were constructed to establish respondents' environmental values. In the questionnaire respondents were presented with a series of statements and were asked to indicate their level of agreement on a scale of 1 (completely agree) to 7 (completely disagree). Following a principal components analysis two latent constructs emerged in the area which were labelled environmental apathy and ecocentric values. These are included as explanatory variables and construct derivation is outlined in greater detail in Section IV.

Finally a variable was included to reflect the RBDs in which the respondent is located. The percentage of rivers of good or high status in the South Western RBD (92 per cent) and the Western RBD (83 per cent) were significantly higher than those in the other RBDs. Hence, these two RBDs were set as the base category and the remaining 4 RBDs (46-66 per cent) were included (no observations were recorded from the Neagh-Bann IRBD as the vast majority is in Northern Ireland) as dummy variables. These variables were included in the regression analysis to examine if there was any spatial heterogeneity in willingness to pay for water quality objectives under the WFD.

Table 3: *Explanatory Variables Included in the WTP Model*

Variable	*Variable Description*	*Mean*	*Min*	*Max*
Social Class	A-B	0.13	0	1
	C1-C2	0.51	0	1
	D-E	0.30	0	1
	F1-F2	0.07	0	1
Income Perception	0= Financial situation of household is very bad or fairly bad. 1= Financial situation of household is neither bad/good, fairly good or very good	0.81	0	1
Trips to river	No. of recreational trips to river.	12.9	0	365
Distance travelled to access river	No. of miles travelled to access river	1.2	0	74
Age	Age of respondent	44	18	88
Gender	0=Male; 1=Female	1.5	1	2
Environmental apathy value	Derived factor score (Table 4)	1	–2.5	2.2
Ecocentric Value	Derived factor score (Table 4)	1	–5.1	2.2
College Education	1 = College degree; 0 = No college degree	0.36	0	1
North West RBD	1=Respondent living in North West RBD; 0= Respondent not living in North West RBD	0.07	0	1
Shannon RBD	1=Respondent living in Shannon West RBD; 0= Respondent not living in Shannon RBD	0.16	0	1
South Eastern RDB	1=Respondent living in South Eastern RBD; 0= Respondent not living in South Eastern RBD	0.12	0	1
Eastern RBD	1=Respondent living in Eastern RBD; 0= Respondent not living in Eastern RBD	0.40	0	1

IV RESULTS

4.1 *Environmental Values*

This research sought to examine the effect of environmental values on respondents' willingness to pay for achieving WFD objectives. In this context respondents were presented with a list of statements and were asked to indicate their level of agreement on a scale of 1 (completely agree) to 7 (completely disagree). Principal component analysis (PCA) was employed to extract underlying latent constructs. PCA involves data reduction and operates by examining the pattern of correlations (or covariances) among a number of variables, ultimately transforming a set of correlated variables into a smaller number of uncorrelated factors or variables (Kline and Wichelns, 1998). Factor loading coefficients were employed to derive standardised value-based factors for the sample population. Each factor has a mean of zero and a standard deviation of one; a respondent's factor value score is relative to the sample mean. Factor scores are advantageous as they can be used in regression analysis in place of the original statements, with the knowledge that the meaningful variation in the original data has not been lost but that the derived variables are uncorrelated thus preventing any potential multi-collinearity problems.

Following PCA a total of two value constructs emerged. The first component had high factor loadings on statements that placed human needs ahead of the environment such as "We worry too much about the future of the environment and not enough about prices and jobs today" and "People worry too much about economic progress harming the environment" and was hence labelled as environmental apathy. The second attitude component had high factor loading on statements that favoured environmental protection such as "It is wrong to destroy natural environments" and "Polluting the environment is not fair on future generations" and as such was labelled ecocentric.

The explained proportion of the total variation of the original variables was 65 percent. A Kaiser-Meyer-Olkin measure of factor suitability was 0.83, indicating the use of factor analysis on this dataset to be appropriate. A reliability test using Cronbach's alpha was applied to test the internal consistency and reliability of the derived factor variables. Values above 0.5 are considered acceptable as evidence of a relationship (Nunnally, 1967), whereas values above 0.7 are more definitive (Peterson, 1994). There is a high degree of consistency in responses to questions relating to the environmental apathy and ecocentric value constructs with Cronbach's alpha of 0.82 and 0.78 respectively. The factor loadings in Table 4 represent correlations between all respondents' answers to each attitudinal statement with the derived component scores.

Table 4: *Environmental Values Component Statements*

	Environmental Apathy	*Ecocentric*
We worry too much about the future of the environment and not enough about prices and jobs today	0.774	–0.091
People worry too much about economic progress harming the environment	0.750	–0.148
I believe society places too much emphasis on environmental issues	0.740	–0.259
I find it hard to get too concerned about environmental issues	0.675	–0.211
Humans have the right to modify the natural environment to suit their needs	0.672	–0.153
It is wrong to prevent people from developing their own land just because it can cause damage to the environment	0.620	0.061
The most important thing about public lands is to provide jobs and income for local people	0.605	0.316
It is wrong to destroy natural environments	–0.078	0.817
I care about the environment	–0.155	0.798
Polluting the environment is not fair on future generations	–0.127	0.772
Natural resources must be preserved even if people must do without some products	–0.007	0.678

4.2 *WTP Results*

Results from the CVM analysis indicate that a large initial percentage (377 respondents or 61.4 per cent) of the sample indicated that they were not willing to pay any additional income (through additional income tax) for the scenario presented (achievement of 100 per cent good status across all rivers in the Republic of Ireland). However, individuals who indicated a €0 WTP were subsequently asked a debriefing question to explore if this was their true WTP or a protest response. Respondents who indicated an objection to paying taxes, believed that the Government/Council should pay, didn't believe the improvements would actually take place were deemed protest response and excluded from the analysis. This reduced the effective sample to 499 respondents. Of this cohort nearly 90 per cent indicated that pollution of rivers was an important or very important issue to them personally, while less than 3 per cent indicated that it was unimportant. Excluding protest responses, 52.5 per cent of the sample stated a €0 WTP for the proposed scenario. For

respondents indicating a positive WTP the most frequent prices chosen by respondents were €10, €20 and €50 representing 8 per cent, 7.8 per cent and 7.6 per cent of the sample respectively. As would be expected *a priori* as the price increased the percentage of the sample willing to pay declined. The mean WTP across the sample was €19 per respondent.

Table 5: *WTP for Achieving Good Status Across Rivers in Republic of Ireland*

Price	*No. of respondents*	*% of sample*
€0	262	52.5
€1	8	1.6
€3	5	1.0
€5	31	6.2
€10	40	8.0
€15	2	0.4
€20	39	7.8
€30	25	5.0
€40	10	2.0
€50	38	7.6
€70	6	1.2
€100	22	4.4
€125	1	0.2
€150	1	0.2
€200	5	1.0
€250	2	0.4
€300	1	0.2
€350	1	0.2
> €350	0	0.0
Total	499	100

Table 6 reports the results of WTP model and indicated that compared to a base category of social class A-B (senior and upper middle management), respondents in social classes C1-C2 (10 per cent significance level), D-E (10 per cent significance level) and F1-F2 had a negative WTP for achieving good status across rivers in the Republic of Ireland. Respondents in social classes C1-C2, D-E and F1-F2 tend to be associated with lower incomes than social class A-B, hence this result would be expected *a priori* and is in line with economic theory. Additionally, it was found that subjective evaluations of a household's economic situation are highly significant also (10 per cent level). The importance of perceptions of financial status may arise if perceptions are a more accurate measure of purchasing power (accounting for differences in cost of living across regions and debt levels). Subjective evaluations of financial status can in turn be shaped by individual circumstances and past experiences. In other words, income levels can be relatively low but individuals can perceive themselves as

being relatively well off and vice versa. Education was also found to have a positive effect (1 per cent level) on WTP, results indicating that respondents with a college degree had higher WTP level than those with no third-level education. Age and gender were not found to have a significant effect on WTP.

Trips taken to the river for recreational purposes were found to have a positive and significant effect on WTP levels (1 per cent level). Again this would be in line with economic theory and reflects stronger use values in that those who use rivers more for recreational purposes are willing to pay more for measures aimed at improving water quality. Average distance travelled to access the rivers for recreational purposes was also found to have a positive and significant effect (1 per cent level) on WTP. This suggests that respondents who travel greater distances for recreational access have higher use values and hence place a higher value on achieving good status across all rivers.

Environmental values were also found to have a significant effect on WTP. Respondents with more of what was termed an ecocentric value orientation had a higher WTP for achieving good status across all rivers (significant at 1 per cent level). This is to be expected as respondents associated with the ecocentric value orientation were positively disposed towards environmental protection. Conversely, respondents associated with more environmental apathy values were inclined to put human needs ahead of the environment. Environmental apathy value orientation had a significant (1 per cent level) negative effect on WTP.

Finally, results indicate significant spatial heterogeneity in the WTP levels of respondents. Table 6 shows that compared to the base category (Western and South Western RBD), respondents in the North West RBD (1 per cent level) and South Eastern, Eastern and Shannon RBDs (10 per cent level) had significantly higher WTP values for achieving good ecological status across rivers in the Republic of Ireland.

A Wald test was performed to test whether the parameters of the model were all equal to zero. The Wald χ^2 statistic shows that, taken jointly, the coefficients for this model specification are significantly different from zero at the 1 per cent level. The mean WTP as estimated by the model was €19, this is same as that calculated based on actual bid selected from payment card in Table 6. According to the last census of population in 2011 (CSO, 2012) the total population of the Republic of Ireland aged 18 and over was 3,439,565. Applying this population number to the average WTP value of €19 returns a total WTP for the population for achieving good status across Irish rivers of €65.35 million per annum.

Table 6: *Results of WTP Model*

Variable	*Coefficient (z-value)*
Social class C1-C2	–8.60*
(5.12)	
Social class DE	–10.47*
(5.66)	
Social class F1-F2	–5.26
(7.85)	
Income perception	6.89
	(4.30)*
Trips to river	0.117
	(0.04)***
Distance travelled to access river	1.05
	(0.29)***
Age	0.07
	(0.1)
Gender	–2.47
	(3.19)
Environmental apathy value	–9.42
	(1.69)***
Ecocentric value	4.36
	(1.61)***
College education	10.10
	(3.63)***
North West RBD	17.70
	(6.74)***
Shannon RBD	9.15
	(5.33)*
South Eastern RBD	10.91
	(5.83)*
Eastern RBD	7.72
	(4.14)*
Constant	7.43
	(9.609)
Observations	478
Chi-Squared	103.24
Log-likelihood	–2,084.72

* significant at 10%; ** significant at 5%; *** significant at 1%.

V DISCUSSION AND CONCLUSIONS

Excluding protest response, nearly 48 per cent of respondents were WTP additional taxation for rivers across the Republic of Ireland to achieve good status under the WFD. Mean WTP was estimated at €19 per respondent per

annum. This is comparable to some results internationally which examined WTP for achieving WFD objectives at a more national scale. Lago and Glenk (2008) used a choice experiment to estimate non-market benefits that may arise from water quality improvements under the WFD in Scotland across the general population. Results show that respondents have a WTP of £2.18 per year per household in increased water charges for a 1 per cent increase in the total area of rivers that are of good ecological status by 2015. Brouwer *et al.* (2006) looked at the Scheldt international river basin district which contains four sub-basins in three countries (France, Belgium and Netherlands). Using CVM they asked respondents in four sub-basins whether they would be WTP (through general taxation) for the implementation of the WFD, i.e. achieving good status by 2015. Over 50 per cent of all respondents were WTP in principle and they found a median WTP of €29.4 per annum in additional taxes. Brouwer (2008) used CVM to ask respondents about their WTP (through increased general taxation) to improve water quality to good status in accordance with the WFD in the Netherlands. Brouwer (2008) found a mean WTP of €90 per household per year with a 95 per cent confidence interval, between €80-€100.

Valuation studies focusing specifically on water body improvements in the Republic Ireland are limited (Goodbody Economic Consultants 2008; Norton *et al.* 2012). The focus heretofore has been predominantly around valuing water-based recreation activity at specific locations (Curtis 2002; Hynes and Hanley, 2006; Doherty *et al.* 2012). Stithou *et al.* (2012) estimated the value of achieving good ecological status in the Boyne river catchment using a choice experiment based on 252 face-to-face interviews in 2010. The four attributes chosen for the CE were river ecology, recreational opportunities, aesthetic appearance of the water and the condition of the river banks. Average WTP to move from the baseline (no change in ecological status of the catchment, 19 per cent was of good status or better at the time) to different medium/high impact management scenarios with various levels of improvement across the aforementioned attributes ranged from €23.32 to €75.56 per household per annum. Doherty *et al.* (2014) also used choice experiments to explore WTP of respondents in the Republic of Ireland for improvements across various water bodies (lakes, rivers, and sea) across a number of attributes relating to WFD objective including aquatic ecosystem health, water clarity and smell, conditions of banks and shoreline and access to recreational activities. Results indicated that improvements in rivers were most preferred; values of between €110-€129 per person per annum were reported for rivers in terms of moving from the lowest level of the various attributes to the highest level.

Results from this study show that social class (proxy for income) and subjective perceptions relating to financial status are positively and significantly associated with WTP values. Income has consistently been found

to influence WTP values in environmental valuation studies and is an important finding for validity (Carson, 2000). Subjective perception relating to financial status was explored in this study, as the Republic of Ireland experienced a significant economic contraction between 2008 and the survey year of 2013. According to statistics from the CSO's Survey on Income and Living Conditions (SILC), incomes peaked in 2008 and declined by 9 per cent to the end of 2010, reflecting decreases in earnings, reduced welfare payments and increases in income taxation levels (NERI, 2012). Associated with this reduction in income has been a significant increase in the levels of personal debt. Ireland has one of the highest levels of personal debt in the Eurozone area (National Competitiveness Council, 2012). In this context subjective perception relating to financial status as well as actual income levels were found to be influential in explaining variability in WTP.

In line with many other studies (Carson *et al.*, 2001) recreational use values were positively and significantly associated with WTP values. Results also indicate WTP values vary significantly across river basin districts. This suggests spatial heterogeneity influences WTP values in line with other research in this area (Tait *et al.*, 2012). This heterogeneity could be explored further with additional research that examines WTP at different spatial levels such as River Basin District, Hydrometric Area or Water Management Unit.

Findings from this study suggest that underlying environmental values are strongly related to WTP. There is now an established link between environmental value orientations and individuals' preferences towards a variety of environmental issues (Thompson and Barton, 1994; Kaltenborn *et al.*, 2008; Howley, 2011). This study found a positive association between an ecocentric value orientation and WTP for improvements in good status. Conversely, a value orientation more reflective of environmental apathy was found to have a negative effect on WTP. The analysis suggests that underlying environmental values are as important a predictor of WTP as conventional socio-demographic variables. Previous work has established that there can be significant variability in environmental values across nations (Kellert, 1993; Aoyagi-Usui *et al.*, 2003) and understanding more about how individuals in different areas relate to the environment could be beneficial in formulating natural resource use decisions that are in keeping with individuals' needs and desires.

The Water Framework Directive mandates Member States to achieve good status across all surface waters by 2015. Derogations from this target have to be proven based on infeasibility or disproportionate cost. Hence, quantification of benefits is an important element in the assessment of the proportionality of costs in the implementation of the WFD. Assessing whether the achievement of good status is disproportionately expensive requires a comparison of the costs of putting measures in place to achieve good status versus the benefits that

might come about as a result of the water body achieving good status. Results from this study can provide policymakers with important information around resource allocation in WFD planning.

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