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Effects of Public Funding on Local Tradeoffs and Willingness to Pay (WTP) in a Choice Experiment: Blackstone River Watershed Management*

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Abstract:

In a split sample design, we examine the impact of federal funding availability on Willingness to Pay (WTP) for watershed management program attributes and tradeoffs in a choice experiment. We also evaluate how presenting respondents with different sets of choice attributes, in alternative survey designs, affects the estimation of preference functions. We also compared preferences for watershed management attributes across sub-watersheds. These issues were evaluated using the Blackstone River Watershed Public Preference Survey, in Rhode Island, USA. Our results indicate that neither federal support nor geographically distinct sub-watersheds had significant impact on tradeoffs elicited among management attributes. However, survey design may induce respondents to show distinct preferences for watershed management. We examined these issues using a multinomial logit model in comparison with a Latent Class Model (LCM) to account for heterogeneity in preferences.

Keywords: Choice experiment, Federal funding, Latent class model, Stated preferences, Watershed management

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1. Introduction

Relatively few studies evaluate whether common aspects of policy or management approaches substantially alter the preferences or choice behavior underlying estimates of willingness to pay (WTP) (Johnston et al. 2002; Swallow and McGonagle 2006; Johnston and Duke 2007). For example, the possibility of government or federal-dollar assistance to fund natural resource management programs may influence respondents' willingness to pay and tradeoffs among watershed management attributes in a stated choice framework. Economists might be interested to know if respondents behave differently in a stated choice setting if they face choices with a distinct source of funding in addition to a payment vehicle for personal cost, such as an increase in new taxes. While the payment vehicle has long been known to affect estimates of WTP, there is no theoretical reason to expect preferences for marginal tradeoffs to be independent of alternative funding sources. In principle, the level of each attribute can alter the relevant range of preferences for other attributes within the conditional indirect utility function (e.g., Hoehn and Randall 1989; Hoehn 1991; Johnston et al. 2002). Therefore, an attribute describing the availability of public (federal) funding could alter the WTP and implied preference tradeoffs for environmental management plans which are otherwise identical in the biophysical or environmental quality goals addressed. Contingent choice experiments allow us to assess tradeoffs among environmental management attributes and estimate dollar-denominated welfare impacts of environmental changes when individuals make stated choices in consideration of various levels of personal cost (Louviere et al. 2000; Alpizar et al. 2003; Adamowicz and Deshazo 2006). Decision makers in public agencies, like the U.S.D.A. Natural Resource Conservation Service (NRCS), may be interested in understanding whether the welfare impacts of changes in natural resource conditions could be affected by the source of funding. Beyond the implications for environmental economists modeling preferences, the approach of our study provides environmental managers insight to how public preferences across outcomes might be affected by policies whereby governments provide partial or matching funds.

Although the choice experiment has become a common stated preference, studies that focus on issues beyond just obtaining marginal willingness to pay for attributes are limited. For example, Ajzen et al. (1996); Kahneman et al. (1999); Louviere (2004); Hensher et al. (2001); Hanley et al. (2005); Hensher (2006); Carlsson and Martinsson (2008) discuss methodological issues affecting elicited preferences, such as the effects of question framing, number of choice sets, context-dependence, and design of price vector). Johnston et al. (1999) examined whether a guarantee as part of the payment vehicle, such that payments made were clearly dedicated to the indicated program, affects welfare values, perhaps through respondents' perception about likely outcomes of multi-attribute policy packages for watershed management employing a stated choice survey. They found that a guarantee of funding allocation altered respondents' WTP for specific watershed management program attributes and point estimates of respondents' Marginal Rate of Substitution (MRS) among plan attributes, including MRS between non-monetary attributes. In another study, Swallow and McGonagle (2006) examined the willingness of the public to re-allocate existing tax dollars as an alternative to standard WTP measures in a stated preference study on open space and coastal access amenities and concluded respondents' preferences implied a non-zero opportunity cost to existing tax dollars. Our paper examines whether inclusion of U.S. federal funds as an attribute in the implementation of watershed management programs in a stated choice survey alters respondents' choice pattern relative to when there is no possibility of federal (public) funding.

The choice survey was part of a project to develop an initial framework for the NRCS to incorporate public preferences in Rapid Watershed Assessment (RWA). RWA is a planning process used by NRCS to prioritize local natural resource concerns in a watershed for optimal allocation of federal conservation funds. Since we had to accommodate a large set of attributes in choice questions, attributes identified for the choice survey were split into two sets of choice questions, using separate orthogonal designs. This split-design allows us to evaluate how presenting respondents with different sets of attributes of choices, in alternative designs, affects estimates of respondents' preference functions. We also compared preferences for watershed management alternatives across distinct portions of the watershed. Such an analysis could interest decision makers in agencies like NRCS to understand preferential heterogeneity across geographically identifiable subpopulations, allowing an agent to direct watershed management actions to serve local priorities within sub-watersheds.

We employed a latent class approach for modeling preferential heterogeneity in our study. Latent Class Modeling (LCM) has been used as an approach to model preferential heterogeneity in discrete choice modeling (Titterington et al. 1985; Swait 1994; Bartholomew and Knott 1999; Wedel and Kamakura 2000; Boxall and Adamowicz 2002; Provensher et al. 2002; Greene and Hensher 2003; Scarpa et al. 2005; Moorey et al. 2006; Breffle et al. 2008). Identifying such groups of residents assists decision-makers to balance the preferences of watershed populations comprised of a number of groups or segments sharing similar within-group preferences. Finally, we evaluate WTP and tradeoffs among watershed management attributes by comparing a multinomial logit (MNL) model with a Latent Class Model (LCM) accounting for heterogeneity in preferences.

The paper is organized as follows. Section 2 gives the theoretical framework for choice modeling, drawing from random utility models. Section 3 outlines choice survey design, development, and implementation. Section 4 tests the hypotheses with respect to federal funding availability, subsets of attributes in the question designs, preferences distinguished by geographically distinct watershed populations, and presents results using multinomial and latent class models. Section 5 concludes the paper and discusses implications of the results.

2. Theoretical Framework for Modeling Preferences

Following common practice, we model respondents' choices for watershed management scenarios within contingent choice experiments based on the Random Utility Model (RUM) (e.g., Hanemann 1984; Mitchell and Carson 1989; Opaluch et al. 1993; Adamowicz et al. 1998). The RUM assumes that respondents act as if they evaluate the attributes of a set of watershed management priorities using a utility function and choose the plan with the higher utility score among the available alternatives. Accounting for unobservable elements, modeled as randomness, in respondents' preferences, RUM assumes that the utility function is composed of a deterministic component and a random component represented by equation (1):

(1) $$U_{ip} = CS_{ip} + \varepsilon_{ip}$$

where CS_{ip} is the Cumulative Score of plan *p* for individual *i*, which is the estimable component of the utility function, and ε_{ip} represents the random component of utility. The estimable component of the utility function, CS, can be considered a mathematical equation that ranks more preferred management plans with a higher score. The scoring function is estimated as:

(2) $$\begin{aligned} CumulativeScore &= CS_{ip} = \beta_{ASC}.ASC + \beta_{C}.PCost \\ &+ \beta_{F}.FCost + \sum_{m=1}^{M}(\beta_{Hm}.High + \beta_{Mm}.Medium + \beta_{Lm}.Low) \end{aligned}$$

where β's represent coefficients on ASC (Alternative Specific Constant) identifying whether plan *p* is the status quo, personal cost, federal cost and corresponding levels of effort for management M activities included in the plan.

A Multinomial Logit Model (MNL) can be used to estimate coefficients on attributes of the Cumulative Score (CS_{ip}) equation assuming identical preferences among individuals having the same socio-economic characteristics, a type I extreme value distribution for the random component, and independence between choice sets and individuals. Based on these assumptions, the probability of individual *i* choosing watershed management plan *p* can be written as:

(3) $$P_{ip} = \frac{\exp(CS_{ip})}{\sum_{q \in A,B,N} \exp(CS_{iq})}, \; p = A, B, N$$

A limitation of a multinomial logit model is that it assumes Independence of Irrelevant Alternatives (IIA), meaning that an individual's probability of choosing a management plan among available alternatives is independent of other available alternatives. IIA may not hold when some of the alternatives available in the choice set are closer substitutes or yield utility values that are more correlated than others. A nested logit model relaxes the assumption of IIA within a nest by allowing a correlation structure to differ among the preferences individuals have for groups of alternative management plans, such that some plans may be better substitutes for each other than are other plans. In a nested logit model, the joint probability of choosing a watershed management plan *p*, assuming independence between alternatives within a nest *k* and a Generalized Extreme Value (GEV) cumulative distribution function for the random component, can be written as:

(4) $$P_{ip} = \frac{\exp(CS_{ip}/\lambda_k)}{\sum_{q \in A,B,N} \exp(CS_{iq}/\lambda_k)} \cdot \frac{\exp(CS_k + \lambda_k I_k)}{\sum_{j=1}^{k} \exp(CS_j + \lambda_j I_j)}$$

where $I_k = \ln \sum_{p \in A,B,N} \exp(CS_p/\lambda_k)$ and I_k is the "inclusive value" or expected utility of choosing among alternatives within nest *k*, and where λ_k is the inclusive value parameter indicating the degree of independence between plans within a nest or a measure of the correlation of the alternatives' random components within nest *k* (Heiss 2002). We will discuss the results of our hypotheses using a multinomial or nested logit model based on Likelihood Ratio (LR) test.

To examine further heterogeneity in preferences, we also employed a Latent Class Model (LCM) which assumes that each respondent can be matched with a latent group, *g*, of the population, g=1,2,…G, characterized by a unique within-group preference function. Formally, a LCM estimates the unconditional probability that an individual *i* can be attributed to a group *g* based on individual-specific characteristics, which can be given as:

$$P_{ig} = \frac{\exp(\omega_g Z_i)}{\sum_{h=1}^{G} \exp(\omega_h Z_i)} \qquad (5)$$

where *i* is an individual, ω_h (h = 1, 2, 3, ….G) is a vector of group membership probability parameters to be estimated, and Z_i is a set of Individual-Specific Characteristics (ISC) for person *i*. After matching an individual with his or her likely group, the conditional probability of choosing management plan *p* by individual *i* in group *g* can be expressed as:

$$P_{ip|g} = \frac{\exp(\gamma_g \beta_g X_{ip})}{\sum_{q \in A,B,N} \exp(\gamma_g \beta_g X_{iq})} \qquad (6)$$

where γ_g is the scale parameter for a group *g* and is normalized to 1 for one group, β_g is the group-specific utility parameter, and X_{ip} is the vector of watershed management attributes of an alternative management plan *p*. In this specification, $\beta_g X_{ip}$ in equation (6) is equivalent to our notation of cumulative score of a plan *p* for individual *i* (CS_{ip}) given that she or he likely belongs to a group *g*. Finally, the joint probability that individual *i* belongs to group *g* and chooses alternative management plan *p* is the product of probabilities specified in equations (5) and (6), given as:

$$P_{ig} = P_{ip|g} * P_{ig} = \frac{\exp(\omega_g Z_i)}{\sum_{h=1}^{G} \exp(\omega_h Z_i)} * \frac{\exp(\gamma_g \beta_g X_{ip})}{\sum_{q \in A,B,N} \exp(\gamma_g \beta_g X_{iq})}$$

(7)

We will discuss our hypotheses employing a LCM approach to heterogeneity in preferences.

3. Public Preferences Survey Design, Development, and Implementation

3.1 Survey Design, Development, and Implementation

The Blackstone River Watershed comprises a total of 640 square miles, with 382 square miles located in south central Massachusetts and 258 square miles in northern Rhode Island. The studied location includes seven HUC-12 level sub-watersheds in the northern Rhode Island section of the Blackstone River Watershed (Figure 1). In the process of designing the choice survey, an expert interview was held at the University of Rhode Island with watershed professionals associated with URI Watershed Watch to identify broad issues associated with watershed management. In addition, a series of focus group discussions, along with pretesting survey questions, were conducted with members of watershed[4] associations to identify the broad issues relevant to the study area. Initially, choice scenarios presented watershed management attributes as quantified outcomes that a plan would deliver, but this approach faced the difficulty of establishing a baseline to which quantified outcomes would be adding and focus group participants and experts questioned whether this approach would have been practical for application across numerous sub-watersheds, particularly at the HUC-12 level. Based on this feedback, we adopted an approach to define watershed management actions in terms of effort directed toward key natural resource concerns. That is, levels of the attributes were identified qualitatively as providing a High, Medium, Low, and No Special level of effort (Table 1).

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[4] Blackstone River Watershed Coalition, Blackstone River Watershed Council, and Massachusetts Audubon Society

We created a total of four different sets of survey booklets based on an efficient experimental design method in SAS ® version 9.1.3. The choice design was created using D-efficiency criterion, which is a standard method of evaluating the efficiency of an experimental design by minimizing the variance matrix (Kuhfeld 2005). Each survey booklet had a total of eight choice scenarios, taking the first four choice scenarios from the design for the first set of attributes, and the remaining four from the design for the second set of attributes (Table 1). This process produced four collections of eight questions. Figure 2 displays an example choice scenario. To examine the issue of federal aid in respondents' response patterns, we used these four sets of questions to create a set of survey booklets, which included federal dollars (F. Cost) and we repeated the same four sets in four more booklets, but these booklets excluded federal cost from the choice questions. This process created eight booklets for a split-sample design allowing some respondents to consider federal cost in all questions (e.g. Figure 2) and allowing a second sample to see the same choices but with the attribute for federal cost removed.

The survey was executed during November and December of 2009 using the Dillman Total Design Method (Dillman 2007)[5]. The mailing was sent to a stratified random sample of residents of the study area. Info-USA, a marketing company, provided a mailing list randomly drawn based on zip codes that fall within the Rhode Island section of the sub-watersheds of the Blackstone River Watershed (Figure 1). Respondents were separated into six individual locations or counties (Burrillville, Cumberland, Gloucester, Lincoln, N. Smithfield and Smithfield). They were randomly assigned to a survey booklet group, dividing 1800 addresses across the 8 booklets.

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[5] As applied here, this method involves sending a series of mailings to potential respondents: (a) an initial letter explaining the purpose of the survey and informing recipients that the survey will be delivered in a few days; (b) a cover letter with an initial copy of the survey; (c) a reminder postcard sent after a week to non-respondents; (d) a second cover letter and another copy of the survey sent after two additional weeks to non-respondents; and (e) a final reminder postcard sent after an additional week. Due to limitation of time and budget, a final reminder postcard was not sent in this study.

3.2 Empirical Model Specification

A set of standard socio-economic characteristics (AGE, HINC, HEDU; Table 2) and opinion factors representing respondents' opinion, attitudes, perceptions and past experiences about watershed issues were utilized to account for preferential heterogeneity in the econometric model (Table 2). Appendix-A provides details of a factor analysis used to establish attitude scales to summarize individual responses to Likert-scale questions in the survey. The empirical econometric model is comprised of various explanatory variables: watershed-management attributes (Attributes also include personal cost P.Cost and federal cost F.Cost) and dummies indicating presence or absence of federal support (FEDERAL), question designs (DESIGN), geographic region of residency (WEST), and Individual-Specific Characteristics (ISCs, including socio-economic characteristics and attitude factors) interacted with the ASC (Alternative Specific Constant). Watershed management attributes were categorical variables in the choice alternatives coded as effects codes (1, 0, -1; Table 1) to create three new variables from each watershed-management attribute representing High, Medium and Low levels of effort and taking No Special Effort as the base level. Personal cost (P. Cost) and Federal Cost (F. Cost) were simply entered as continuous variables. Variables representing presence or absence of federal dollars (FEDERAL), identifying the question design used in the respondent's booklet (DESIGN), and the respondent's geographic region (WEST) were simply coded using dummy (1, 0) variables. Socio-economic characteristics of respondents (AGE, HINC and HEDU; Table 2) were coded using the dummy (1, 0) coding method and factor scores from factor analysis were used as continuous variables. The most unrestricted multinomial logit model is described by:

$$
\begin{aligned}
(8)\quad & CumulativeScore = CS = \beta_{ASC} \bullet ASC + \beta_{Attributes} \bullet Attributes + \beta_{ISC.ASC} \bullet ISC \bullet ASC + \\
& \beta_{Federal.ASC} \bullet Federal \bullet ASC + \beta_{Design.ASC} \bullet Design \bullet ASC + \beta_{West.ASC} \bullet West \bullet ASC \\
& + \beta_{Attributes.Federal} \bullet Attributes \bullet Federal + \beta_{ISC.ASC.Federal} \bullet ISC \bullet ASC \bullet Federal + \\
& \beta_{Attributes.Design} \bullet Attributes \bullet Design + \beta_{ISC.ASC.Design} \bullet ISC \bullet ASC \bullet Design \\
& + \beta_{Attributes.West} \bullet Attributes \bullet West + \beta_{ISC.ASC.West} \bullet ISC \bullet ASC \bullet West
\end{aligned}
$$

4. Results

The net response rate, after accounting for undeliverable and refused surveys, was 18.3%, with 310 surveys returned with responses to at least one choice question. The total number of observed choices used in the model estimation was 1839 because each respondent faced eight choice scenarios but some respondents completed fewer than all eight choices. Out of 1839 observed choices, 874 choice responses (48%) included federal dollars assistance in the execution of watershed management plan and the number of observed choices from the two question designs was approximately equal (938 choices in design A, 51%, versus 901 choices in design B, 49%). About 61% of the total number of observed choices was from the residents living in the western portion of the Blackstone River Watershed (Figure 1; Clear, Branch and Chepachet sub-watersheds). In the choice data, 74% of the choice responses indicated that respondents preferred some watershed management plans over status quo i.e., they chose either Plan A or Plan B over Neither Plan.

A likelihood Ratio (LR) test failed to reject the null hypothesis of Independence of Irrelevant Alternatives (IIA), suggesting the multinomial logit model is more appropriate than a nested logit model (LR Test for inclusive value parameter equals 1: $\boldsymbol{\chi 2} =$ 0.23, 1 df, P<0.6292). Therefore, we proceed without considering the nested logit model.

4.1 Multinomial Logit (MNL) Hypothesis Tests

Table 3 lists log-likelihood values for the unrestricted model, various restricted models, and likelihood-ratio (LR) tests. The unrestricted model (equation 8) consists of 139 parameters including effort attributes, personal cost, federal cost and interactions. Hypothesis tests in Table 3 all proceed relative to the unrestricted model. The unrestricted model is statistically significant (χ^2 = 549.84, 138 df, P<0.0001). The initial hypothesis examines the joint significance of all interactions (dummies for FEDERAL, DESIGN, and WEST interacted with plan attributes and individual-specific characteristics). This Likelihood Ratio (LR) test rejects the null hypothesis that restrictions are true as a group (Table 3, Restricted 1; P<0.0038). This result suggests a need for examining individual restrictions with respect to the unrestricted model.

Next, a set of hypothesis tests is conducted to assess the possible effect of presence or absence of federal assistance on elicited preferences. Results show that the presence of federal support does significantly affect the preference model (Table 3; Restricted 2, P<0.0047) but this result does not arise from an effect on tradeoffs among attributes (Table 3, Restricted 3; P<0.4868). Rather the significance of the FEDERAL dummy seems due to interactions between the individual-specific characteristics and the ASC (Table 3, Restricted 4; P<0.0001). That is, FEDERAL affects the utility of the Neither plan alternative, but the multinomial logit model shows that the availability of public funding does not significantly alter respondents' preferences for tradeoffs among watershed management attributes.

Next, a set of hypotheses was tested to address whether presenting respondents with different sets of choice attributes, in alternative question designs, affects estimates of respondents' preference functions. Results show an insignificance of the overall restrictions of the dummy variable DESIGN with management plan attributes and individual-specific characteristics (Table 3, Restricted 5; P<0.3393). However, one would expect DESIGN to only impact tradeoffs among plan attributes, not the base utility of Neither. Therefore, despite the non-significance of the overall test, we examine the significance of interactions of DESIGN with management plan attributes that were common to both sets of questions. Results shows a significant effect on respondents' utilities (Table 3, Restricted 6; P<0.0586), meaning respondents' WTP and MRS differ for WQTYDRY and HNON between the two different designs; these variables are the watershed management attributes common in both designs (Table 1), in addition to P. Cost and F. Cost. Respondents exhibit distinct preferences for common attributes across the two designs.

Our third focus concerns whether residents living in different geographic locations have similar preferences about watershed management actions. Likelihood Ratio (LR) tests show that residents of the eastern and western portions of the Blackstone watershed differ in their preference function (Table 3, Restricted 8; P<0.0235). However, this difference appears only to derive from the effects of WEST on parameters for the ASC and individual-specific characteristics, and therefore the utility of the Neither plan option (Table 3, Restricted 10; P<0.0001). Consequently, results suggest that respondents have similar preferences for the attributes within an active management plan, irrespective of residency, meaning respondents from the eastern and western portions of Blackstone do not differ in their preferences for tradeoffs among watershed management efforts (Table 3, Restricted 9; P<0.9486). This result may interest agencies like NRCS because results show there is no need for separate watershed management preference models for east and west Blackstone, in terms of the composition of plans involving at least some effort addressing some resource concerns. However, while preferences for tradeoffs among plan attributes were not affected by residential location, the effects of WEST on the ASC coefficients will affect overall WTP for a particular plan relative to the status quo of no significant effort in all areas.

4.2 Parsimonious Multinomial Logit (MNL) Model Results

Table 4 presents maximum likelihood estimated coefficients for the model with non-significant restrictions retained , as listed in Table 3 for Restricted 3, 7, and 9. In order to help focus discussion on watershed management attributes and the interactions more relevant to management decisions, we generated a parsimonious model through a structured pre-test estimation process[6] (Table 5). The parsimonious model retains 37 parameters from the model presented in Table 4. Likelihood Ratio (LR) test suggests that restrictions required to obtain the parsimonious model fails to reject the null hypothesis of zero collective influence (LR Test: $\boldsymbol{\chi 2}$ **=** 25.418, 31 df, P<0.7487). We focus our following discussion on watershed management attributes more likely to be relevant to management decisions using our parsimonious model presented in Table 5.

A negative coefficient on the ASC variable indicates that on average respondents have a lower utility from the "Neither Plan" alternative; the more negative is the overall coefficient on ASC, the more likely it is that a respondent prefers some active plans to no plan. High and medium level of watershed management efforts focused on improving surface water quality for fish, aquatic wildlife and human recreation purposes, preserving native forest habitats, controlling non-native species, preserving wetlands, open space preservation and constructing green corridors along the river, for bicycling, significantly (P<0.10) added positive utility values to respondents' utility scores (Table 5; SWQFH, HNONH, OSPH, OSPM, SWQRECH, SWQRECM, WQTYWETH, OSBIKEH, OSBIKEM). In the case of efforts for controlling flooding and reducing the frequency that rivers and streams run dry (Table 5; WQTYFM and WQTYDRYM), respondents are exhibiting that a moderate or medium level of effort would be likely to increase utility, as compared to high effort levels (which were dropped from the

[6] We employed a step-wise regression procedure retaining variables significant at the 10% level.

parsimonious model). This result is consistent with what we would expect if respondents hold the perception that some resource concerns require only a moderate effort to address what respondents might consider to be an infrequent problem relative to other natural resource concerns in the watershed. For example, the survey was conducted before the 400-year devastating flood hit Rhode Island in March of 2010. We could have different results had we conducted the survey after March, since the flood may have convinced some respondents that flood control is a more pervasive need than they perceived at the time of the survey. The negative coefficient on P. COST has the expected sign, meaning the more costly a plan becomes, the lower will be respondents' utility. A positive coefficient on F. COST indicates that more federal (public) dollars provide a higher utility value to respondents, increasing WTP.

The interaction of individual-specific characteristics with the ASC reveals that an older person having lower education is more likely to choose status quo alternative on average (Table 5; AGE•ASC and HEDU•ASC). Respondents having a concern for wildlife habitat restoration or preservation not specifically tied to outdoor recreation and surface water quality improvement are more inclined to choose the no action, status quo alternative (Table 5; PROREC•ASC, PROWL•ASC, and PROWQ•ASC). The availability of federal support to execute watershed management actions is more likely to induce a respondent with low income (<$100,000 per year) to choose the status quo, ceteris paribus (Table 5; HINC•ASC•FEDERAL). Respondents who are particularly concerned with watershed issues focused on improving surface water quality, and respondents with the perception that development benefits in their watershed could be reduced by environmental protection, are more likely to vote for the status quo option when there is federal funding available on an average (Table 5; PROWQ•ASC•FEDERAL and PRODEV•ASC•FEDERAL). Average respondents with higher education (higher than a Bachelor's degree), concerned about outdoor recreational opportunities, and surface water quality improvement, or from the western portion of the watershed are more inclined to choose the status quo alternative, *ceteris paribus* (Table 5; PROREC•ASC•WEST and PROWQ•ASC•WEST).

4.3 Latent Class Model (LCM) Approach

Recently, it has been recognized that the previous approach of modeling indirect utility to include interactions of individual-specific characteristics with the attributes of choices, may limit our ability to characterize respondents based on their perceptions or attitudes toward the environment. Researchers have developed Latent Class Modeling (LCM) as an approach that attributes respondents latently to a specific class or group with similar intra-group preferences and distinct inter-group preferences. Socio-economic characteristics and attitude scores measured using factor analysis were used to characterize respondent-groups in our study.

4.3.1 Number of Classes Selected

Table 6 presents compares Latent Class Models with up to 4 classes. The number of classes in a LCM is not a parameter that can be determined by comparing the log likelihood values or using a likelihood ratio test because models with different numbers of classes are not nested. A consensus has developed that one expects improvement in the log likelihood values by adding additional classes in the model, but the model fits must be penalized for the increase in the number of parameters estimated for additional classes (Greene and Hensher 2003). There does not exist any statistical test with known distributions, so that, by consensus, many practitioners use information criteria (Wedel and Kamakura 2000). Information criteria compare the improvement in the model fit with number of extra parameters and the best fitting model minimizes the information criteria. Following this consensus (Kamakura and Russel 1989; Gupta and Chintagupta 1994; Swait 1994; Roeder et al. 1999; Boxall and Adamowicz 2002; Greene and Hensher 2003), the optimal number of classes in our study was determined using minimum Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) among four classes presented in Table 6. The 2-class LCM minimizes both the AIC and BIC, suggesting adding an additional class beyond two classes doesn't gain much improvement in the model fit.

4.3.2 Latent Class Model (LCM) Hypothesis Tests

We re-examined the hypothesis tests done using multinomial logit model in LCM approach as well. Table 7 lists log-likelihood values for the unrestricted model, restricted models, and Likelihood Ratio (LR) tests. We used the 2-class LCM to conduct all the hypothesis tests. However, our 2-class LCM unrestricted model was limited in part by difficulty in convergence using NLOGIT 4.0. Our unrestricted model is the most comprehensive we could estimate while focusing on the effects of FEDERAL and WEST. Because of the convergence difficulty, we first specified the following unrestricted model:

$$\begin{aligned} &CumulativeScore = CS = \beta_{ASC} \bullet ASC + \beta_{Attributes} \bullet Attributes + \beta_{Federal.ASC} \bullet Federal \bullet ASC + \\ &\beta_{West.ASC} \bullet West \bullet ASC + \beta_{Attributes.Federal} \bullet Attributes \bullet Federal + \\ &\beta_{ISC.ASC.Federal} \bullet ISC \bullet ASC \bullet Federal + \beta_{ISC.ASC.West} \bullet ISC \bullet ASC \bullet West \end{aligned} \tag{9}$$

Results from MNL analysis hold consistent in LCM approach as well, meaning that the interaction of the FEDERAL dummy with management plan attributes is not significant (Table 7, Restricted 1; P<0.3102) but the interaction of the FEDERAL dummy with ASC and ISC is significant (Table 7, Restricted 2; P<0.0027). Similar conclusions for the significance of the interaction of the residency dummy, WEST, with ASC and ISC can be derived in the 2-class LCM as well (Table 7, Restricted 3; P<0.0001). After testing for significance of interactions of FEDERAL with attributes, and failing to reject the null hypothesis (Table 7, Restricted 1), we restricted the FEDERAL-attributes coefficients to zero and added the interaction of ASC with ISC and the interaction of DESIGN with plan attributes, ISC and ASC to equation (9), yielding equation (10) presented below:

$$CumulativeScore = CS = \beta_{ASC} \bullet ASC + \beta_{Attributes} \bullet Attributes + \beta_{ISC.ASC} \bullet ISC \bullet ASC + \beta_{Federal.ASC} \bullet Federal \bullet ASC + \beta_{Design.ASC} \bullet Design \bullet ASC + \beta_{Design.Attributes} \bullet Design \bullet Attributes + \beta_{ISC.ASC.Design} \bullet ISC \bullet ASC \bullet Design + \beta_{West.ASC} \bullet West \bullet ASC + \beta_{ISC.ASC.Federal} \bullet ISC \bullet ASC \bullet Federal + \beta_{ISC.ASC.West} \bullet ISC \bullet ASC \bullet West$$

Using equation (10) as an unrestricted model, the LR test rejects the null hypothesis that interactions involving DESIGN, ASC and ISC interactions are zero (Table 7, Restricted 4; P<0.0008). Next, we re-examined hypothesis tests regarding the interaction of dummy DESIGN with management plan attributes and ISC. Results under LCM approach are consistent with those under MNL approach, meaning the restriction of interaction between the DESIGN dummy and management attributes and the ISCs is not significant (Table 7, Restricted 5; P<0.9382). As for the multinomial model, however, we expected the DESIGN dummy to operate on the tradeoffs between attributes that were common to both designs. Therefore, we conducted two more tests that evaluate this conjecture. The results show that insignificance of the complete set of the Design-dummy interactions seems mainly due to insignificance of interaction of with ISC (Table 7, Restricted 7; P<0.7713), because the interactions with management attributes are significant at the 10% level (Table 7, Restricted 6; P<0.0.0521).

Due to the convergence problem in LCM, as mentioned above, we could not conduct hypothesis tests for significance of the WEST dummy interacted with management attributes within the utility function for each class. However, for the LCM, we could examine our qualitative conclusion under the multinomial logit model in an indirect way. For all hypothesis tests in LCM case, the set of Individual-Specific Characteristics (ISC) specified is presented at the end of Table 8, including WEST and eight other ISCs listed in the class-probability model and in interactions with the ASC in the utility function for each class. The LR test shows the WEST dummy in the class membership equation is not significant (LR Test: χ^2= 0.59, 1 df, P<0.4424). Therefore, from Table (8), we conclude that the WEST dummy is not significantly affecting the estimation of class-specific utility parameters on attributes indirectly through the class membership model. To the extent that we can estimate the model and conduct the hypothesis tests, results from the LCM approach are consistent with results under the MNL approach.

4.3.2 Parsimonious Latent Class Model (LCM) Results

Table 8 shows the maximum likelihood estimated coefficients for the model with the restrictions retained for tests in Table 7 for Restricted 1 and 7. Using a structured pre-test estimation process, we developed a parsimonious Latent Class Model (LCM) to help focus our discussion on watershed management attributes and interactions of relevance and significance for management decision-making. The parsimonious model generated here reduces the parameters to 88 from the model shown in Table 8 and we focus our following discussion on the results in Table 9.

Respondents concerned about outdoor recreational activities in the watershed tend to be in class two, based on the final class probability model (Table 9). The difference in preferences between the two classes is concentrated around a subset watershed management activities. High, medium and low level of effort for controlling or removing non-native species adds significantly to utility for members of class two and not for members of class one (Table 9; HNONH, HNONM, and HNONL). However, members in class two don't seem to gain significantly in utility from management efforts on open space preservation, while effort dedicated for open space does significantly affect utility for respondents in class one (Table 9; OSPH, OSPM, and OSPL). Members of both classes have significant and expected signs on P. Cost and F. Cost.

4.4 Willingness to Pay (WTP) for watershed management plans

Table 10 presents the calculation of Willingness to Pay (WTP) values for example watershed management plans characterized by a specific focus on certain management actions against a status quo or no plan. For example, Plan A delivers high levels of effort to improve surface water quality for aquatic wildlife and human recreation, preserve open space, and establish more miles of biking corridors. We employed attribute coefficients from the parsimonious multinomial logit model (MNL) (Table 5) and calculate WTP for each example management plan under three different scenarios: (i) when federal dollars and the federal-cost attribute are excluded, (ii) when the federal-cost attribute is included but federal dollars are set to zero, and (iii) when federal-cost dollars are $500,000 per year. All WTP values were calculated for a typical respondent in our sample with mean age, low income and low education. All WTP values are higher for an average respondent in our sample from the western portion of the watershed than those from eastern section. WTP values are highest in case of management plans that deliver a high level of effort on improving surface water quality for aquatic wildlife and human recreational uses, a medium level of effort on water quantity issues in the watershed such as wetland restoration, controlling flood (See Plan-D in Table 10).

5. Conclusions and Implications

In this paper, we examined the effect of federal funding availability on WTP and Marginal Rate of Substitution (MRS) among management plan attributes employing a standard contingent choice experiment designed to assess public preferences for watershed management programs in the Blackstone River Watershed. Our results show that the availability of federal (public) dollars for watershed management has a significant marginal effect on respondents' utility values, although the availability of federal support did not affect the marginal rate of substitution (MRS) among management attributes. Our results imply that an alternative (public) funding source in a contingent choice framework can affect WTP estimates, which is not particularly surprising. However, the results also show effects of public funding beyond simply the marginal utility obtained from public dollars allocated to management; rather, the data produce significant interactions between the availability of public funds and heterogeneity in preferences for the status quo (interactions with the ASC and ISC variables) so that effects on gross WTP is systematically related to individual characteristics while preferences (and WTP) for marginal tradeoffs are independent of availability of alternative.

These results contrast with existing studies. Johnston et al. (1999; 2002) found that characteristics of the payment vehicle (for personal cost) not only affected gross WTP, but also affected at least some marginal tradeoffs for some attributes. Swallow and McGonagle (2006) used a standard payment vehicle along with the allocation of existing tax dollars as an alternative payment vehicle, and found that preferences for allocating tax dollars implied a non-zero opportunity cost for the allocation of existing tax dollars. This latter study also uncovered an interaction between the alternative payment vehicle and ISCs, notably lower income levels, which raised questions about the influence of valuation on equity.

In the present study, results show a WTP to obtain public funds (federal dollars), implying that this attribute may indicate to respondents a positive enhancement of watershed management outcomes associated with a given portfolio of management effort. Yet our study approach does not simply add another attribute to the estimated utility function; the presence of the attribute creates a non-marginal, discrete effect, changing the calculation of utility relative to the status quo of neither plan through interactions with individual-specific characteristics. The utility of the status quo (the neither plan) is the foundation or reference-level of utility against which the utility of an active plan is calculated, and the presence of federal dollars is changing that reference-level of utility.[7] We are unaware of a similar result appearing previously in the choice experiment literature. In this case, the discrete effect interacts with differences in income, education, or environmental attitudes, which may raise questions about how management choices affect different groups.

Our results suggest that respondents' WTP and MRS between plan attributes were affected by the design of questions with different subsets of attributes; respondents exhibited systematic differences in preferences for attributes common to the two designs (i.e., the two subsets of attributes). This result implies that respondents may have viewed different subsets of attributes to produce different watershed outcomes than would be expected if different effort-attributes contributed independently to utility. Respondents always faced the first four questions from the first design and the remaining four from the second design. This ordering of choice questions in a survey booklet does not allow us more flexibility in testing whether the order of presenting choice scenarios had a significant effect separately from the designs. However, Carlsson and Martinsson (2008) did not find significant effects of the ordering of choice sets on

[7] We are mindful of the fact that the presence of the federal cost attribute is part of the active (non-status quo) plans, such that an econometrically equivalent model could have involved interactions between FCOST and (1-ASC). Thus, it is not so much that the utility of the status quo changes, rather than a discrete effect on the utility of the active plans relative to the status quo that changes. Our exposition follows more directly from the econometric model (or style) presented, which is standard within the discrete choice literature.

elicited preferences, in contrast to Holmes and Boyle (2005). For studies involving a large number of attributes, the effects of using subsets of attributes in designing a subset of questions deserves further investigation regarding effects on preference and WTP estimation.

Our hypothesis that respondents living in geographically distinct regions may have different preferences was rejected with respect to effects on the tradeoffs among plan attributes. However, respondents from East and West Blackstone showed different preferences with respect supporting an active management plan over the status quo alternative, and this preference change interacted with individual-specific characteristics. For agencies like NRCS, this result supports the idea that respondents living in distinct geographic regions may evaluate tradeoffs similarly, in regard to the composition of a management plan, although the benefits of the plan relative to the status quo may differ as measured by WTP.

All the conclusions we made regarding our hypotheses using the multinomial logit model are qualitatively and logically consistent with the results under LCM. In addition, the LCM approach allowed us to characterize respondents based on a set of individual- specific characteristics, identifying two latent classes or groups with distinct preferences. For example, members in class two tend to be outdoor recreation lovers, favoring plans that allocate effort toward improving surface water quality for recreational uses and establishing more miles of biking and walking paths along the river corridor.

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Table 1: Watershed management plan attributes and management activities included in the study

Watershed Attributes	Watershed Management Activities	Survey Design	Levels
Surface Water Quality	For Fish and Aquatic Wildlife Survival (SWQFW)	A	H, M, L and NSE (Base) ☞
	For Human Recreational Uses i.e., Boating, Fishing, Swimming etc. **(SWQREC)**	B	,,
Water Quantity	Flood Control **(WQTYF)**	A	,,
	Stream-flow Regulation **(WQTYDRY)**	A, B	,,
	Wetlands Restoration **(WQTYWET)**	B	,,
Wildlife Habitat	Native Forests Habitats Restoration **(HNATIVE)**	A	,,
	Non-native Species Management **(HNON)**	A, B	,,
	Establishment of Natural Trout Habitat **(HTROUT)**	B	,,
Open Space	Open Space Preservation **(OSP)**	A	,,
	Establishment of Biking/Hiking/Walking Trails **(OSBIKE)**	B	,,
Personal Cost	Hypothetical increase in your household tax dollars per year **(P. Cost)**	A, B	$ 25, $40, $65 and $110
Federal Cost	Dollars of Federal Government added to money from local tax payers for your watershed **(F. Cost)**	A, B	$ 175,000, $500,000, $900,000 and None

☞ H, M, L and NSE mean, respectively, High, Medium, Low, and No Special Effort (NSE) for the corresponding management attribute defined as follows:

High Effort: Noticeable improvements over 5-10 years
Medium Effort: Some improvements over 5-10 years
Low Effort: Minimal improvements over 5-10 years
No Special Effort: Degradation may occur over 5-10 years

Each attribute represented using three effects-coded variables, and for each H, M or L level, taking a value of 1 for the corresponding level, -1 for the NSE level, and 0 otherwise.

Table 2: Individual-Specific characteristics of the respondents

Individual-Specific Characteristics	Variable Definition	Levels	Description	Percent
Income **(HINC)**	1 if High Income 0 otherwise	High Income	>$100,000 per year	45.9
		Low Income	<$100,000 per year	54.1
Education **(HEDU)**	1 if High Education 0 otherwise	High Education	Bachelor's degree or higher	52.46
		Low education	Lower than a Bachelor's degree	47.54
Age **(AGE)**	Age of the respondent in years		54.49 (13.05)☟ ☟ Mean (S.D.)	
PROENV PROREC PROWL PROWQ PRODEV	Attitude variables normalized to mean 0 and 1 standard deviation. Please see Appendix-A for detail of attitude factors analysis and description.			

Table 3: Multinomial Logit (MNL) Model Statistics and Hypothesis Tests

Model	**Econometric Restrictions**	**Log-likelihood (No. of Parameters)**	**$\chi 2$ (df)**	**P <**
Unrestricted (Equation 8)	None	-1745.06203 (139)	N/A	N/A
Restricted 1	$\beta_{\text{Attributes.Federal}}$, $\beta_{\text{ISC.ASC.Federal}}$ =0 $\beta_{\text{Attributes.West}}$, $\beta_{\text{ISC.ASC.West}}$ =0 $\beta_{\text{Attributes.Design}}$, $\beta_{\text{ISC.ASC.Design}}$ =0	-1812.95413 (44)	135.7842 (95)	0.0038
Restricted 2	$\beta_{\text{Attributes.Federal}}$, $\beta_{\text{ISC.ASC.Federal}}$ =0	-1777.92340 (100)	65.7227 (39)	0.0047
Restricted 3	$\beta_{\text{Attributes.Federal}}$ =0	-1760.35893 (108)	30.5938 (31)	0.4868
Restricted 4	$\beta_{\text{ISC.ASC.Federal}}$ =0	-1762.85007 (131)	35.5761 (8)	0.0001
Restricted 5	$\beta_{\text{Attributes.Design}}$, $\beta_{\text{ISC.ASC.Design}}$ =0	-1753.93261 (123)	17.7412(16)	0.3393
Restricted 6	$\beta_{\text{Attributes.Design}}$ =0	-1752.57740 (131)	15.0307 (8)	0.0586
Restricted 7	$\beta_{\text{ISC.ASC.Design}}$ =0	-1746.36108 (131)	2.5981 (8)	0.9569
Restricted 8	$\beta_{\text{Attributes.West}}$, $\beta_{\text{ISC.ASC.West}}$ =0	-1774.88094 (99)	59.6378 (40)	0.0235
Restricted 9	$\beta_{\text{Attributes.West}}$ =0	-1755.13678 (107)	20.1495 (32)	0.9486
Restricted 10	$\beta_{\text{ISC.ASC.West}}$ =0	-1764.47789 (131)	38.8257 (8)	0.0001

Estimation based on 1839 choices

Table 4: Maximum-Likelihood Estimation of MNL

Variables	Coefficients (S.E.)	Variables	Coefficients (S.E.)
ASC	**-0.944 (0.5381)***	**DESIGN•ASC**	**-0.4152(0.2108)****
SWQFWH	**0.5359 (0.0864)*****	**AGE•ASC**	**0.0074(0.0088)***
SWQFWM	0.1648 (0.1095)	**HINC•ASC**	**0.4423(0.2334)***
SWQFWL	-0.0141 (0.1078)	**HEDU•ASC**	**-0.6927(0.2308)*****
WQTYFH	-0.1141 (0.1323)	**PROENV•ASC**	**0.1481 (0.1156)*****
WQTYFM	**0.3442 (0.1172)*****	PROREC•ASC	-0.1531 (0.1152)
WQTYFL	-0.0392 (0.1242)	**PROWL•ASC**	**0.2928 (0.1271)*****
WQTYDRYH	-0.0999 (0.1217)	**PROWQ•ASC**	**-0.4176 (0.1227)*****
WQTYDRYM	**0.4224(0.1127)*****	PRODEV•ASC	-0.0828 (0.1123)
WQTYDRYL	-0.1851 (0.1144)	AGE•ASC•FEDERAL	$6.9\sim10^{-4}$ (0.0107)
HNONH	0.1333 (0.0942)	**HINC•ASC•FEDERAL**	**-0.9026 (0.2579)*****
HNONM	0.0727 (0.0976)	**HEDU•ASC•FEDERAL**	**0.3308(0.2609)***
HNONL	0.0145 (0.1121)	PROENV•ASC•FEDERAL	0.1695 (0.1248)
HNATIVEH	**0.3504(0.0931)*****	PROREC•ASC•FEDERAL	-0.1252 (0.1226)
HNATIVEM	-0.0987 (0.1041)	PROWL•ASC•FEDERAL	0.0318 (0.1278)
HNATIVEL	**0.1959 (0.1144)***	**PROWQ•ASC•FEDERAL**	**0.3239 (0.1276)****
OSPH	**0.5279(0.0951)*****	**PRODEV•ASC•FEDERAL**	**0.4549 (0.1263)*****
OSPM	**0.1663 (0.0907)***	AGE•ASC•WEST	$4.48\sim10^{-3}$ (0.0107)
OSPL	**-0.2156 (0.1029)****	HINC•ASC•WEST	-0.1859 (0.2622)
SWQRECH	**0.4055(0.0871)*****	**HEDU•ASC•WEST**	**0.5902 (0.2632)****
SWQRECM	**0.1802(0.1028)***	PROENV•ASC•WEST	-0.0838 (0.1249)
SWQRECL	0.1484 (0 .1023)	**PROREC•ASC•WEST**	**0.6325 (0.1267)*****
WQTYWETH	**0.3831 (0.0935)*****	PROWL•ASC•WEST	-0.0535 (0.1386)
WQTYWETM	**0.2155 (0.0974)****	**PROWQ•ASC•WEST**	**0.3411 (0.1321)*****
WQTYWETL	-0.0901 (0.0906)	PRODEV•ASC•WEST	-0.0566 (0.1279)
HTROUTH	0.0775 (0.0934)	**WQTYDRYH•DESIGN**	**0.3705 (0.1568)****
HTROUTM	0.0377 (0.0962)	**WQTYDRYM•DESIGN**	**-0.2949 (0.1492)****
HTROUTL	-0.0675 (0.1061)	WQTYDRYL•DESIGN	0.1894(0.1461)
OSBIKEH	**0.2332(0.0953)*****	HNONH• DESIGN	0.0205 (0.1344)
OSBIKEM	**0.2419 (0.0896)*****	HNONM• DESIGN	0.0629 (0.1364)
OSBIKEL	**-0.1712(0.1001)***	HNONL• DESIGN	-0.2389 (0.1579)
PCOST	**$-9.07\sim10^{-3}$($1.96\sim10^{-3}$)*****	PCOST•DESIGN	$-2.19\sim10^{-3}$ ($2.85\sim10^{-3}$)
FCOST	**$4.8\sim10^{-4}$ ($1.9\sim10^{-4}$)*****	FCOST•DESIGN	$4.211\sim10^{-5}$($2.529*10^{-4}$)
FEDERAL•ASC	0.1869 (0.6115)		
WEST•ASC	-0.4628 (0.6119)		

Log-likelihood Value = -1771.97636
Number of Parameters (P) = 68
Number of Observations (N) = 5517 (1839 choices)
*** Significant at the 1% level, ** Significant at the 5% level and * Significant at the 10% level

Table 5: Maximum Likelihood estimation of Parsimonious MNL

Variables	Coefficients (S.E.)	Variables	Coefficients (S.E.)
ASC	**-1.0651(0.3428)****	WEST•ASC	-0.2733 (0.1799)
SWQFWH	**0.5029 (0.0746)*****	**DESIGN•ASC**	**-0.2793 (0.1171)****
WQTYFM	**0.2417 (0.0942)*****	**AGE•ASC**	**0.0107 (0.0051)****
WQTYDRYM	**0.3203(0.0928)*****	**HEDU•ASC**	**-0.5113 (0.1939)*****
HNONH	**0.0863 (0.0506)***	HINC•ASC	0.2396 (0.1617)
HNATIVEH	**0.3489(0.0797)*****	PROENV•ASC	0.0969 (0.0761)
OSPH	**0.4688(0.0878)*****	**PROREC•ASC**	**0.1938(0.0965)****
OSPM	**0.1297 (0.0793)***	**PROWL•ASC**	**0.2884 (0.0637)*****
OSPL	**-0.2742 (0.0963)*****	**PROWQ•ASC**	**0.4334 (0.1172)*****
SWQRECH	**0.4037(0.0761)*****	**HINC•ASC•FEDERAL**	**-0.7354 (0.2396)*****
SWQRECM	**0.2185(0.0874)****	PROENV•ASC•FEDERAL	0.2065 (0.1162)
WQTYWETH	**0.3227 (0.0765)*****	**PROWQ•ASC•FEDERAL**	**0.3411 (0.1321)*****
WQTYWETM	0.1312 (0.0843)	**PRODEV•ASC• FEDERAL**	**0.3652 (0.0907)*****
OSBIKEH	**0.2391(0.0902)*****	**HEDU•ASC•WEST**	**0.4931(0.2447)*****
OSBIKEM	**0.1576 (0.0808)***	**PROREC•ASC•WEST**	**0.6069 (0.1221)*****
OSBIKEL	-0.1388(0.0944)	**PROWQ•ASC•WEST**	**0.3814(0.1263)*****
PCOST	**$-8.4\sim10^{-3}(1.15\sim10^{-3})$*****	**WQTYDRYH•DESIGN**	**0.1764 (0.0771)****
FCOST	**$5.2\sim10^{-4}$ $(1.4\sim10^{-4})$*****	**WQTYDRYM•DESIGN**	**-0.2248 (0.1223)***
FEDERAL•ASC	0.2589 (0.1676)		

Log-likelihood Value = -1784.68515
Number of Parameters (P) = 37
Number of Observations (N) = 5517 (1839 choices)
***Significant at the 1% level, ** Significant at the 5% level and *Significant at the 10% level

Table 6: Comparison of Panel Latent Class Models up-to 4 Classes

Number of Classes	**Number of Parameters (P)**	**Log-likelihood Values at Convergence (LL)**	**AIC**[+]	**BIC**[++]
1	36	-2108.525	4289.05	4492.5416
2	**81**	**-1370.4123**	**2902.8246**	**3360.6423**
3	126	-1331.5134	2913.0268	3627.1877
4	171	-1287.5069	2917.0138	3883.5178

Sample size is 2105 choices (N) from 325 individuals

[+]AIC (Alkaike Information Criterion) is calculated as {-2(LL-P)}

[++] BIC (Bayesian Information Criterion) is calculated as {-2LL+[P*ln(N)]}

Table 7: Latent Class Model (LCM) Statistics and Hypothesis Tests

Model	**Econometric Restrictions**	**Log-likelihood (No. of Parameters)**	**$\chi2$ (df)**	**P <**
Unrestricted (Equation 9)	None	-1117.85446 (174)	N/A	N/A
Restricted 1[❷]	$\beta_{\text{Attributes.Federal}} = 0$	-1151.34449 (112)	66.98006 (62)	0.3102
Restricted 2[❷]	$\beta_{\text{ISC.ASC.Federal}} = 0$	-1135.90806 (158)	36.1072 (16)	0.0027
Restricted 3[❷]	$\beta_{\text{ISC.ASC.West}} = 0$	-1142.21636 (158)	48.7238 (16)	0.0001
Restricted 4[σ]	$\beta_{\text{ISC.ASC}} = 0, \beta_{\text{Design.ASC}} = 0$	-1129.80587(130)	43.07724 (18)	0.0008
Restricted 5[σ]	$\beta_{\text{ISC.ASC.Design}} = 0, \beta_{\text{Attributes.Design}} = 0$	-1119.45935 (162)	20.69304 (32)	0.9382
Restricted 6[σ]	$\beta_{\text{Attributes.Design}} = 0$	-1106.39267 (146)	26.13336 (16)	0.0521
Restricted 7[σ]	$\beta_{\text{ISC.ASC.Design}} = 0$	-1125.25716	11.59562 (16)	0.7713

[❷] LR Test relative to unrestricted model presented in equation 9
[σ] LR Test relative to unrestricted model presented in equation 10
Estimation based on 1839 choices

Table 8: Maximum Likelihood Estimation of 2-Class LCM

LCM: Class One		LCM: Class Two	
Variables	**Coefficients (S.E.)**	**Variables**	**Coefficients (S.E.)**
ASC	**-6.7404 (2.5201)***	ASC	-1.9249 (1.9659)
SWQFWH	0.3489 (0.2691)	SWQFWH	1.1532 (1.1041)
SWQFWM	0.3747 (0.45)	SWQFWM	0.4552 (1.1089)
SWQFWL	0.0758 (0.3958)	SWQFWL	0.1781 (0.8008)
WQTYFH	-0.5225 (0.4977)	WQTYFH	0.2574 (0.7608)
WQTYFM	**1.1316 (0.4396)**	WQTYFM	-0.2686 (1.5544)
WQTYFL	0.1809 (0.4815)	WQTYFL	-0.1045 (0.8989)
WQTYDRYH	-0.3446 (0.4214)	WQTYDRYH	-0.1717 (0.5474)
WQTYDRYM	0.6948 (0.5078)	WQTYDRYM	0.8165 (0.6345)
WQTYDRYL	0.0566 (0.4508)	WQTYDRYL	-0.2101 (0.7257)
HNONH	0.0608 (0.3057)	HNONH	0.5039 (0.7042)
HNONM	0.0677 (0.3295)	HNONM	-0.1448 (0.5528)
HNONL	0.3872 (0.4036)	HNONL	-0.2592 (0.8175)
HNATIVEH	0.3174 (0.3797)	HNATIVEH	0.8511 (0.6345)
HNATIVEM	-0.1738 (0.3659)	HNATIVEM	-0.1233 (0.9544)
HNATIVEL	**0.903 (0.4545)**	HNATIVEL	0.1258 (0.9975)
OSPH	0.4853 (0.3154)	OSPH	0.3526 (1.0059)
OSPM	0.4431 (0.3029)	OSPM	0.0572 (0.7744)
OSPL	-0.1693 (0.3152)	OSPL	0.2277 (1.0128)
SWQRECH	0.4069 (0.2658)	SWQRECH	0.8412 (0.6239)
SWQRECM	0.4651 (0.4148)	SWQRECM	0.2719 (0.8608)
SWQRECL	0.1395 (0.4445)	SWQRECL	-0.2095 (1.0539)
WQTYWETH	0.4689 (0.3282)	WQTYWETH	0.6604 (0.7903)
WQTYWETM	0.2222 (0.2594)	WQTYWETM	1.0184 (0.9247)
WQTYWETL	-0.0065 (0.2538)	WQTYWETL	-0.3393 (0.9444)
HTROUTH	0.1112 (0.2849)	HTROUTH	0.0919 (0.925)
HTROUTM	0.1412 (0.322)	HTROUTM	0.3599 (0.5006)
HTROUTL	-0.2851 (0.3662)	HTROUTL	-0.2961 (1.4025)
OSBIKEH	0.2234 (0.3118)	OSBIKEH	0.5479 (0.671)
OSBIKEM	0.2698 (0.3166)	OSBIKEM	0.3076 (1.0527)
OSBIKEL	-0.1944 (0.2901)	OSBIKEL	-0.3623 (0.7891)
PCOST	**$-1.39\sim10^{-2}(7.8\sim10^{-3})$***	PCOST	$-8.5\sim10^{-3}(9.2\sim10^{-3})$
FCOST	**$9.3\sim10^{-4}$ $(3.4\sim10^{-4})$**	FCOST	$2.1\sim10^{-4}$ $(1.1\sim10^{-3})$
FEDERAL •ASC	1.7489 (2.8376)	FEDERAL •ASC	1.2824 (2.5279)
WEST•ASC	0.60007 (2.5388)	WEST•ASC	1.334 (2.1317)
DESIGN•ASC	-1.5186 (1.0248)	DESIGN•ASC	-0.9757 (0.7465)
AGE•ASC	**0.723 (0.038)**	**AGE•ASC**	**0.723 (0.038)**
HINC•ASC	1.1492 (0.8696)	HINC•ASC	1.1492 (0.8696)
HEDU•ASC	-1.2906 (0.8885)	HEDU•ASC	-1.2906 (0.8885)
PROENV•ASC	0.2116 (0.4168)	PROENV•ASC	0.2116 (0.4168)
PROREC•ASC	-0.5699 (0.3147)	PROREC•ASC	-0.5699 (0.3147)
PROWL•ASC	-0.1364 (0.6887)	PROWL•ASC	-0.1364 (0.6887)
PROWQ•ASC	-0.8059 (0.4659)	PROWQ•ASC	-0.8059 (0.4659)
PRODEV•ASC	-0.2155 (0.4075)	PRODEV•ASC	-0.2155 (0.4075)
AGE•ASC•FEDERAL	-0.0091 (0.0464)	AGE•ASC•FEDERAL	-0.0091 (0.0464)
HINC•ASC•FEDERAL	-0.7234 (0.8542)	HINC•ASC•FEDERAL	-0.7234 (0.8542)
HEDU•ASC•FEDERAL	-0.8834 (1.1309)	HEDU•ASC•FEDERAL	-0.8834 (1.1309)
PROENV•ASC•FEDERAL	0.4536 (0.4629)	PROENV•ASC•FEDERAL	0.4536 (0.4629)
PROREC•ASC•FEDERAL	-0.0112 (0.3866)	PROREC•ASC•FEDERAL	-0.0112 (0.3866)
PROWL•ASC•FEDERAL	0.4558 (0.3898)	PROWL•ASC•FEDERAL	0.4558 (0.3898)
PROWQ•ASC•FEDERAL	0.5675 (0.3897)	PROWQ•ASC•FEDERAL	0.5675 (0.3897)

PRODEV•ASC•FEDERAL	**1.4378 (0.4944)*** **	**PRODEV•ASC•FEDERAL**	**1.4378 (0.4944)*** **
AGE•ASC•WEST	-0.0313 (0.0412)	AGE•ASC•WEST	-0.0313 (0.0412)
HINC•ASC•WEST	0.2142 (1.0834)	HINC•ASC•WEST	0.2142 (1.0834)
HEDU•ASC•WEST	0.4553 (1.1008)	HEDU•ASC•WEST	0.4553 (1.1008)
PROENV•ASC•WEST	0.1997 (0.4171)	PROENV•ASC•WEST	0.1997 (0.4171)
PROREC•ASC•WEST	0.5368 (0.3285)	PROREC•ASC•WEST	0.5368 (0.3285)
PROWL•ASC•WEST	0.3351 (0.6226)	PROWL•ASC•WEST	0.3351 (0.6226)
PROWQ•ASC•WEST	**0.9375 (0.485)***	**PROWQ•ASC•WEST**	**0.9375 (0.485)***
PRODEV•ASC•WEST	-0.0687 (0.5764)	PRODEV•ASC•WEST	-0.0687 (0.5764)
WQTYDRYH•DESIGN	**0.9789 90.4543)****	**WQTYDRYH•DESIGN**	**0.9789 90.4543)****
WQTYDRYM•DESIGN	-0.4763 (0.5193)	WQTYDRYM•DESIGN	-0.4763 (0.5193)
WQTYDRYL•DESIGN	-0.1859 (0.4594)	WQTYDRYL•DESIGN	-0.1859 (0.4594)
HNONH•DESIGN	0.0108 (0.44)	HNONH•DESIGN	0.0108 (0.44)
HNONM•DESIGN	0.4222 (0.3919)	HNONM•DESIGN	0.4222 (0.3919)
HNONL•DESIGN	-0.7384 (0.4993)	HNONL•DESIGN	-0.7384 (0.4993)
PCOST•DESIGN	-0.01 (0.011)	PCOST•DESIGN	-0.01 (0.011)
FCOST•DESIGN	$1.374\sim10^{-5}$ $(6.9\sim10^{-4})$	FCOST•DESIGN	$1.374\sim10^{-5}$ $(6.9\sim10^{-4})$

Class Probability Model(ω_i)

	Class One		Class Two
Variables	**Coefficients (S.E.)**	**P<**	
Intercept	-0.2538 (1.6956)	0.8810	0
AGE	0.0143 (0.026)	0.5820	0
HEDU	-0.5959 (0.7359)	0.4181	0
HINC	**1.1153 (0.6229)**	**0.0734**	**0**
PROENV	-0.0929 (0.3522)	0.7919	0
PROREC	**-0.5731 (0.3448)**	**0.0965**	**0**
PROWL	-0.1557 (0.2685)	0.5620	0
PROWQ	0.2388 (0.3477)	0.4921	0
PRODEV	0.1719 (0.3274)	0.5996	0
WEST	-0.0317 (0.6232)	0.9594	0
Average Class probabilities	**0.6479**		**0.3521**

Log-likelihood Value = -1132.42337
Number of Parameters (P) = 114
Number of Observations (N) = 5517 (1839 choices)
***Significant at the 1% level, ** Significant at the 5% level and *Significant at the 10% level

Log-likelihood Value without setting ASC interactions same for both classes = -1125.25716 (146)
LR Test: $\chi 2$ =14.332 32 df, P <0.9969

Table 9: Maximum Likelihood Estimation of 2-Class Parsimonious LCM

LCM: Class One		LCM: Class Two	
Variables	**Coefficients (S.E.)**	**Variables**	**Coefficients (S.E.)**
ASC	**-1.4022 (0.4786)*** **	**ASC**	**3.1169 (0.611)*** **
SWQFWH	**0.2666 (0.1196)** **	**SWQFWH**	**1.4209 (0.2311)*** **
WQTYFM	**0.4759 (0.1890)** **	WQTYFM	-0.2619 (0.2588)
WQTYDRYH	-0.1485 (0.1466)	**WQTYDRYH**	**-0.6082 (0.3281)***
WQTYDRYM	**0.6078 (0.1888)*** **	**WQTYDRYM**	**1.1409 (0.3334)*** **
WQTYDRYL	**0.2191 (0.0978)** **	**WQTYDRYL**	**-0.5847 (0.2057)*** **
HNONH	0.0685 (0.0950)	**HNONH**	**0.4313 (0.1946)** **
HNONM	0.0757 (0.1013)	**HNONM**	**0.5489 (0.2080)*** **
HNONL	0.0279(0.1016)	**HNONL**	**-0.6566 (0.2323)*** **
HNATIVEH	**0.4498 (0.1425)*** **	**HNATIVEH**	**0.90008 (0.2259)*** **
OSPH	**0.2721 (0.1473)***	OSPH	0.3724 (0.2308)
OSPM	**0.3233 (0.1202)*** **	OSPM	-0.2254(0.2542)
OSPL	**-0.4912 (0.1558)*** **	OSPL	0.3797 (0.2568)
SWQRECH	**0.3708(0.1164)*** **	**SWQRECH**	**1.2754 (0.2699)*** **
SWQRECM	**0.2674 (0.1361)** **	**SWQRECM**	**1.0425 (0.3249)*** **
WQTYWETH	**0.3346 (0.1181)*** **	**WQTYWETH**	**0.5662 (0.2626)** **
WQTYWETM	0.1738 (0.1271)	**WQTYWETM**	**1.2953 (0.3169)*** **
OSBIKEH	0.2149 (0.1494)	**OSBIKEH**	**0.9165 (0.3049)*** **
OSBIKEM	**0.2033 (0.1213)***	OSBIKEM	0.2914 (0.3050)
OSBIKEL	0.1921 (0.1453)	**OSBIKEL**	**-0.6847 (0.3378)** **
PCOST	**$-9.96\sim10^{-3}(1.81\sim10^{-3})$*** **	**PCOST**	**$-1.42\sim10^{-2}(3.61\sim10^{-3})$*** **
FCOST	**$8.3\sim10^{-4}$ $(2.1\sim10^{-4})$*** **	**FCOST**	**$7.1\sim10^{-4}$ $(4.2\sim10^{-4})$***
FEDERAL •ASC	**0.6609 (1.2026)*** **	FEDERAL •ASC	0.3809 (0.9717)
WEST•ASC	**-2.7665 (0.5623)*** **	**WEST•ASC**	**-1.0013 (5393)***
DESIGN•ASC	-0.2257 (0.2864)	**DESIGN•ASC**	**-1.0339 (0.3072)*** **
HEDU•ASC	-0.6164 (0.0934)	**HEDU•ASC**	**-1.3776 (0.7781)***
HINC•ASC	**-1.5505 (0.4827)*** **	HINC•ASC	0.5195 (0.5780)
PROREC•ASC	-0.2444 (0.2771)	**PROREC•ASC**	**-0.4821(0.2382)** **
PROWL•ASC	**0.6039 (0.2547)** **	PROWL•ASC	0.0569 (0.2047)
PRODEV•ASC	**-0.8609 (0.2436)*** **	PRODEV•ASC	-0.6649 (0.2584)
AGE•ASC•FEDERAL	0.0105 (0.0217)	AGE•ASC•FEDERAL	$3.0786\sim10^{-5}$ (0.0167)
HINC•ASC•FEDERAL	**1.5154 (0.7599)** **	HINC•ASC•FEDERAL	-0.8788 (0.6812)
HEDU•ASC•FEDERAL	**-3.8209 (0.9325)*** **	HEDU•ASC•FEDERAL	-0.7808 (0.8383)
PROENV•ASC•FEDERAL	**1.1003 (0.2158)*** **	**PROENV•ASC•FEDERAL**	**1.0271 (0.2583)*** **
PROREC•ASC•FEDERAL	0.5651 (0.3833)	**PROREC•ASC•FEDERAL**	**0.4514 (0.2519)***
PROWL•ASC•FEDERAL	0.7499 (0.383)	PROWL•ASC•FEDERAL	0.2859 (0.2634)
PROWQ•ASC•FEDERAL	**-0.7553 (0.3514)** **	**PROWQ•ASC•FEDERAL**	**-0.5955 (0.2612)** **
PRODEV•ASC•FEDERAL	**1.252 (0.3248)*** **	**PRODEV•ASC•FEDERAL**	**1.3721 (0.3070)*** **
HEDU•ASC•WEST	**3.0235 (0.7209)*** **	**HEDU•ASC•WEST**	**1.1135 (0.6582)***
PROREC•ASC•WEST	0.0109 (0.3634)	**PROREC•ASC•WEST**	**0.6025 (0.2725)***
PROWQ•ASC•WEST	-0.0944 (0.2662)	PROWQ•ASC•WEST	0.1416 (0.1802)
WQTYDRYH•DESIGN	0.1471 (0.190)	**WQTYDRYH•DESIGN**	**1.2929 (0.3945)*** **
WQTYDRYM•DESIGN	**-0.6042 (0.2268)*** **	**WQTYDRYM•DESIGN**	**-0.7277 (0.3985)***

Class Probability Model (ω_i)

	Class One		Class Two
Variables	**Coefficient (S.E.)**	**P<**	
Intercept	0.7602 (0.1759)	0.0001	0
PROREC	**-0.5113 (0.3036)**	**0.0921**	**0**

Average Class Probabilities: **0.6763** **0.3237**

Log-likelihood Value = -1145.54328
Number of Parameters (P) = 88
Number of Observations (N) = 5517 (1839 choices)
***Significant at the 1% level, ** Significant at the 5% level and * Significant at the 10% level

Table 10: Example management plans and WTPs

Model	**Plan**	**Plan Attributes Ψ**	**Plan CS**[Φ]	**WTP (West)**[ΦΦ]	**WTP (East)**[ΦΦ]
Parsimonious MNL	Neither	ASC and ASC interactions	-1.0371 (-0.7638)	-	-
(Without Federal	Plan-A	SWQFWH, OSPH, SWQRECH, OSBIKEH	0.1634	142.92	110.38
Dollars and FEDERAL	Plan-B	WQTYFM, WQTYDRYM, HNONH, HNATIVEH, WQTYWETH	-0.3874	77.35	44.81
attribute excluded)	Plan-C	SWQFWH, HNONH, HNATIVEH, SWQRECH	-0.2563	92.95	60.42
	Plan-D	SWQFWH, WQTYFM, WQTYDRYM, SWQRECH, WQTYWETH	0.7739	215.59	183.06
	Plan-E	HNONH, HNATIVEH, OSPH, OSBIKEH	-0.9979	4.67	-27.86
	Plan-F	WQTYFM, WQTYDRYM, OSPH, WQTYWETH, OSBIKEH	0.0323	127.31	94.77
Parsimonious MNL	Neither	ASC and ASC interactions	-0.7782 (-0.5049)	-	-
(Without Federal	Plan-A	SWQFWH, OSPH, SWQRECH, OSBIKEH	0.1634	112.09	79.56
Dollars but FEDERAL	Plan-B	WQTYFM, WQTYDRYM, HNONH, HNATIVEH, WQTYWETH	-0.3874	46.53	13.99
attribute included)	Plan-C	SWQFWH, HNONH, HNATIVEH, SWQRECH	-0.2563	62.13	29.59
	Plan-D	SWQFWH, WQTYFM, WQTYDRYM, SWQRECH, WQTYWETH	0.7739	184.78	152.24
	Plan-E	HNONH, HNATIVEH, OSPH, OSBIKEH	-0.9979	-26.15	-58.69
	Plan-F	WQTYFM, WQTYDRYM, OSPH, WQTYWETH, OSBIKEH	0.0323	96.49	63.95
Parsimonious MNL	Neither	ASC and ASC interactions	-0.7782 (-0.5049)	-	-
(With $ 500,000	Plan-A	SWQFWH, OSPH, SWQRECH, OSBIKEH	0.4234	143.05	110.51
Federal Dollars)	Plan-B	WQTYFM, WQTYDRYM, HNONH, HNATIVEH, WQTYWETH	-0.1274	77.48	44.94
	Plan-C	SWQFWH, HNONH, HNATIVEH, SWQRECH	0.0037	93.09	60.55
	Plan-D	SWQFWH, WQTYFM, WQTYDRYM, SWQRECH, WQTYWETH	1.0339	215.73	183.19
	Plan-E	HNONH, HNATIVEH, OSPH, OSBIKEH	-0.7379	4.79	-27.74
	Plan-F	WQTYFM, WQTYDRYM, OSPH, WQTYWETH, OSBIKEH	0.2923	127.44	94.91

Ψ Please see Table 1 for the description of attributes and their levels

Φ Plan Cumulative Score (CS) is calculated using equation (2) and score for Neither option for Eastern Blackstone is in parenthesis.

ΦΦ $WTP = (CS_i - CS_n)/\beta_{\cos t}, i = plan, n = noplan$

Figure 1: Map of the study location

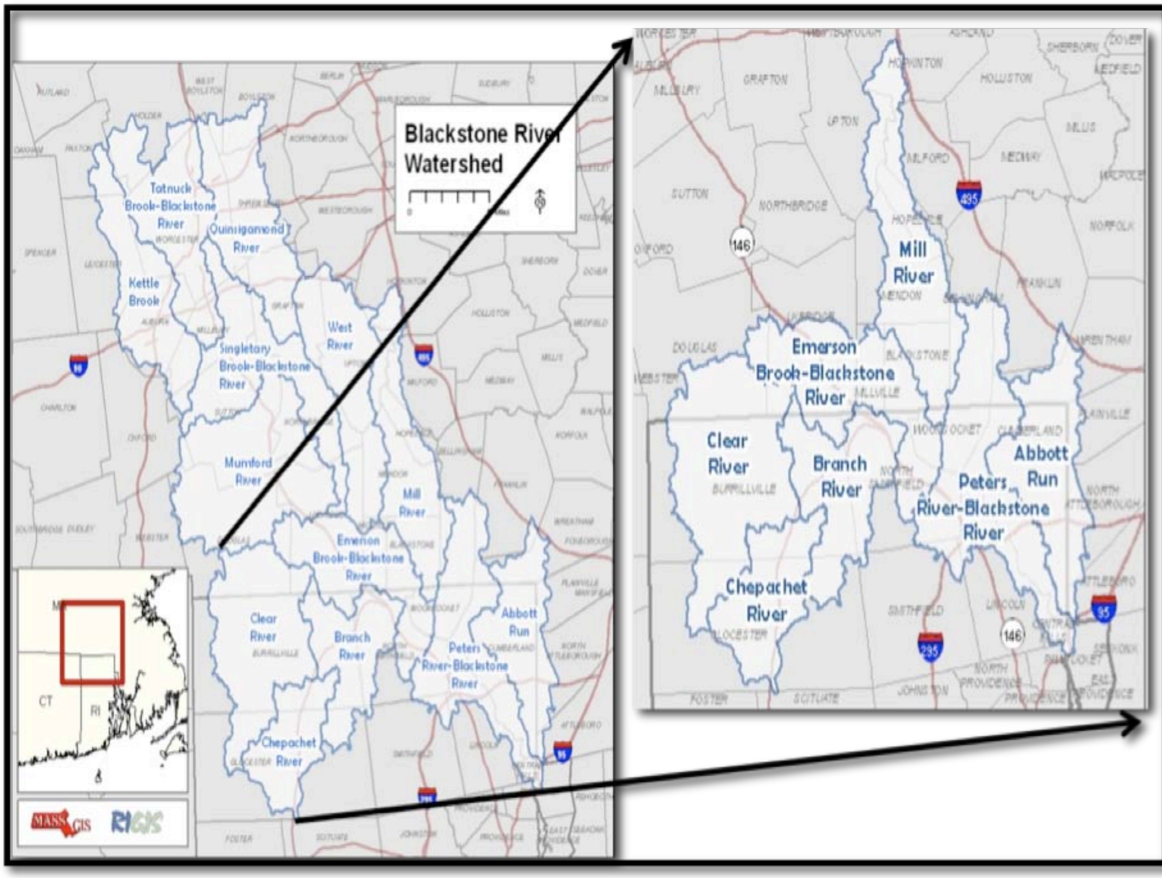

Figure 2: An example choice scenario

Watershed Conditions/ Costs	Management Activity	Plan A Activity Levels	Plan B Activity Levels	Neither Plan
Surface water quality	Effort on water quality in rivers and streams for fish and wildlife survival	Low effort	Moderate effort	No special effort of any kind, so degradation may occur in some or all aspects of watershed conditions
Water quantity	Effort to control flooding of roads	High effort	No special effort	
	Effort to reduce number of weeks (the frequency) that parts of local rivers run low or dry during summer	Moderate effort	High effort	
Habitat	Effort to restore forest habitats to sustain native plants and wildlife	Low effort	No special effort	
	Effort to reduce or remove non-native species	High effort	Moderate effort	
Open space	Effort to preserve undeveloped farm and forestland as open space	High effort	Moderate effort	
Personal cost	This plan requires your household to contribute new taxes each year of:	$45 per year	$45 per year	
Federal cost	Dollars of federal government money added to money from local taxpayers for your watershed	$500,000 per year	$175,000 per year	

Based on your preference, which plan would you prefer to see implemented? I vote for:

☐ **Plan A** ☐ **Plan B** ☐ **Neither Plan**

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Appendix-A: Details of Factor Analysis on Discrete Attitudinal Statements about Watershed Issues

The survey booklet also contained a section to elicit respondents' opinions and attitudes towards various environmental issues in the watershed. Respondents were asked to state their extent of agreement (concerned) or disagreement (not concerned) on various watershed issues mentioned below on a scale of 1 through 5, 1 being Strongly Agree (Highly Concerned) and 5 being Strongly Disagree (Not Concerned at all). These questions were employed to construct psychometric measures or indexes of attitude towards environmental issues in the watershed using factor analysis with principal component factors and rotated using VARIMAX rotation for the number of factors retained with Eigen values greater than one (Kaiser 1958; Kaiser 1960; Mulaik 1972; Harman 1976; Kline and Wichelns 1998). Using following five factors, each respondent's factor scores were calculated based on the degree to which their opinions or attitudes differ from the sample mean score for each factor (Tarlov et. al. 1989).

The following tables present the statements used in factor analysis and associated factor loadings. Based on the opinion statements, factor one has significant factor loadings on statements about overall watershed issues in general. Positive coefficients on opinion statements about overall issues of surface water quality, water quantity, wildlife habitat and open space preservation may indicate "Pro-environment (PROENV)" preferences for a watershed management plan that addresses these issues in their watershed. Factor two has significant loadings on opinion statements about outdoor recreational opportunities. Positive coefficients on these statements may imply "Pro-recreation (PROREC)" preferences of the respondents to see management plans focused on creating more outdoor recreational opportunities such as biking, hiking, preserving natural areas as recreational spots. Factor three may be associated with "Pro-wildlife (PROWL)" preferences because it has positive factor loadings about the concerns for preserving and /or restoring wildlife habitats which would indicate respondents' preferences for protecting wildlife habitats in their watershed. Factor four has significant factor loadings on the concerns about improving surface water quality in the Blackstone River indicating "Pro-water quality (PROWQ)" preferences. Factor five seems to indicate "Pro-development (PRODEV)" preferences as it has significant positive factor loading on the statements to favor development in the watershed.

Statements	**PROENV**	**PROREC**	**PROWL**	**PROWQ**	**PRODEV**
Clean and Safe Water (Q3a)	0.3761	0.2461	-0.0869	**0.4104**	-0.3996
Swimming as Leisure Activity if Swimmable Water (Q3b)	0.1461	0.1446	0.1810	**0.8002**	0.0527
Boating as Recreational Activity if Boatable Water (Q3c)	0.0146	0.2921	0.0857	**0.7495**	0.0331
Fishing as Recreational Activity if Fishable Water (Q3d)	0.0963	0.1639	0.4637	**0.4937**	0.1283
Sufficient Amount of Water in the River (Q3e)	**0.4347**	0.2638	0.2221	0.2840	-0.1399
Recreational Activities Affected by Insufficient Water (Q3f)	0.1355	0.3006	**0.5318**	0.4246	0.0739
Fish and Aquatic Habitat Affected by Insufficient Water (Q3g)	0.2137	0.0639	**0.7469**	0.2046	0.0652
Protecting Habitat (Fish, Aquatic &Wildlife) (Q3h)	0.4306	**0.5567**	0.2609	0.0807	-0.2649
Unpleasant Non-native Species Experiences (Q3i)	0.1135	0.0327	**0.6782**	0.1785	0.0806
Noticed Habitats (Fish, Aquatic and Wildlife) Degraded (Q3j)	0.2415	0.2510	**0.7231**	-0.0089	-0.0847
Natural Areas as Open Space (Q3k)	0.4760	**0.6225**	0.1749	0.0574	-0.2696
Enjoy in Natural Areas as Leisure Activity (Q3l)	0.1547	**0.7107**	0.2487	0.3727	0.0428
Enjoy Hiking and Biking Green Corridors along River if Available (Q3m)	0.0440	**0.7942**	0.0381	0.2671	0.1440
Concern about Runoff for Water Quality (Q4a)	**0.8095**	0.1219	0.0087	0.1802	-0.0421
Concern about Excessive Use Chemicals Use in Lawns (Q4b)	**0.7880**	-0.0372	0.0454	0.1343	-0.0039
Concern about Water Pollution due to Soil Erosion (Q4c)	**0.8203**	-0.0199	0.0734	0.1962	0.0492
Concern about Impervious Surface for Ground Water Recharge (Q4d)	**0.7966**	0.1979	0.1587	-0.0103	-0.0051
Concern about Wetland Loss for Ground Water Recharge (Q4e)	**0.7656**	0.2942	0.1406	0.0281	-0.0455
Concern about Insufficient Volume of Water in Rivers (Q4f)	**0.6959**	0.1020	0.3501	-0.0168	0.1453
Concern about Native Habitat Loss due to Invasion (Q4g)	**0.7281**	0.2296	0.2578	-0.0184	0.1632
Concern about Habitat Loss for Wild Trout (Q4h)	**0.5564**	0.2913	0.3285	0.0639	0.3639
Concern about Open Space Loss due to Development (Q4i)	**0.5818**	0.3541	0.1273	-0.0390	0.1102
Concern about Lack of Hiking and Biking Trails along River Corridors (Q4j)	0.3287	0.4954	0.0437	0.0877	**0.5633**
Concern about Reduced Development Benefits due to Environmental Protection (Q4k)	0.0367	-0.0504	0.0414	0.0897	**0.7790**

Numbers in bold represent VARIMAX rotated highest factor loading for a given statement indicating agreement or concern for positive coefficient and vice versa.

Total variation explained by the five factors= 63.56%

Detailed Statements

Variables	Statements
Q3a	Having clean and safe water in rivers, streams and lakes in my watershed is important to me.
Q3b	I would go swimming as a leisure activity in rivers, streams and lakes in my watershed if water quality is "swimmable."
Q3c	I would do recreational boating activities such as paddling, canoeing and kayaking in rivers, streams and lakes in my watershed if water quality is "boatable."
Q3d	Fishing is a recreational activity of high interest to me if water quality is "fishable" in rivers, streams and lakes in my watershed.
Q3e	Having sufficient volume/amount of water in rivers and streams is important to me.
Q3f	My recreational activities are affected by rivers and streams in my watershed running low or dry.
Q3g	I have noticed fish and other aquatic species habitats in my watershed have been affected by low water.
Q3h	Protecting habitats for fish, other aquatic species and wildlife in my watershed is important to me.
Q3i	I have had unpleasant experiences with non-native species while boating, fishing and /or farming and forest operations.
Q3j	I have noticed fish, aquatic species and wildlife habitats being degraded in my watershed.
Q3k	Protecting and preserving natural areas as open space in my watershed is important to me.
Q3l	I would enjoy my leisure time in those natural areas if available in my watershed.
Q3m	I would enjoy hiking and biking green corridors along rivers, streams and lakes if available in my watershed.
Q4a	I am concerned about runoff water entering directly into local rivers and streams from roads, parking lots, rooftops, driveways, etc., making water polluted and unsafe in my watershed.
Q4b	I am concerned about excessive use of chemicals used on residential lawns in my watershed.
Q4c	I am concerned about pollution of water in the rivers and streams due to eroded soil materials from farm, forestlands or stream bank erosion.
Q4d	I am concerned that impervious surfaces replace natural vegetative cover in my watershed, decreasing the chance of rainwater recharging ground water.
Q4e	I am concerned about loss of wetlands that help to recharge ground water resources in my watershed.
Q4f	I am concerned about an insufficient volume of water in rivers and streams during summer season in my watershed.
Q4g	I am concerned about loss of habitat available to native species due to invasion by non-native species in my watershed.
Q4h	I am concerned about loss of stream habitats for wild trout in my watershed.
Q4i	I am concerned about loss of open space due to increased development efforts in my watershed.
Q4j	I am concerned about lack of hiking and biking trails along rivers and stream corridors in my watershed.
Q4k	I am concerned that environmental protection will reduce benefits I receive from development in my watershed.

Scale for variables Q3a through Q3l- 1=Strongly Agree; 5=Strongly Disagree
Scale for variables Q4a through Q4k- 1=Very Concerned; 5=Not Concerned at all