Marine Resource Economics, Volume 7, pp. 75–85
Printed in the USA. All rights reserved.

0738-1360/92 $3.00 + .00

Estimating the Benefits of Water Quality Improvements in the Upper Narragansett Bay

KAREN M. HAYES

CTAA-EMBRAPA
Rio de Janeiro, Brazil

TIMOTHY J. TYRRELL

Department of Resource Economics
University of Rhode Island
Kingston, Rhode Island 02881-0814

GLEN ANDERSON

North Carolina Environmental Defense Fund
Raleigh, North Carolina 27601

The discrete choice model from the Thesis is re-estimated herein. But no mean / median per household WTP figures are given

Abstract *An EPA-sponsored study of the benefits to Rhode Island residents of the water quality improvement in the Upper Narragansett Bay showed that the estimated annual costs ($2.9 million) exceeded the expected annual benefits ($2.0 million). That analysis evaluated only user benefits which were measured via expenditures; nonuser (intrinsic) benefits were not included. This study estimated the benefits to Rhode Island residents using the "Contingent Valuation" approach and reponses from 435 residents to a 1985 survey about swimming and shellfishing. Aggregate annual benefits were estimated to be in the range of $30–60 million for "swimmable" and $30–70 million for "shellfishable" water quality, depending on the type of measure (mean or median) and survey format. Secondary objectives of the study were to test different versions of "willingness to pay" questions and compare mean and median values for measurement. Aside from payment vehicle bias, we found no evidence of serious bias.*

Keywords Contingent valuation, pollution, water quality benefits

Introduction

A temperate estuary opening into Rhode Island Sound, Narragansett Bay is considered one of Rhode Island's most valuable natural resources. It covers an area of 265 square kilometers (102 square miles), and is an important spawning and feeding ground for many fish species (see map).

Pollution in the Upper Narragansett Bay is one of Rhode Island's most critical environmental problems. Agricultural, domestic and industrial borne pollutants enter the Bay from several sources: discharges from rivers and streams outside of the state boundaries, non-point runoff, combined sewer overflows, industrial dis-

Research supported by the Sea Grant Program, the Department of Resource Economics, College of Resource Development, and the Rhode Island Agricultural Experiment Station at the University of Rhode Island. (AES Contribution No. 2730).

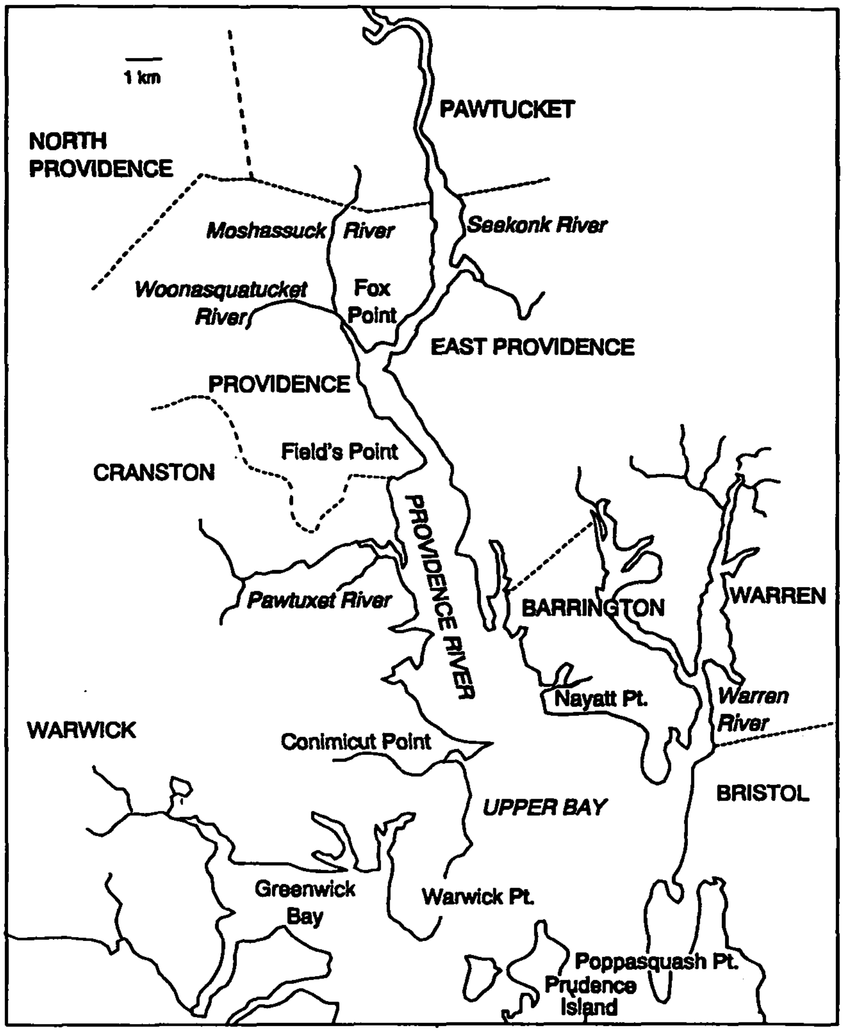

Figure 1. Map of Upper Narragansett Bay.

charges and sewage treatment plants. Such continued discharges of pollutants jeopardizes the environmental integrity of the entire Bay. High pollution levels force frequent closures of fishing and shellfishing areas, limit the extent of water-based activities such as swimming and boating, and create an unattractive waterfront environment.

Scientists have spent considerable time and money studying the Bay to determine the sources and extent of pollution (Olsen and Lee, 1979; Robadue and Lee, 1980; Deason and Robadue, 1982; Hoffman, *et al.*, 1982). The potential economic gains of improved water quality have received less attention. In particular, there has been no significant research which addresses the potential benefits of improving sewage treatment facilities along the Upper Narragansett Bay.

Widespread public concern in Rhode Island about the condition of the Narragansett Bay ecosystem led to increased recognition of the urban problems of the state, especially as they affect water quality. This concern was clearly expressed by the overwhelming support of the 1980 referendum which created the Narragansett Bay Water Quality Management District Commission, and authorized an $87.7 million bond issue to help cover the state's share of financing for projects to upgrade the Providence sewage treatment plant and combined sewer overflow system (General Laws of R.I., Title 46 Ch. 25). Approval of the bond issue indicates a strong public belief that expenditures in the area of pollution control are socially desirable. The public support for water quality projects was reaffirmed by the approval of the 1986 referendum which authorized a $35 million bond issue to assist communities in matching federal funds for improving sewage treatment facilities to reduce the amount of pollutants entering Narragansett Bay.

Metcalf and Eddy (1983), under contract by the U.S. EPA, conducted an analysis of water quality benefits of proposed pollution control projects for the City of Providence, RI. They estimated the benefits from the restoration of swimming beaches, based on parking fees and food purchases, to be $200,000 per year, assuming that the beaches would be open 50% of the summer. The benefits of making available additional shellfishing areas were estimated at $2,008,000. Metcalf and Eddy had estimated the annual costs water quality projects at $2,900,000. Based on these estimates, the annual costs of the project were judged to exceed the potential annual benefits.

The primary objective of this study was to re-estimate the potential benefits to Rhode Island residents of improving water quality in the Upper Narragansett Bay using the "Contingent Valuation" approach. Additional objectives were to test different versions of "willingness to pay" questions and compare mean and median values for measurement.

Overview

Water quality can be viewed as a public good. For most pure public goods, environmental goods in particular, markets do not exist, therefore, the benefits associated with changes in their levels are difficult to measure. In attempting to overcome these problems, economists have developed several approaches for valuing nonmarket environmental commodities (Freeman, 1979; Bishop and Heberlein, 1979, 1980; Cummings, *et al.*, 1986; Anderson and Bishop, 1986; Mitchell and Carson, 1987).

The contingent valuation approach (CV) uses survey data to estimate an individual's expressed preferences (as willingness to pay) for changes in the level of environmental goods (e.g., water quality), "contingent upon" a hypothetical market transaction. It is assumed that people will respond to the contingent market as if it were a real market transaction, where consumers are assumed to maximize their utility.

The primary advantages of this approach are its simplicity and directness in questioning, or surveying, consumers about their valuation of the resource. Researchers can ask direct questions about Hicksian welfare measures (Currie, *et al.*, 1971; Just, *et al.*, 1982) rather than estimating them from market demand curves. CV allows the inclusion of nonusers in the study, therefore allowing to measure intrinsic benefits (i.e., option value, existence value, and bequest value). Also, researchers can use CV for ex-ante analyses. Respondents can be asked to value improvements in water quality before they actually occur.

Contingent Valuation is not without problems however. Because of the hypothetical nature of CV surveys, several potential biases may be observed (see Mitchell and Carson, 1987; Cummings, *et al.*, 1986; Schulze, *et al.*, 1981). Bias must be inferred from partial understanding of respondent behavior—how they interpret and respond to questions, and from evidence which shows that changing the wording of scenarios in ways that are not expected to affect the WTP amount, in fact do.

It has been argued that a carefully worded description of the resource or the change in environmental quality that is to be valued is necessary to provide respondents with enough information to elicit informed value judgements. Water quality ladders have been used in the past as visual aids (see Mitchell and Carson, 1981; Desvouges, *et al.*, 1983; Edwards, 1984). We were concerned that such ladders may provide more information than necessary and may bias results, therefore, one was not used in our survey.

The choice of payment vehicle in CV surveys should also be expected to influence WTP amounts. Respondents are not valuing levels of provision of an amenity in the abstract, they are valuing a policy which includes the conditions under which the amenity will be provided and how they will be asked to pay for it (Mitchell and Carson, 1987).

The Narragansett Bay Application

The Narranganset Bay water quality survey was designed to obtain information about the value Rhode Island residents place on improved water quality in Narragansett Bay. The survey was conducted during March and April of 1985. A random sample of 1500 households throughout the State was selected from the current Rhode Island telephone directories. The number of households sampled from each town was proportional to its population density as measured in the 1980 R.I. Census of Population and Housing. Each household received a survey in the mail. Follow-up postcards and a second mailing were used. 500 questionnaires were completed and returned. 77 questionnaires could not be delivered, and disregarding them, the final response rate was approximately 35-percent. Tests of mean response differences between waves of reminders revealed no apparent bias due to non-response, thus we believed the sample to be representative for the purposes of this study.

The questionnaire was divided into four sections. The first section asked respondents about their use of the Upper and Lower Narragansett Bay: the types of recreational activities they engaged in, and their perceptions of water quality.

The second section asked respondents to value two water quality changes: (1) an improvement which allows safe swimming, and (2) an improvement such that shellfishing areas in the upper bay would not have to be closed due to pollution. While the informational value and potential bias caused by a water quality ladder was not tested in this study, we did attempt to test for other aspects of information, vehicle and perception bias by employing eight different versions of the questionnaire. (See Appendix 1). Two valuation techniques were employed. For each water quality change, we first asked respondents whether or not they would be willing to pay a specific dollar amount, BID (determined at random between \$1 and \$100), each year until water quality projects are paid in full. Respondents were then asked to state the maximum amount they would be willing to pay each year for the improvements.

Since the state's major swimming beaches are less than 30 minutes away from the "Upper Bay" and since it is "common knowledge" that this area is not swimmable, it is believed that our somewhat loosely-defined quality level referred to as "safe swimming" elicits the least biased response for recreational users. In addition, since openings and closings of shellfishing grounds of the Upper Bay are well publicized and highly debated in the media, it is believed that the quality level referred to by the statement that "shellfish areas in the Upper Bay would not be closed due to pollution" provides the appropriate amount of information for respondents to formulate an opinion.

The third section asked respondents where they lived; why they chose to live there; their length of residency in RI; whether they rented or owned their residence, and what portion of the year they lived there; and whether their property had a view of the Bay or frontage on the Bay. We believed that such demographic characteristics would influence willingness to pay for improved water quality.

The final section requested socioeconomic information (i.e., age, education, occupation and income) about the respondent.

The Discrete Choice Model

Although two hypothetical valuation approaches were employed (discrete choice and open-ended), only the results of the discrete choice willingness to pay (WTP) questions will be presented here.[1] Hanemann (1985) suggests that individuals responses will be more reliable if they are only required to place bounds on their willingness to pay. Cameron and James (1987) also suggest that the "closed-ended" CV approach generates a scenario most similar to that encountered by consumers in their usual market transactions.

Responses to the discrete choice willingness to pay questions were evaluated using the methodology outlined by Hanemann (1984; 1985), which relates the logit model to the underlying utility theoretic model of individual behavior. Individuals are assumed to prefer higher levels of water quality to lower levels, and to be willing to pay for improved water quality.

Respondents were asked if they would be willing to pay a specific dollar amount, BID (between \$1 and \$100), for each water quality change. Following Seller *et al.* (1986) it was assumed that the probability that respondent is willing to pay BID takes the form of the general logit model with utility difference represented by the log-linear form. Thus, the probability that a respondent would pay BID when his income is Y is given by:

$$P = (1 + \exp(-(a - B\ BID/Y))) - 1,$$

The coefficients a and B, were estimated using the individual responses to WTP questions by the maximum likelihood method.

Conceptually, we wish to know the individual's maximum willingness to pay for improved water quality. Hanemann (1984, 1985) has suggested that either the mean or median of the distribution might be used. Both can be estimated from the fitted statistical response model. The mean is equal to the expected value of the area under the response probability function while the median is the value at which the estimated response probability is .5.

Estimation Results

The data collected in 1985, was used to estimate the value which residents place on improved water quality in the Upper Narragansett Bay. Responses from 435 (433) residents were used in the analysis of willingness to pay for water quality that is safe for swimming (shellfishing). The model was estimated using the maximum likelihood method. The variables TAX, INFO and WTPQ2 (in WTP2 model) were included to test for potential bias related to the survey format. The results of the logit model are presented in Table 1. For the logit model, the dependent variable is the logarithm of the odds that the randomly selected individual is willing to pay to have water quality improved to a level that is safe for swimming (WTP1) or shellfishing (WTP2).

The negative sign on the estimated coefficient for BID/Y was expected. As BID increases relative to income, Y, then the probability that the individual would be willing to pay the amount decreases.

The variable TAX represents the payment vehicle used (TAX = 1 if the tax vehicle was specified, and TAX = 0 if no payment vehicle was specified). The tax vehicle was specified such that the respondent was led to believe that the amount would be allocated from existing state taxes, no increase in taxes was implied. As pointed out to us by a reviewer, the ommission of a tax vehicle in 4 versions of the questionnaire may be too unrealistic for respondents. In fact, the response rates to the "no vehicle" versions of the questionnaire were consistently ⅔ that of the "vehicle-specified" versions. Despite the possibility of such a non-response bias, it appears that individuals were more likely to be willing to pay for improved water quality when the tax vehicle was specified (e.g., amount paid indirectly through taxes) than when no vehicle was specified (e.g., amount would come from own pocket). The apparent significance of the estimated coefficient at the .01 level suggests that a bias may be introduced by the specification of the tax vehicle.

The variable INFO was specified such that INFO = 1 if respondent was given additional information concerning the reduction of industrial pollutants, and

Table 1
Logit Models for the Valuation of Improvements in Water Quality

Explanatory Variables	Safe for Swimming		Safe for Shellfishing	
	Coeff.	t-stat	Coeff.	t-stat
INTERCEPT	1.0035	4.60	0.7281	3.21
BID/Y	−249.8031	−5.15	−195.8959	−4.15
TAX	0.8224	3.58	0.6736	3.07
INFO	0.0831	0.36	0.3542	1.62
WTPQ2			−0.2077	−0.95
N		435		433
Likelihood Ratio		215.045		176.613
Pseudo-R2		0.107		0.078

INFO = 0 otherwise. WTPQ2 represented the way in which the second WTP question was framed; WTPQ2 = 1 if respondent asked to value water quality suitable for both shellfishing and swimming, and WTPQ2 = 0 if asked to value just water quality suitable for shellfishing. The low t-statistics on the estimated coefficients for INFO and WTPQ2 indicate that information and scenario bias were not a factor.

The likelihood ratios were found to be significant at the .005 level, hence the likelihood ratio test led to the rejection of the null hypothesis that all of the parameters, except the intercept are equal to zero. The low pseudo-R^2 is characteristic of models using cross-sectional data.

no mean/median WTP per household

Water Quality Benefits

Following Hanemann's procedure, we estimated maximum willingness to pay for the average household in each of the state's 39 cities and towns, by applying median household income (inflated to 1984 dollars) to the fitted response probability function. The resulting estimates were then multiplied by the total number of households (as occupied housing units) and summed across towns to obtain estimates for the aggregate benefits to the State of R.I. from improved water quality in the Upper Narragansett Bay. Table 2 lists the estimated benefits by water quality change and version of the survey. We estimated both the mean and the median of the distribution of WTP.

The aggregate benefits (or willingness to pay) were higher, in general, for improvements in water quality to a level that allows for shellfishing than for water quality that is safe for swimming. This shows that residents had a good perception of water quality requirements. Shellfishing requires a higher level of water quality than swimming. The omission of the water quality ladder did not appear to present a significant problem.

TABLE 2
Estimated Benefits to the State of Rhode Island from Improved Water Quality (in Millions of Dollars)

	Safe for Swimming[1]		Suitable for Shellfishing	
Version	Mean	Median	Mean	Median
1	39.5	31.6	42.2	29.2
2c	39.5	31.6	37.2	20.9
3a	59.2	57.3	60.6	56.1
4a,c	59.2	57.3	54.7	47.6
5b	41.4	34.1	51.6	43.3
6b,c	41.4	34.1	46.0	34.9
7a,b	61.4	60.1	71.1	70.5
8a,b,c	61.4	60.1	64.9	61.9

[1] Only 4 versions for valuation question.
[a] Tax vehicle specified.
[b] Additional information provided concerning reduction of industrial pollutants.
[c] Respondent asked to value water quality suitable for shellfishing and swimming combined.

Willingness to pay estimates were higher when the tax vehicle was specified as opposed to when no payment vehicle was specified. Although non-response bias may be present, it is our belief that the difference was due to resident's uncertainty as to how they would be asked to pay for the improvement in water quality. A tax is a payment vehicle to which most people are familiar. They know when and how the money will be collected, and can plan for this in their budget. However, when no payment vehicle is specified, individuals have a difficult time planning for the expense since they do not know how or when it will be collected. This is an important consideration for households trying to allocate income over all expenses (fixed and variable).

The additional information provided in versions 5–8 concerning the reduction of pollution from industrial sources had more influence on willingness to pay for water quality that is suitable for shellfishing. Since shellfish are used for human consumption, people react to the idea that the shellfish they eat may be contaminated by industrial pollutants (e.g., heavy metals, toxic chemicals, etc.).

The phrasing of the second water quality change presented some problem. In versions 2,4,6,8 respondents were asked to value an improvement water quality to a level such that shellfishing areas in the Upper Bay would not have to be closed due to pollution and it would be safe to swim in the Upper Bay, while the other versions asked respondents to value water quality suitable for shellfishing. Given that water quality suitable for shellfishing is also suitable for swimming, we would expect the values to be similar. However, we found that when asked to value shellfishing and swimming combined, willingness to pay estimates were 10–15% lower than when asked to value shellfishing alone.

We estimated both the mean and the median of the distribution of WTP. There are many conflicting opinions as to which of these measures gives a better estimate. Hanemann (1989) points out that the mean is more sensitive to skewness in the original data, which is a highly relevant consideration for CV data. Hanemann also shows that the mean is very sensitive to the method used in estimating the structural model (e.g., maximum likelihood vs generalized least squares). Johansson, Kristrom and Maler (1989), on the other hand, argue that the mean value is more relevant to cost-benefit analysis. Our results show mean values greater than median values. The median values appear to be more sensitive to variations in survey format.

Discussion

The objective of this study was to estimate the potential benefits, to the State of Rhode Island, of improving water quality in the Upper Narragansett Bay. The Contingent Valuation method was employed to evaluate the benefits (as willingness to pay) of attaining "swimmable" and "shellfishable" water quality. We estimated aggregate benefits in the range of \$30–60 million for "swimmable" and \$30–70 million for "shellfishable" water quality, depending on the type of measure (mean or median)and survey format. Aside from payment vehicle bias, we found no evidence of serious bias.

One motive for this study was the fact that considerable money was being spent to rehabilitate and modernize the Providence wastewater treatment facility and combined sewer overflow system, without any knowledge as to the benefits to the state. It was estimated that over $200 million would be spent between 1982 and 1992, with funds provided by federal, state and local sources. Prior to our study, the only study undertaken to evaluate the benefits of the water quality projects was the study by Metcalf and Eddy discussed earlier. However, the results of Metcalf and Eddy's study showed that the estimated annual costs exceeded the expected annual benefits. Their analysis evaluated only user benefits which were measured via expenditures, they did not include nonuser (intrinsic) benefits. However, the benefits of improving water quality in the Upper Narragansett Bay will accrue to users and nonusers alike. Empirical studies have consistently shown nonuse values to be positive and nontrivial. Empirical evidence indicates that excluding intrinsic benefits would underestimate the total benefits of water quality improvements (Fisher and Raucher, 1984; Desvouges, *et al.*, 1983). Therefore we chose the contingent valuation method, as opposed to the travel cost or hedonic price methods, because it allows the inclusion of nonusers in the study, therefore allowing to measure intrinsic benefits. We find considerable difference between our estimates of water quality benefits to those of Metcalf and Eddy which we attribute to a more correct formulation of the benefit concept including the possibility of intrinsic (option, existence and bequest) values.

Acknowledgements

The authors wish to thank the Brazilian National Center for Food Technology Research, CTAA-EMBRAPA, for technical and computer support provided while rerunning the estimated models. They also thank two anonymous reviewers for valuable insights and clarification.

Note

1. Contact the authors for the results of the open-ended willingness to pay questions.

Appendix 1
Willingness to pay question format and bias tested

Bias Tested	Version	Characteristic of WTP Question
Information	1–4	Water quality enhanced through modifications of sewage treatment plants surrounding the Upper Bay.
	5–8	Water quality enhanced through modifications of sewage treatment plants and through reduction in pollution (e.g., heavy metals, petroleum, toxic metals) from industrial sources.
Vehicle	1,2,5,6	No payment vehicle specified. Would you be willing to pay $X each year until water quality projects are paid in full.

	3,4,7,8	Tax vehicle specified. Would you be willing to pay $X each year out of various state taxes until water quality projects are paid in full.
Scenario/Amenity	1,3,5,7	Scenario presented in second WTP question—value an improvement in water quality to the extent that shellfishing areas in the Upper Bay would not have to be closed due to pollution.
	2,4,6,8	. . . improvement in water quality to the extent that shellfishing areas in the Upper Bay would not have to be closed due to pollution and it would be safe to swim in the Upper Bay.

References

Anderson, Glen D. and Bishop, Richard C. 1986. "The Valuation Problem." In Natural Resource Economics: Policy Problems and Contemporary Analysis. Ed. by Daniel W. Bromley; Hingham, MA; Kluwer Nijkoff.

Bishop, Richard C. and Heberlein, Thomas A. 1979. "Measuring Values of Extramarket Goods: Are Indirect Measures Biased?" American Journal of Agricultural Economics, Vol. 61(5):926–930.

Bishop, Richard C. and Heberlein, Thomas A. 1980. "Simulated Markets, Hypothetical Markets, and Travel Cost Analysis: Alternative Methods of Estimating Outdoor Recreation Demand." University of Wisconsin Agr. Exp. Sta. Bull. No. 187.

Cameron, T. A. and James, M. D. 1987. "Efficient Estimation Methods for Closed-ended Contingent Valuation Surveys." Review of Economics and Statistics, 69(2):269–76.

Cummings, R. G., Brookshire, D. S. and Schulze, W. D. 1986. Valuing Environmental Goods: An Assessment of the Contingent Valuation Method. Totowa, NJ; Rowman and Allanheld, Pub.

Currie, John M.; Murphy, John A. and Schmitz, Andrew. 1971. The Concept of Economic Surplus and Its Use in Economic Analysis." The Economic Journal, Vol. 81 (Dec.):749–799.

Deason, E. and Robadue, D. 1982. Planning for Water Quality Improvements in Upper Narragansett Bay and Its Tributaries. Draft Report to the Harbor Estuary and Land Planning Advisory Committee of the Coastal Resource Management Council. Coastal Resource Center, URI, Kingston, RI. 46p.

Desvouges, W. H.; Smith, V. K. and McGivney, M. P. 1983. "A Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvements." Prepared for U.S. EPA, Washington, D.C.

Edwards, Steven F. 1984. An Analysis of the Non-Market Benefits of Protecting Salt Pond Water Quality in Southern Rhode Island: An Application of the Hedonic Price and Contingent Valuation Techniques. Unpublished Ph.D. Dissertation. University of Rhode Island, Kingston, R.I.

Fisher, A. and Raucher, R. 1984. "Intrinsic Benefits of Improved Water Quality: Conceptual and Empirical Perspectives." In *Applied Micro-Economics*, Vol. 3, eds. V. Kerry Smith and Ann D. Witte. Greenwich, CT: JAI Press.

Fomby, Thomas B.; Hill, R. Carter and Johnson, Stanely R. 1984. *Advanced Econometric Methods*. New York: Springer-Verlag.

Freeman, A. Myrick, III. 1979. *The Benefits of Environmental Improvement*. Baltimore: The Johns Hopkins University Press.

Hanemann, W. Michael. 1984. "Welfare Evaluations in Contingent Valuation Experiments with Discrete Responses." *American Journal of Agricultural Economics*. Vol. 66 (Aug.):332–341.

Hanemann, W. Michael. 1985. "Some Issues in Continuous- and Discrete-Response Contingent Valuation Studies." *Northeast Journal of Agricultural and Resource Economics*. Vol. 14, No. 1:5–13.

Hensher, David A. and Johnson, Lester W. 1981. *Applied Discrete Choice Modelling*. New York: John Wiley & Sons.

Hoffman, E. J.; Latimer, J. S.; Mills, G. L. and Quinn, J. G. 1982. "Petroleum hydrocarbons in urban runoff from a commercial land use area." *Journal Water Pollution Control Federation*. Vol. 54, No. 11:1517–1525.

Just, R. E.; Hueth, D. L. and Schmitz, A. 1982. *Applied Welfare Economics and Public Policy*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Metcalf and Eddy. 1983. "Water Quality Benefits of Proposed CSO Control Projects for Providence, Rhode Island." Prepared for the USEPA Region 1 and Rhode Island Department of Environmental Management.

Mitchell, R. C. and Carson, R. T. 1987. Using Surveys to Value Public Goods: The Contingent Valuation Method, Resources for the Future (Preliminary Draft).

Mitchell, R. C. and Carson, R. T. 1981. An Experiment in Determining Willingness to Pay for National Water Quality Improvements. Prepared for U.S. EPA.

Narragansett Bay Commission. 1985. Annual Report.

Olsen, Stephen and Lee, Virginia. 1979. A Summary and Preliminary Evaluation of Data Pertaining to the Water Quality of Upper Narragansett Bay. Coastal Resources Center, URI. Narragansett, RI.

Rhode Island. The Narragansett Bay Water Quality Management District Commission Act (1980), Title 46, Chapter 25.

Robadue, D. and Lee, V. 1980. "Upper Narragansett Bay: An Urban Estuary in Transition." Coastal Resource Center, URI. Narragansett, RI (Preliminary Report).

Schulze, W. D., D'Arge, R. C. and Brookshire, D. S. 1981. "Valuing Environmental Commodities: Some Recent Experiments." *Land Economics*, Vol. 57 (May):151–172.

Sellar, Christine, Jean-Paul Chavas and John R. Stoll. 1986. "Specification of the Logit Model: The Case of Valuation of Non-Market Goods." *Journal of Environmental Economics and Management* Vol. 13, No. 4:382–390.