

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	v
ABSTRACT.....	xi
LIST OF TABLES	xvii
LIST OF FIGURES.....	xix
CHAPTER	
1. INTRODUCTION.....	1
1.1 Groundwater as a Vital Natural Resource.....	2
1.2 Statement of Research Problem.....	4
1.3 Research Objectives.....	7
2. LITERATURE REVIEW: PART 1 - AN OVERVIEW OF GROUNDWATER QUALITY ISSUES.....	8
2.1 Introduction-What is Groundwater?	8
2.2 How Does Groundwater Contamination Occur?.....	11
2.3 Groundwater Protection Efforts.....	12
2.4 The Sources, Extent, and Dangers of Groundwater Contamination.....	17
2.4.1 Residential Sources of Contamination	19
2.4.2 Agricultural Sources of Contamination.....	21
2.4.3 Industrial Sources of Contamination.....	22
2.4.4 Natural Sources of Contamination	22
2.4.5 Health Effects of Groundwater Contamination	23
2.5 The Case of MTBE: Is the Cure Worse than the Disease?	25
3. LITERATURE REVIEW: PART 2 - VALUATION METHODOLOGY.....	56
3.1 The Valuation Methodology Debate	57
3.2 Indirect or Revealed Preference Methods	59
3.2.1 The Hedonic Pricing Technique	59
3.2.2 Travel Cost Analysis	60
3.2.3 Averting Cost Analysis	60
3.2.4 The Importance of Non-Use Value: Why Revealed Preference Methods Sometimes Fall Short.....	61

3.3	Direct or Stated Preference Methods	62
3.3.1	The Contingent Valuation Method	63
3.3.2	Conjoint Analysis	101
3.4	The Role of Respondent Uncertainty in Stated Preference Studies.....	104
3.5	Willingness-to-Pay Estimates for Groundwater Quality	113
3.5.1	Averting Cost Studies.....	113
3.5.2	Contingent Valuation Studies	115
3.5.3	Conjoint Analysis Studies.....	117
3.6	Summary.....	118
4.	LITERATURE REVIEW: PART 3 - AN OVERVIEW OF DISCOUNTING ISSUES	121
4.1	A Historical Overview of the Discounting Debate	122
4.2	The Classical Model of Discounting	127
4.3	Choice of Discount Rate.....	129
4.3.1	The Marginal Social Rate of Time Preference	130
4.3.2	The Marginal Social Opportunity Cost of Capital.....	132
4.3.3	The Weighted Average Method.....	134
4.3.4	The Shadow Price of Capital	135
4.3.5	Four Methods, No Easy Answers	136
4.4	The Discounting Debate Re-Emerges	138
4.5	Challenges to the Classical Model of Discounting.....	153
4.5.1	Kahneman and Tversky's Prospect Theory	153
4.5.2	Loewenstein's Theory of Intertemporal Choice	153
4.5.3	Kahneman and Thaler: Intertemporal Preference for Sequences	155
4.5.4	Loewenstein and Prelec's Four "Anomalies"	156
4.5.5	Empirical Evidence of Non-Constant Discounting	158
4.5.6	Empirical Evidence of Negative Rates of Time Preference	159
4.6	Health as a Unique Commodity	161
4.6.1	Should Future Health Benefits Be Discounted?	161
4.6.2	Is the Constant-Rate Discounted Utility Model Appropriate for Health-Related Outcomes?	164

4.7	Alternatives to the Classical Discounting Model.....	168
4.8	Relationships between Rate of Time Preference and Individual Characteristics.....	171
4.9	The Individual versus the Citizen: Which role do we play when we attempt to place a value on public goods?	173
4.10	Summary.....	176
5.	LITERATURE REVIEW: PART 4 – VALUING HEALTH AND SAFETY RISKS	180
5.1	Methodology for the Valuation of Health Risks.....	181
5.1.1	The Cost of Illness Approach	182
5.1.2	Willingness-to-Pay Approaches	183
5.1.3	QALY Analysis	190
5.2	Special Considerations: how do we think about risk?.....	196
5.2.1	Uncertainty in Risk Measurement.....	196
5.2.2	The Role of Knowledge and Information	197
5.2.3	The Trouble with Valuing Small Changes in Risk.....	198
5.2.4	Communicating Risk.....	200
5.2.5	Are WTP estimates adequately sensitive to the size of the risk reduction?	207
5.3	Summary.....	214
6.	ECONOMIC THEORY	219
6.1	The Individual’s Problem.....	222
6.2	Estimating Willingness-to-Pay Using Discrete Response CVM Data	223
6.3	Estimating Willingness-to-Pay Using Conjoint Ratings Data	228
6.3.1	The Conjoint Binary Response Model.....	234
6.3.2	The Conjoint Binary Response Ratings Difference Model	235
6.4	Summary.....	235
7.	SURVEY DESIGN	238
7.1	Survey Composition and Mailing List.....	238
7.2	Survey Development	239
7.3	Survey Description	242

8. EMPIRICAL RESULTS.....	248
8.1 Survey Response Rates.....	248
8.2 Descriptive Statistics	250
8.2.1 Socioeconomic Characteristics.....	250
8.2.2 Attitudes towards Groundwater Quality Issues	253
8.2.3 Attitudes towards Risk-Money Trade-offs	257
8.2.4 Beliefs about the Role of Technology	259
8.3 Preferences for Present- Versus Future-Oriented General Life-Saving Programs.....	261
8.3.1 Responses to the Valuation of Two General Life-Saving Programs.....	261
8.3.2 Implicit Discount Rates for General Life-Saving Programs.....	266
8.3.3 Econometric Models of Discounting Behavior	271
8.4 Valuation of Groundwater Protection Programs.....	277
8.4.1 Model Specification.....	280
8.4.2 Predicting the Probability of Undertaking a Groundwater Protection Program.....	294
8.4.3 Measuring Goodness-of-Fit of the Econometric Models.....	296
8.4.4 Estimating Median Willingness-to-Pay	298
8.4.5 Implicit Discount Rates for Groundwater Protection.....	305
8.4.6 Model Comparisons and Summary	309
9. CONCLUSIONS	357
9.1 Implications and Relevance of the Study	357
9.2 Directions for Future Research	361
APPENDICES	
A. TRANSCRIPTS OF PRE-TEST SESSIONS.....	366
B. GROUNDWATER PROTECTION PROGRAM VALUATION SECTIONS OF THE SURVEY	419
C. SECTIONS OF THE SURVEY COMMON TO ALL VERSIONS.....	426
D. SUPPLEMENTAL SURVEY MATERIALS	442
BIBLIOGRAPHY	446

LIST OF TABLES

Table	Page
2.1 National Primary Drinking Water Regulations.....	38
2.2 Phase I and Phase II Contaminants.....	53
2.3 Drinking Water Contaminant Candidate List-March 1998.....	54
8.1 Western Massachusetts Towns Included in the Survey Sample.....	325
8.2 Descriptive Statistics: Respondent Socioeconomic Characteristics.....	326
8.3 Descriptive Statistics for the General Population in Western Massachusetts.....	327
8.4 Descriptive Statistics for Groundwater Quality Issues.....	328
8.5 Testing for Differences in the Mean Characteristics of Respondents: differences between those who stated they were unwilling to make trade-offs between health risks and money, and the rest of the sample.....	329
8.6 Testing for Differences in the Mean Characteristics of Respondents: differences between those who stated they were “pro-technology” and the rest of the sample.....	330
8.7 Respondent Preferences for General Life-Saving Programs.....	331
8.8 Testing for Differences in the Mean Characteristics: differences between those respondents who indicated their choice between the two life-saving programs and those that did not.....	332
8.9 Testing for Differences in the Mean Characteristics of Respondents: differences between respondents that indicated their indifference point between life-saving programs and those that did not.....	333
8.10 Testing for Differences in the Mean Characteristics of Respondents: differences between respondents that stated they would never choose the future-oriented life-saving program and the rest of the sample.....	334
8.11 Mean Implicit Discount Rates for Life-Saving Programs.....	335
8.12 Summary Statistics for Implicit Discount Rates for Life-Saving Programs.....	336
8.13 Percentages of Respondents with Zero and Negative Mean Discount Rates for Life-Saving Programs.....	337

8.14	Respondent Comments on the Role of Technology	338
8.15	Correlations between Respondent Characteristics.....	339
8.16	Estimation of the Probability of Unwillingness to Trade Present and Future Lives	340
8.17	Estimating a Linear Discount Rate Function	341
8.18	Predicted Values of the Discount Rate for Life-Saving Programs Using the Estimated Linear Discount Rate Function	341
8.19	Descriptive Statistics for the Dependent Variables	342
8.20	Model Specification.....	343
8.21	The Traditional Dichotomous Choice CVM Model.....	344
8.22	The Modified Dichotomous Choice CVM Model.....	345
8.23	The Conjoint Binary Response Ratings Model.....	346
8.24	The Conjoint Binary Response Ratings Difference Model.....	347
8.25	Testing the Null Hypothesis that the Coefficient on the Present Risk Reduction and the Coefficient on the Future Risk Reduction are Equal	348
8.26	Summary Statistics for the “Average” Groundwater Protection Program.....	348
8.27	Estimated Probability of Undertaking the Average Level of Groundwater Protection	349
8.28	Estimated Probability of Undertaking Specific Groundwater Programs.....	350
8.29	Results of the Hosmer and Lemeshow Goodness-of-Fit Tests.....	352
8.30	Estimates of Median WTP for the Average Groundwater Protection Program	354
8.31	Median WTP for Private versus Public Groundwater Protection.....	355
8.32	Testing for Differences in the Mean Characteristics of Respondents: certain respondents versus uncertain respondents	356

LIST OF FIGURES

Figure	Page
2.1 The Hydrologic Cycle.....	31
2.2 The Unsaturated and Saturated Zones	32
2.3 The Capillary Fringe	33
2.4 The Recharge Process.....	34
2.5 Unconfined and Confined Aquifers (A)	35
2.6 Unconfined and Confined Aquifers (B)	36
2.7 Major Sources of Groundwater Contamination	37
4.1 Trade-offs between Present and Future Consumption.....	178
4.2 Exponential versus Hyperbolic Discounting.....	179
5.1 Relationship Between Actual and Perceived Probabilities.....	216
5.2 Risk Ladder to Communicate Risk.....	217
5.3 Pie Charts to Communicate Risks.....	218
6.1 Benefit Measures.....	237
8.1 Survey Question Modified from Cropper et al.'s (1991) Study.....	324
B.1 Versions A and AA – Conjoint Analysis / Traditional DC CVM / Modified DC CVM.....	419
B.2 Versions B and BB – Conjoint Analysis and Modified DC CVM.....	422
B.3 Versions C and CC – Traditional DC CVM and Modified DC CVM.....	424
C.1 Survey Booklet Front Cover.....	426
C.2 Survey Questions about Household Characteristics and Groundwater Quality Issues.....	427

C.3	Preferences for Present Versus Future-Oriented General Life-Saving Programs	433
C.4	Information Section for the Valuation of Groundwater Protection Programs.....	435
C.5	Questions about Respondents' Motivations for Choosing Certain Programs	436
C.6	Survey Questions about Respondents' Socioeconomic Characteristics	439
C.7	Survey Booklet Back Cover	441
D.1	Text of the Newspaper Ad to Recruit Subjects for Pre-Testing.....	442
D.2	Postcard that Informs Respondents They Will Be Receiving a Survey Shortly	443
D.3	Cover Letter that Accompanied Survey.....	444
D.4	Reminder Postcard Sent to Respondents	445