RACC

Research on Adaptation to Climate Change in the Lake Champlain Basin And Vermont's Waterways

Report:
Value of Water Quality and Public Willingness to Pay for Water Quality Policy and Project Implementation

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ABSTRACT

A recent report by the Vermont Agency of Natural Resources has indicated that approximately $156 million is needed annually for the next ten years for the State of Vermont to meet its obligations under the Clean Water Act, though confidence has declined in this estimate. Recent public opinion polling indicates that the most publicly-acceptable means for raising funds are through one-time development fees and annual stormwater fees. Further polling indicates that the median willingness to pay among Vermont households is $40 per year, when raised through water utility and vehicle registration fees. The polling also suggests that willingness to pay could be increased through outreach and education.

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Executive Summary

This report contains a summary of two pieces of analysis pertaining to Vermont resident's perceptions of water quality and "willingness to pay" to sustain water quality. These surveys include: the Research on Adaptation to Climate Change (RACC) project's 2013 Water Quality Public Opinion Survey[1] and the 2014 annual Vermonter Poll,[2] which included questions regarding Vermont residents' willingness to pay for water quality across the State of Vermont. This report revisits some of the major findings coming out of the initial report, reexamines some of the data from this report, and integrates a second survey of Vermont residents undertaken in the winter of 2014. An overview of the methods employed in this research may be found in the Appendix A.

Two major conclusions may be drawn from the analysis of this data:

Vermonters' place a high value on water quality.

In the first report of Vermont residents' perception of water quality, released in January of 2014 by the Research on Adaptation to Climate Change in the Lake Champlain Basin (RACC) team,[3] several main findings were ascertained:

1. Vermont residents are deeply concerned about water quality, more so than any other surveyed policy issue.

2. Vermont residents believe that water is a public good, and that we ought to focus on the maintenance of recreational opportunities, high quality of life, and economic health as the primary impacts of water quality policy.

3. Vermont residents show a strong preference for state-level responsibility for water quality, and also believe that responsibility ought to be clearly designated.

4. Vermont residents are convinced that adequate funding ought to be dedicated to water quality in Vermont.

5. Water quality exerts a significant influence on Vermont residents' recreational choices.

6. Socioeconomic, cultural, and life stage factors influence Vermont residents' perception of water quality-related legal and economic issues.

[1] Koliba *et al*, 2014
[2] Center for Rural Studies, no date, "Vermonter Poll," Most Recently Accessed: 23 Oct 2014
[3] Chris Koliba, Asim Zia, Steve Scheinert, and Katherine Logan, 2014, "2013 Water Quality Survey," Burlington, VT.

7. Vermont residents have a fairly high level of confidence in experts on climate change.[4]

This initial report highlighted Vermont residents' hesitance to pay fees or taxes for improved water quality. However, additional polling data commissioned by RACC researchers shed new light on Vermont residents' willingness to pay (WTP) for water quality. These results gave cause to revisit the conclusions we drew from the first survey and seek to develop a more comprehensive picture of Vermont residents' willingness to pay for clean water.

A majority of Vermonters are willing to pay for water quality.

While approximately 35% of Vermont residents polled reported an unwillingness to pay additional fees, the remaining 65% have strong willingness to pay to conserve water quality (See Figure 5).

In most Vermont counties, residents are willing to pay $40 or more as additional water utility and vehicle registration fees per year. The exceptions are the following counties: Caledonia, Essex, Franklin, Lamoille and Orange (See Figure 6).

Additionally, Vermont residents with shorter residency time (e.g., more transplants to the area)) reveal a higher willingness to pay for water quality.

Older and college educated respondents were more likely to be willing to pay $80 or more annually for clean water than the general population. Respondents who revealed an affiliation with the Democratic Party were more likely than individuals with any other political affiliation to be willing to pay more than $40 a year for clean water.

In a geographic dimension, the distance that respondents lived from Lake Champlain did not appear to be a significant determinant of respondents' willingness to pay (See Table 3).

We estimate that 189,552 households in Vermont would be assessed the additional water utility fee. If an additional fee of $20 per year is added on to the water utility bills of these households, we estimate that $3,791,000 per year could be collected. Further, if a $20 per year additional fee is levied on vehicle registrations for the estimated 605,000 motorized vehicles registered in Vermont,[5] an additional $12,100,000 could be raised. Both water utility and vehicle registration fees could add a combined total of $15.89 million per year.

The results from the first survey, the RACC Water Quality Survey,[6] correlate well with these findings (See Table 1).

- 58.7% of respondents find one-time development fees acceptable.
- 41.3% of respondents find annual development fees acceptable.

[4] Koliba *et al*, 2014, 2.
[5] Data from the Vermont Department of Motor Vehicles.
[6] Koliba *et al*, 2014,

- 58.9% of respondents find stormwater fees acceptable.
- 34.2% of respondents find broad-based taxes acceptable.
- 46.1% of respondents find excise taxes acceptable.

Self-reported Democrats and Progressives are more likely to support one-time development fees, stormwater fees, broad-based taxes, and excise taxes for water quality improvement.

Age, income and education play a limited, but statistically significant role in determining respondents' willingness to pay.

The distance that respondents lived from Lake Champlain does not appear to exert a significant influence on respondents' willingness to pay (See Table 2).

Summary Conclusion:

These data indicate that political identity and education are the most consistent predictors of increased acceptability of payment mechanisms and increased willingness to pay. This provides two suggestions about how policy can promote willingness to pay. The first suggestion derives solely from these observations of the data. Vermont, with its high proportion of registered Democrats and Progressives can rely on their political beliefs to support policies that raise money to pay for water quality programs. Additionally, greater education and outreach about the problem are likely to increase voter support for water quality programs.

The second suggestion arises when the observations about political identity, education, and sense of place[7] are examined together. In interviews, state agency representatives involved with water quality, report hearing complaints from Vermont residents who live outside of the Lake Champlain Basin (LCB) suggesting that too much attention is paid to the LCB area, to the exclusion of other watersheds. With water quality problems evident throughout Vermont, these data can be interpreted to suggest that efforts to raise awareness and address water quality concerns should include a state-wide portrait of water quality challenges. Greater support for water quality programs across the state might be found by increasing awareness of other watersheds, thereby increasing broader voter awareness of program activity throughout Vermont.

[7] B. Hannon, 1994, "Sense of place: Geographic discounting by people, animals, and plants," *Ecological Economics*, 10(2); B.P. Kaltenborn, 1998, "Effects of sense of place on responses to environmental impacts: A study among residents of Svalbard in the Norwegian high Arctic," *Applied Geography*, 18; B.W. Eisenhauer, R.S. Krannich, and D.J. Blahna, 2000, "Attachments to special places on public lands: An analysis of activities, reason for attachments, and community connections," *Society and Natural Resources*, 13(5); M. Vorkinn and H. Riese, 2001, "Environmental concern in a local context: The significance of place attachment," *Environment and Behavior*, 33(2); B.S. Jorgensen and R.C. Stedman, 2003, "A comparative analysis of predictors of sense of place dimensions: Attachment to, dependence on, and identification with lakeshore properties," *Journal of Environmental Management*, 79; A. Zia, B. Norton, S. Metcalf, P. Hirsch, and B. Hannon, 2014, "Spatial Discounting, Place Attachment and Environmental Concern: Toward an Ambit-Based Theory of Sense of Place," *Journal of Environmental Psychology*, 40.

Background Context:

The On-Going Efforts to Improve Water Quality in the Lake Champlain Basin and Control of Harmful Algal Blooms

In 2012, responding to both the on-going process for writing a new Total Maximum Daily Load (TMDL) implementation plan and recent experience with Tropical Storm Irene, the Vermont Legislature passed Act 138. Section 19 of Act 138 tasked the Vermont Agency of Natural Resources (VTANR) to report on the costs necessary for Vermont to meet its obligations under the Clean Water Act in the Lake Champlain Basin and what policy options were available for raising the revenue to meet these costs. The report estimated that it would require approximately $156 million annually, for ten years to meet these requirements, based on current state programs. This includes $1.8 million for river, floodplain and shoreland management, $8.7 million for agricultural and forestry non-point source reduction, $63.9 million for municipal infrastructure and regulated stormwater programs, and $81.3 million for municipal non-point source reduction.[8] Officials are, however, less confident in the accuracy of these figures today, as they instead look to spread the work over 20 or more years rather than ten years.[9] The report went on to identify 16 different financial tools that could be used to raise the necessary funds. The report estimates that eight of these tools would, together, generate approximately $25.85 million, annually, while the remaining eight options would generate only small amounts each.[10] Raising money at this rate would require five years to cover each year of current needs under the Act 138 estimate, and likely place significant, and politically unpopular, costs on the population of Vermont.

In light of this funding gap, the Vermont Department of Environmental Conservation (VTDEC) continues to pursue efforts to find funding sources. The need for funding becomes more acute as that need goes unmet and the underlying causes continue to worsen. The Clean Water Act compels Vermont to meet clean water standards. In an effort to meet these standards, Vermont had submitted a TMDL to the Environmental Protection Agency (EPA), which was first accepted, but then withdrawn once the standards were challenged in court. Representatives of VTDEC and the Vermont Agency of Agriculture, Farms, and Markets, have been working diligently to propose a new TMDL implementation plan. In a letter to VTDEC, dated May 8th, 2014, the EPA expressed concerns that the then-current draft of the plan lacked sufficient identification of funds and staff to implement the plan. Negotiations to define the details of this plan continue between VTDEC and the EPA. In August, 2014, lower revised revenue projection forced the Shumlin Administration to submit a revised annual budget request that cuts $30

[8] Vermont Agency of Natural Resources, 2013, "Water Quality Remediation, Implementation, and Funding Report," Montpelier, VT (January), 29.
[9] ANR informant, 14 November 2014.
[10] ANR, 2013, 8.

million from the state budget.[11] These events have heightened the need to review possible funding mechanisms for both their revenue raising potential and political acceptability.

Research Objectives

This report reviews recent survey results that address the potential for raising funds, and political acceptability of a range of suggested funding mechanisms. Some of these mechanisms, including the deployment of fees on development and construction, raising fees for stormwater management through vehicle registration fees, and the implementation of new excise taxes on certain goods which impact water quality, are included in the Act 138 report. Other funding mechanisms considered here are not included in the Act 138 report. The surveys asked about the acceptability of these different funding options, including questions designed to elicit how much individuals were willing to pay through these mechanisms to support water quality.

We examine survey responses to determine how acceptable different fundraising mechanisms might be, including how acceptability varies in relation to how far the respondent lives from Lake Champlain, and how the acceptability varies with a range of demographic data, including education, age, income level, duration of time as a Vermont resident, and political affiliation. This will provide a picture of several things: how willing Vermont residents are to support spending on water quality; how that varies across the state; how different demographic characteristics influence the acceptability of different funding mechanisms; and the level of willingness to pay (WTP) to support water quality programs. Survey questions that ask about how much individuals are willing to pay through specific mechanisms allow for an analysis of the amount of funds that the listed mechanism could raise.

Data and Methods

This report addresses two research questions to draw an overall picture of Vermont residents' willingness to pay for water quality projects and programs. Identifying the population's willingness to pay requires carefully crafted questions that will promote accurate assessments of individuals' willingness to pay. Since all the relevant methods for doing this have shortcomings[12] this report will rely on triangulation through multiple questions and question types, gathered through multiple data sources. Specifically, two broad-based surveys will provide data. One source is a public opinion poll performed during summer 2013, for the University of Vermont's NSF EPSCoR Research on Adaptation to Climate Change in the Lake Champlain Basin (RACC) project. The other source is the annual Vermonter Poll, which the

[11] Stuart Ledbetter, 2014, "Vt. lawmakers agree to revised list of budget cuts," WPTZ News, 13 Aug.
[12] P.A. Diamond, and J.A. Hausman, 1994, "Contingent Valuation: Is Some Number better than No Number?" *The Journal of Economic Perspectives*, 8(4); R.T. Carson, J.J. Louviere, and N. Wasi, 1999, "A Cautionary Note on Designing Discrete Choice Experiments: A Comment on Lusk and Norwood's 'Effect of Experimental Design on Choice-Based Conjoint Valuation Estimates,'" *American Journal of Agricultural Economics*, 91(4).

University of Vermont's Center for Rural Studies performs.[13] RACC researchers arranged for the 2014 poll to include a question that addressed Vermont residents' willingness to pay for water quality protections in the Lake Champlain Basin.

It is logical to assume that those who live closer to water bodies will be willing to pay more since they are more directly affected.[14] How does Vermont residents' willingness to pay vary by their relative distance to an impaired water body? Figure 1 shows the distances from the centroid of each town in the State to the shore of Lake Champlain. Understanding how background characteristics and residents' distance from Lake Champlain provides a picture of willingness to pay to support water quality varies across Vermont. However, it is unlikely that this effect exists solely for a Vermont residents' distance from Lake Champlain.

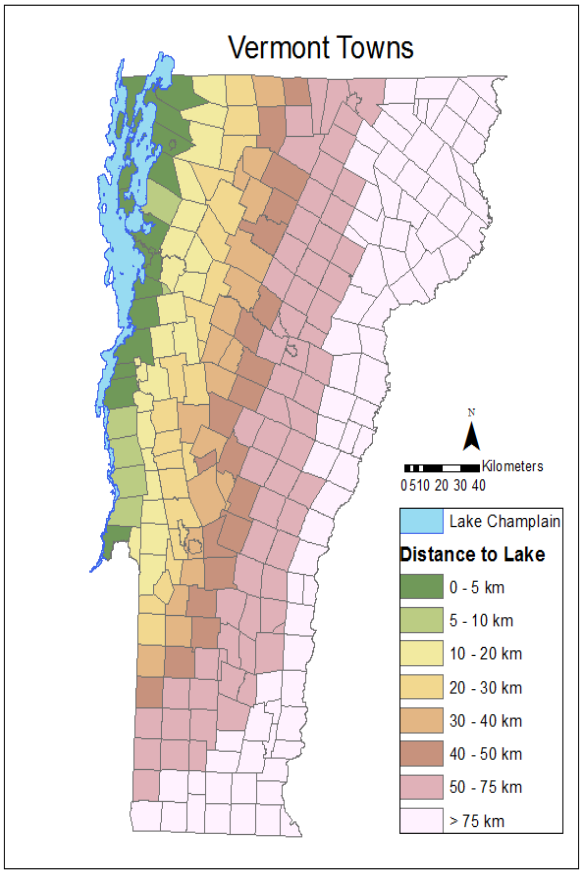


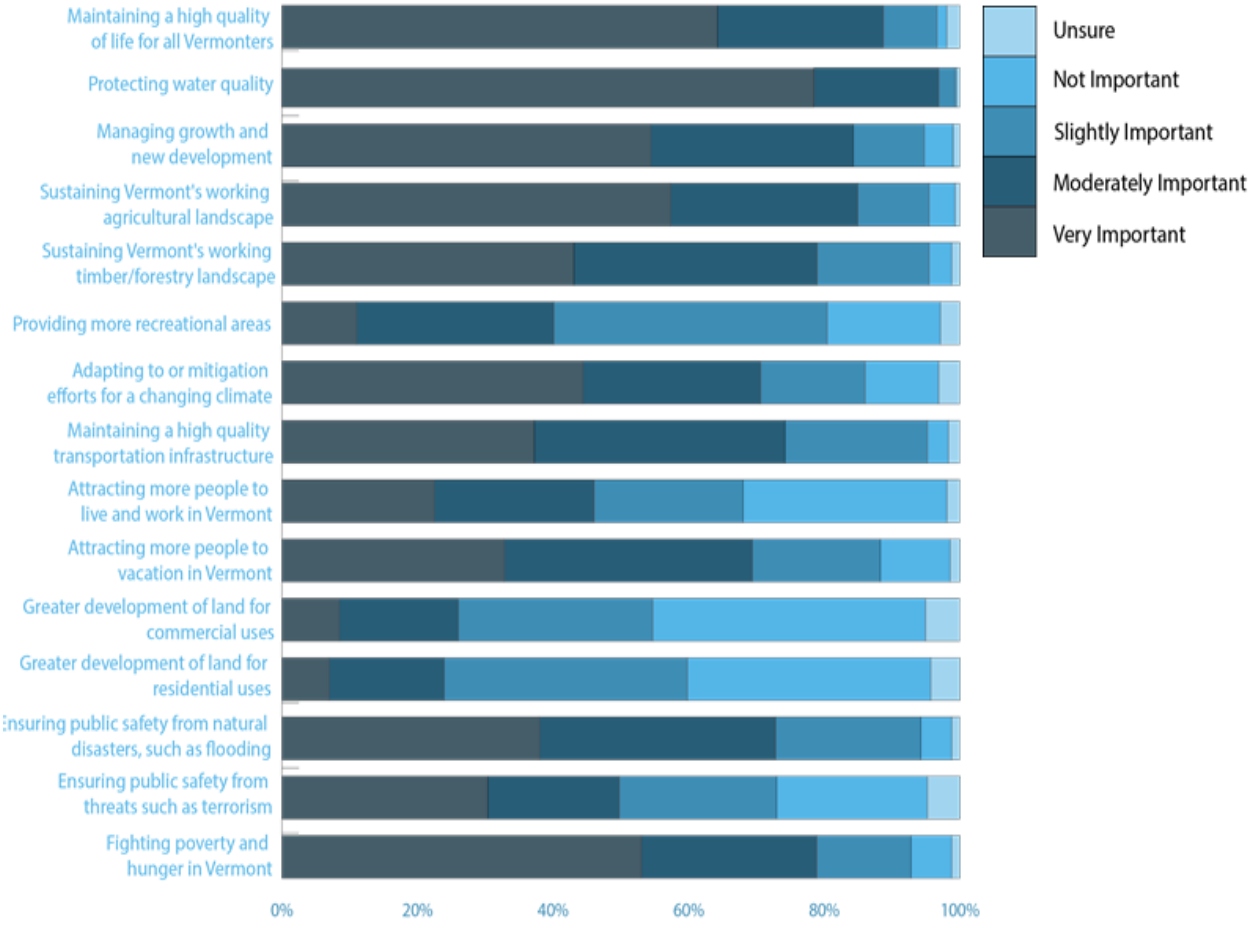
Figure 1. Distance to Lake Champlain from Town Centroids

Results

An earlier report (Koliba *et al*, 2014) examined the results of the 2013 public opinion poll to understand how Vermont residents rate the importance of water quality issues relative to other policy issues that Vermont currently faces. We start by reviewing some that report's key findings. Figures 2, 3 and 4 include the relevant results from this previous report. As seen in Figure 2, more than 95% of respondents marked water quality as either "moderately important" or "very important,"[15] more than for any other issue.[16] Figure 3 provides greater depth to the results from Figure 2. The data show that Vermont residents largely do not think that the current laws protecting water quality have a negative effect on development or that the current laws are adequate to protect water quality. Only approximately 21%[17] and 41%[18] of respondents,

[13] Center for Rural Studies.
[14] B. Hannon, 1994; B.P. Kaltenborn, 1998; B.W. Eisenhauer, R.S. Krannich, and D.J. Blahna, 2000; M. Vorkinn and H. Riese, 2001; B.S. Jorgensen and R.C. Stedman, 2003; A. Zia, B. Norton, S. Metcalf, P. Hirsch, and B. Hannon, 2014.
[15] Exact results are that 78.47% and 18.42% of respondents marked water quality as "very important" or "moderately important," respectively, totaling 96.89% of respondents.
[16] The next highest category was "Maintaining a high quality of life" with 64.27% and 24.46% or respondents answering "very important" or "moderately important," respectively, totaling 88.73% of respondents.
[17] When asked if tough water quality protection laws negatively affects development 6.97% and 14.18% of respondents marked "strongly agree" and "agree," respectively, covering 21.15% of respondents.

respectively, agree with these statements. Vermont residents, instead, think that both Vermont's quality of life and economy depend on water quality, with more than 85%[19] and over 80%[20] of respondents agreeing with these two statements, respectively. , Figure 4 shows that over 80% of respondents feel that it is important that the State of Vermont raise adequate funds to manage water quality in Vermont's waters.[21] These results, that more than 95% of respondents think water quality is at least moderately important, that Vermont's quality of life and economic health depend on water quality, that more needs to be done to protect water quality, which will not negatively impact development, and over 80% agree that it is important for the State of Vermont to raise adequate funds indicate that, even in this time of well-publicized economic and security concerns, funding water quality policy and projects remains very important to Vermont residents.



[18] When asked if environmental laws in Vermont are adequate for protecting water quality 9.90% and 31.64% of respondents marked "strongly agree" and "agree," respectively, covering 41.54% of respondents.
[19] When asked if the quality of life in Vermont is affected by water quality 40.57% and 46.06% of respondents marked "strongly agree" and "agree," respectively, covering .68.63% of respondents.
[20] When asked if the economic health of Vermont communities depends upon water quality 36.12% and 46.17% of respondents marked "strongly agree" and "agree," respectively, covering 82.29% of respondents.
[21] Exact results are that 38.79% and 41.63% of respondents either strongly agree or agree with the statement, respectively.

Figure 2. Public Opinion on the Relative Importance of Different Policy Issues Facing Vermont (Koliba et al, 2014; Reproduced with authors' permission)

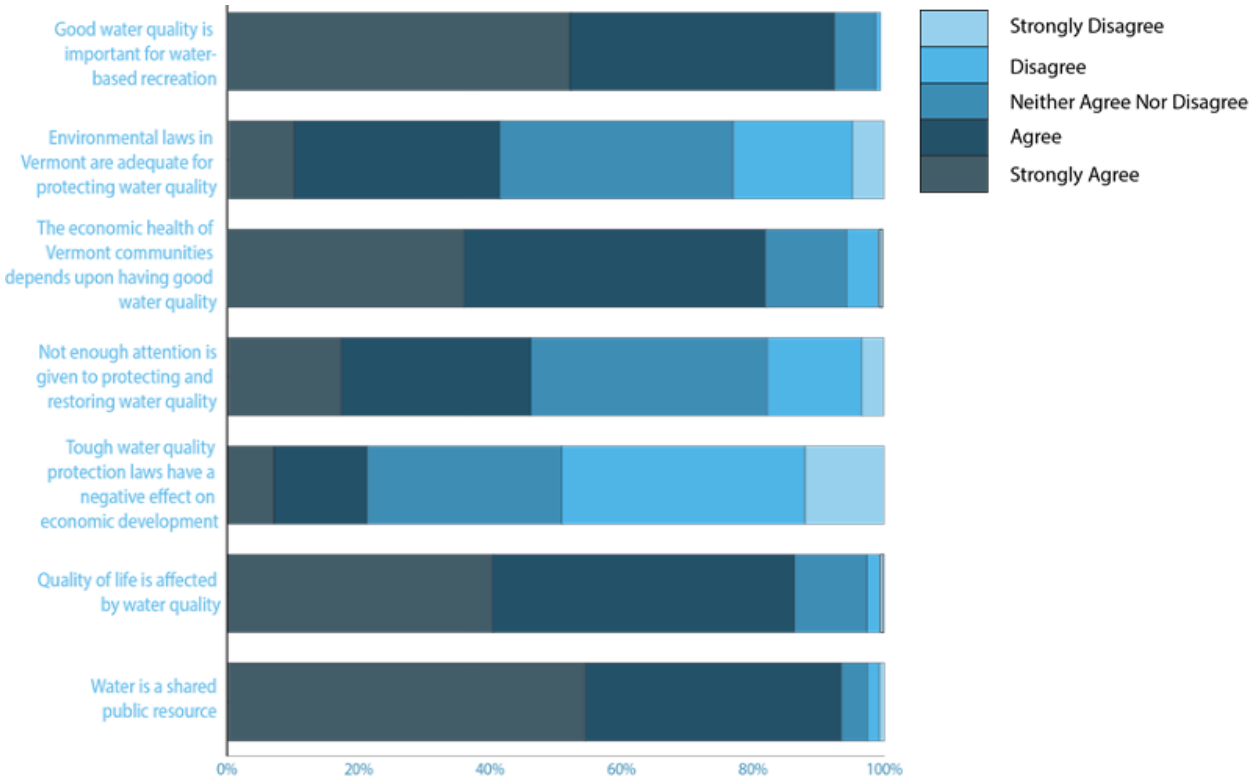


Figure 3. Public Opinion on Water Quality Priorities among Vermont Residents (Koliba et al, 2014; Reproduced with authors' permission)

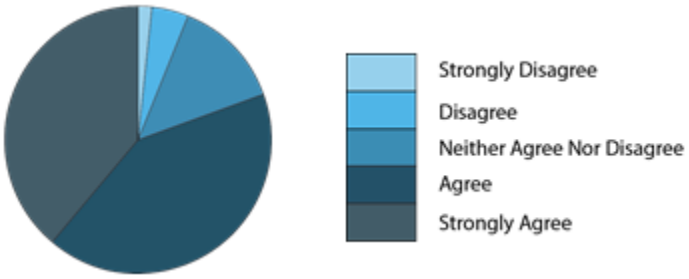


Figure 4. Public Opinion Results on the Importance of Raising Necessary Funds for Water Quality Projects (Koliba et al, 2014; Reproduced with authors' permission)

New analyses reveal a range of results, many of which are inconsistent across demographic characteristics and fundraising mechanisms. The differences in how the questions in each survey

are framed allow them to support different conclusions. The questions for the 2013 Public Opinion Survey were primarily designed to elicit opinions about the trade-offs between the different fundraising mechanisms, combined with an effort to gauge levels of willingness to pay. Conversely, the question included in the Vermonter Poll was specifically designed to gauge respondents' willingness to pay. The analysis presented below is shaped by the specific emphases of the two surveys; the Public Opinion Survey's data assesses preferences regarding the method of raising funds while the Vermonter Poll's data determines the fundraising capacity for embedding fees in either respondent's water bills or vehicle registration fees

How to Raise Funds

To gauge general acceptance, Table 1 reports the percentage of respondents that answered in each category in the Public Opinion Poll data. These basic results form a baseline for interpreting the results in Table 2, since the results in Table 1 are measured as changes from the results in Table 2.

Table 1. General Acceptance of Fundraising Mechanisms

Fundraising Mechanism	Unacceptable	Unsure	Undesired but Acceptable	Desired	Strongly Desired
One-Time Development Fees	21.4%	20.0%	20.9%	21.4%	16.4%
Annual Development Fees	35.9%	22.9%	18.4%	12.6%	10.3%
Stormwater Fees	34.5%	6.6%	25.7%	20.4%	12.8%
Broad-based Taxes	59.3%	6.5%	18.5%	12.0%	3.7%
Excise Taxes	42.8%	11.2%	20.5%	18.6%	7.0%

The results in Table 1 indicate that stormwater fees are the most popular option.

- 58.9% of respondents find stormwater fees acceptable.
- 58.7% of respondents find one-time development fees acceptable.
- 46.1% of respondents find excise taxes acceptable.
- 41.3% of respondents find annual development fees acceptable.
- 34.2% of respondents find broad-based taxes acceptable.

These numbers indicate the percentage of respondents that identified each policy tool as either: Undesired but Acceptable, Desired, or Strongly Desired. Viewed this way, stormwater fees have the highest overall acceptability, with one-time development fees being almost as acceptable. Table 2 indicates which demographic characteristics change the likelihood of a respondent answering something other than "Unacceptable." Cells where a "+" exists indicate where that column's characteristic is associated with a greater chance of the respondent providing that row's opinion. The results in Table 2 for each tool will be discussed separately below.

Table 2. Acceptability of Different Fundraising Mechanisms (Reference Answer is "Unacceptable")

		Distance from Lake Champlain	Income	Age	Female	Democrat/ Progressive	Reside in LCB	Religious Conservative	Religious Liberal	Attended College
One-Time Development Fees	Acceptable but Undesired									
	Unsure	+				+		-(b)		
	Desired		+(b)			++				
	Strongly Desired					+				
Annual Development Fees	A/U						-(b)	--		
	Unsure	+		+	++			--		
	Desired		+(b)			+				
	S. Desired									
Stormwater Fees	A/U					+			+	+(b)
	Unsure					+		X	+(b)	
	Desired			+(b)		++				+(b)
	S. Desired				+(b)	++			+	
Broad-Based Taxes	A/U		++		+	+			+(b)	
	Unsure				+(b)	+				-(b)
	Desired					+				+(b)
	S. Desired			+						
Excise Taxes	A/U		++	+	+					
	Unsure		+			++		X	+(b)	
	Desired					++				+
	S. Desired		+		+(b)					

Key for Table 2	
+	increased probability
-	decreased probability
(b)	Borderline statistical significance ($0.05 < p < 0.1$)
Double (++/--)	strong stat. sig. ($p < 0.01$)
Blank Cell	No statistically significant relationship
X	Insufficient observations to estimate

Development Fees

The Public Opinion Survey considered two types of development fees. As described in the Act 138 Report, developers would be assessed these fees either once, likely at the time of construction, or annually on the buildings that they own and operate. The goal would be to offset costs associated with runoff from impervious surfaces. Table 2 indicates that the most powerful predictor that a respondent will find these acceptable is if they are a registered Democrat or registered Progressive. Increasing distance from a water body increases the chances that a respondent will be unsure of the mechanism's acceptability. For development fees, increases in income have a possible effect in increasing the chances that the mechanism will be desired, but these results were not sufficiently significant to be fully certain that there were observed.

Stormwater Fees

Under Act 138, these would be assessed in a broad-based way, by being added to the cost of annual vehicle registration fees, thereby increasing these fees. Stormwater fees are used to offset water quality losses that result from stormwater runoff from roadways and other impervious surfaces. Table 2 shows Democrats and Progressives are much more likely than other political affiliations to be in favor of stormwater fees. Also, those who describe their religious identity as liberal and those who have attended college show signs of an increased chance of finding these fees acceptable, though the results are largely of borderline statistical significance.

Broad-Based Taxes

Broad-based taxes, in this context, is a catch-all term for using increases in sales and property tax and a surtax on existing income tax liability to generate a very broad base of supporters, allowing for potentially more funds to be raised while minimizing the burden on any individual or any one group. While this is in contrast to development fees, which would be paid primarily by developers, it is likely that those costs would be passed on to residents and businesses in the form of greater construction or rental costs. Broad-based taxes are clearly the least popular option, with few demographic factors indicating a greater likelihood for acceptance. Only higher incomes clearly increase acceptance, and then only in the category of 'Acceptable but

undesired.' Only respondents politically identifying as a Democrat or Progressive indicate increased likelihoods in more than one acceptability category.

Excise Taxes

Following from Act 138, excise taxes include specific taxes on a number of specific products, including motor fuels, flushable consumer products, pesticides, and bottled beverages. While more popular than broad-based taxes, this mechanism is still quite unpopular. The strongest results indicate that, again, Democrats and Progressives and those with higher incomes, have a greater likelihood of finding this mechanism acceptable.

Estimated Fundraising Capacity

The Vermonter Poll posed a differently framed question and collected different demographic data, though its data bear on the same questions about how willingness to pay varies across Vermont. Posed with clearly defined dollar values, these data allow for an estimate of how much funding can be raised from a single funding mechanism, the imposition of additional annual fees for water utility usage and motor vehicle registration. These data are concerned primarily with the influence of distance to the lakeshore and duration of residency in determining how much a respondent is willing to pay through fees embedded in water utility bills and vehicle registration. Representative results are presented in Table 3. Coefficients in the table indicate which background characteristics correlate with greater willingness to pay. A coefficient equal to '1' indicates when a background characteristic has no impact on a respondent's answers; respondents with this characteristic are equally likely to respond with the associated willingness to pay as they are to respond that they have a zero willingness to pay. Characteristics with a coefficient greater than '1' indicate an increased greater willingness to pay by indicating that a respondent with that characteristic will be more likely to give that column's answer, which, in all cases in the table, are represent any measurable willingness to pay greater than zero. Characteristics with a coefficient between 0 and 1 indicate a decreased willingness to pay by indicating that a respondent with that characteristic is more likely to respond with a zero willingness to pay.

These data, which explicitly asked about willingness to pay for water quality problems designed to aid the Lake Champlain Basin, show that the distance from a respondent's residence to the nearest point on the lakeshore did not influence the level of their willingness to pay. Coefficients for these variables, with only one exception, are not statistically different from '1.' Instead, the data show that newer residents have a greater willingness to pay, particularly for the highest dollar amount payments. They show that women and Democrats, which have the highest coefficients, are willing to pay to support water quality programs, but that female Democrats are actually less likely than either women or Democrats, in general, due to coefficients far less than 1. These results corroborate the story from the Public Opinion Survey data that distance to the lake is not a primary determinant of willingness to pay.

Table 3. Willingness to Pay Estimation Using Vermonter Poll Data

WTP	Model 3 N=450			Model 4 N=450		
	$1-$40	$41-$80	>$80	$1-$40	$41-$80	>$80
Euclidian Distance	0.995 *[0.989, 1.002]*	1.000 *[0.991, 1.008]*	0.991* *[0.982, 1.001]*	0.996 *[0.989, 1.003]*	1.000 *[0.991, 1.009]*	0.992 *[0.982, 1.002]*
Residency Time	0.986* *[0.972, 1.001]*	0.986 *[0.969, 1.004]*	0.969*** *[0.950, 0.988]*	0.987* *[0.972, 1.001]*	0.987 *[0.970, 1.006]*	0.970*** *[0.951, 0.989]*
Age	1.011 *[0.992, 1.031]*	1.004 *[0.979, 1.029]*	1.028** *[1.001, 1.055]*	1.012 *[0.992, 1.032]*	1.004 *[0.979, 1.029]*	1.028** *[1.001, 1.056]*
College	1.132 *[0.681, 1.881]*	1.156 *[0.604, 2.213]*	2.283** *[1.065, 4.891]*	1.137 *[0.679, 1.902]*	1.192 *[0.622, 2.286]*	2.313** *[1.077, 4.968]*
Female	1.173 *[0.734, 1.875]*	1.154 *[0.641, 2.076]*	1.341 *[0.697, 2.578]*	1.931** *[1.074, 3.472]*	1.243 *[0.562, 2.749]*	1.810 *[0.724, 4.528]*
Homeowner	1.194 *[0.504, 2.829]*	0.792 *[0.265, 2.368]*	0.317* *[0.096, 1.043]*	1.226 *[0.511, 2.942]*	0.803 *[0.266, 2.422]*	0.321* *[0.097, 1.062]*
Single Family	1.029 *[0.514, 2.060]*	0.827 *[0.344, 1.987]*	1.532 *[0.525, 4.472]*	1.018 *[0.505, 2.053]*	0.848 *[0.350, 2.053]*	1.537 *[0.526, 4.494]*
White	1.923 *[0.415, 8.909]*	0.409 *[0.098, 1.704]*	†	1.877 *[0.398, 8.862]*	0.392 *[0.094, 1.636]*	†
Democrat	0.906 *[0.500, 1.641]*	2.276** *[1.153, 4.494]*	2.240** *[1.073, 4.674]*	2.390* *[0.890, 6.419]*	3.839** *[1.294, 11.388]*	4.457** *[1.372, 14.472]*
Republican	0.861 *[0.441, 1.682]*	0.904 *[0.360, 2.269]*	1.393 *[0.504, 3.844]*	1.975 *[0.725, 5.383]*	0.677 *[0.129, 3.548]*	1.769 *[0.382, 8.193]*
Progressive	1.714 *[0.316, 9.282]*	3.771 *[0.631, 22.534]*	3.514 *[0.516, 23.928]*	1.113 *[0.147, 8.397]*	1.990 *[0.238, 16.661]*	2.352 *[0.178, 31.067]*
Income	0.870 *[0.712, 1.063]*	1.230 *[0.954, 1.586]*	1.292* *[0.972, 1.719]*	0.870 *[0.710, 1.065]*	1.231 *[0.955, 1.586]*	1.295* *[0.974, 1.723]*
Female Democrat				0.198** *[0.057, 0.685]*	0.441 *[0.109, 1.789]*	0.320 *[0.071, 1.455]*
Female Republican				0.215** *[0.056, 0.829]*	1.463 *[0.198, 10.816]*	0.632 *[0.085, 4.703]*
Female Progressive				†	†	†
Pseudo R-Square	Cox and Snell: 0.165 Nagelkerke: 0.178 McFadden: 0.069			Cox and Snell: 0.190 Nagelkerke: 0.205 McFadden: 0.081		

Reference category WTP=0; Values greater than 1 show increased willingness to pay; Values less than 1 show decreased willingness to pay.
† Insufficient observations generated outlier values that could not be interpreted.
Significance is represented by *p<0.10, **p<0.05, ***p<0.01
Bracketed range is the 95% confidence interval.

The results from Table 3 provide the basis for estimating revenue raising capacity. Figure 5 shows the distribution of Vermont residents' annual WTP through additional water utility bills and vehicle registration fees that underlies the results in Table 3. While approximately 35% of respondents are unwilling to pay additional fees, the remaining 65% have a strong willingness to pay to protect water quality in the Lake Champlain Basin in the face of climate change. Based on this distribution, we estimate a median willingness to pay of $40 per year, evenly split into a $20 flat fee added onto current water utility bills and a $20 flat fee added onto current vehicle registrations rates.

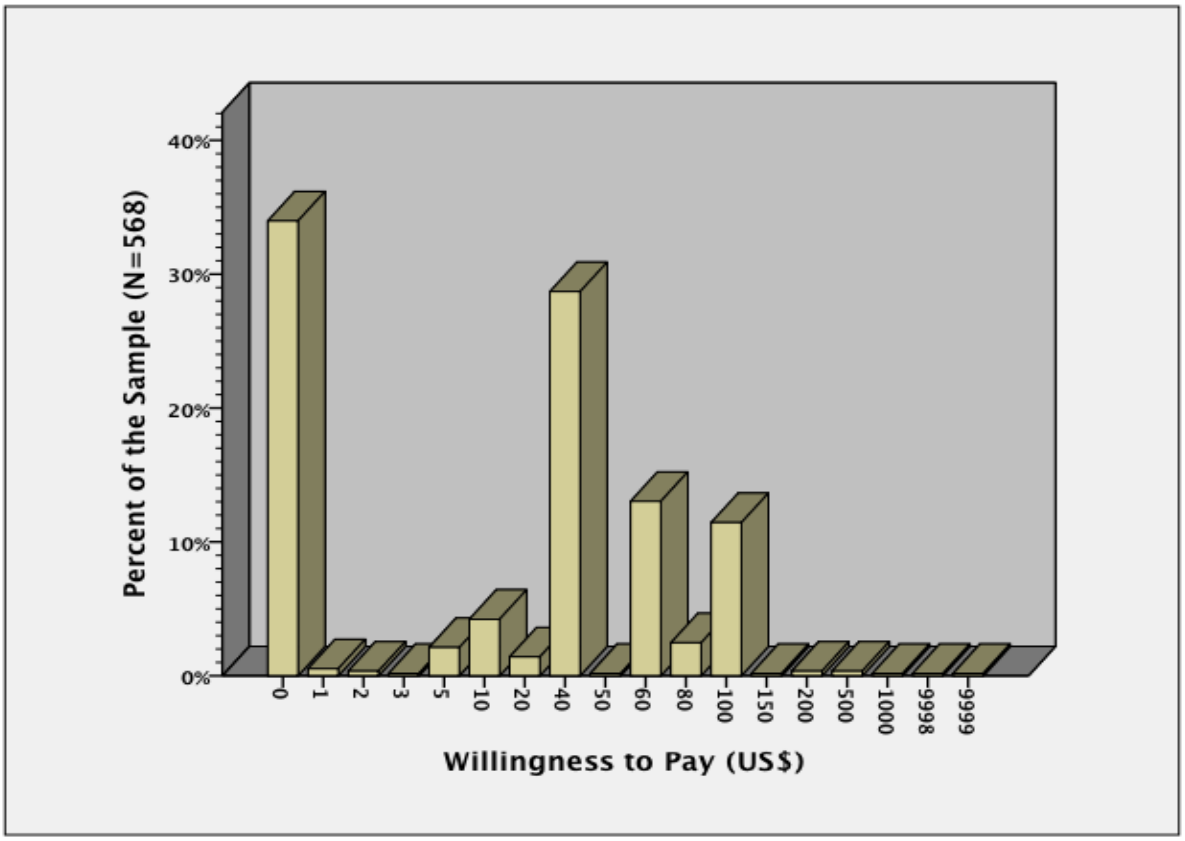


Figure 5.Vermonter's Annual Willingness to Pay from Spring 2014 Vermonter Poll

Figure 6 shows that respondents in most of the counties are willing to pay $40 or more as additional water utility and vehicle registration fees per year. The exceptions are the following counties: Caledonia, Essex, Franklin, Lamoille and Orange.[22] Boxes represent the middle quartiles of the distribution for willingness to pay in each county. The whiskers extending beyond the boxes represent minimum and maximum values, as appropriate. Black bars represent the median value of the distribution. Outliers are indicated individually where appropriate.

[22] Too few observations were made in Grand Isle to support a statistical distribution.

We estimate that 189,552 households in Vermont would be assessed the additional water utility fee.[23] If $20 per year in additional fees is added on to the water utility bills of these households, we estimate that $3,791,000 per year could be collected through increased fees in water utility bills. Further, if a $20 per year additional fee is levied on vehicle registrations for estimated 605,000 motorized vehicles registered in Vermont,[24] we estimate that an additional $12,100,000 could be raised through vehicle registration fees. Both water utility and vehicle registration fees could add combined total of $15,891,000 per year.

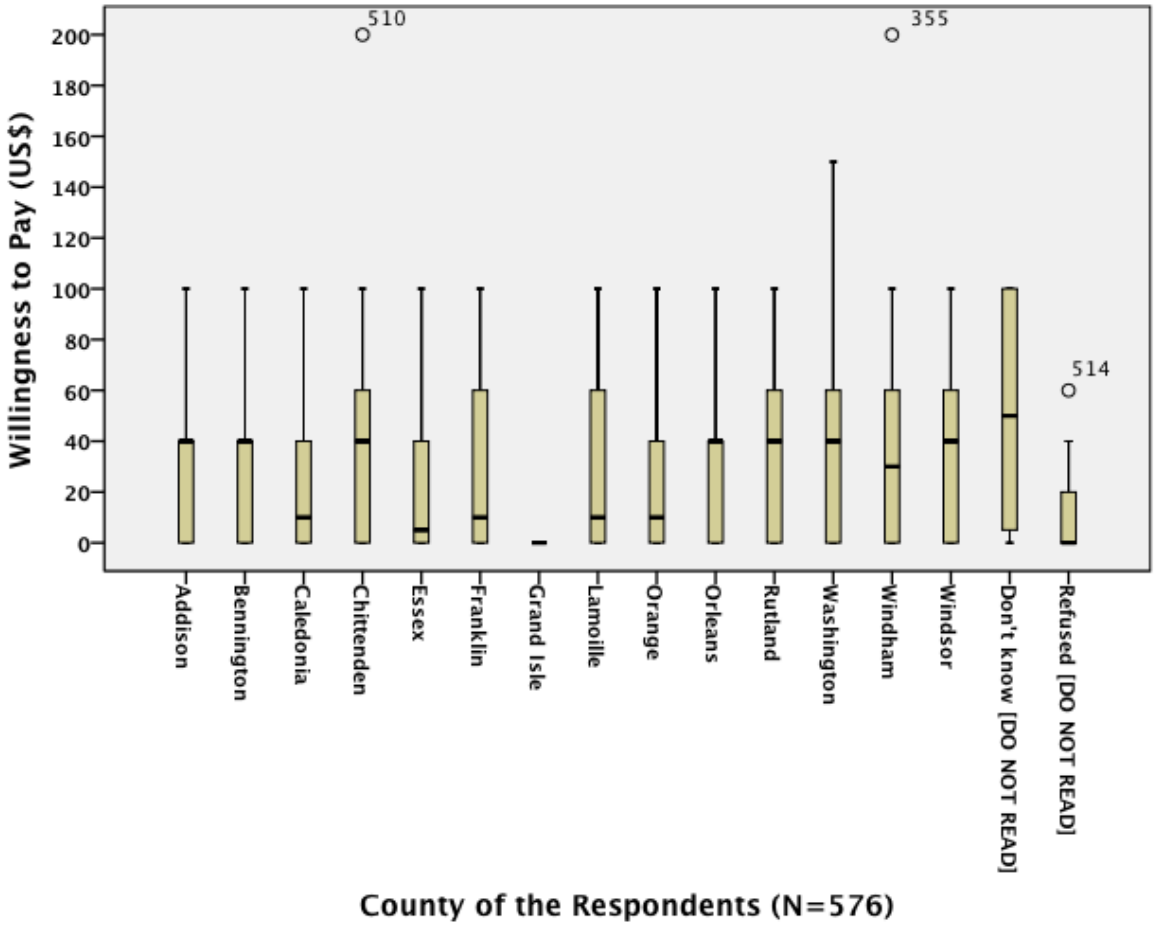


Figure 6. Boxplot of Vermonter's Annual WTP distributed by county of their residence

[23] Data from a 2013 Government Performance Results Act (GPRA) report, stored the Environmental Protection Agency's Safe Drinking Water Information System (SDWIS) database indicates that public water utilities serve 450,054 residents in Vermont. The US Census's 2013 American Community Survey (ACS) indicates that the households occupied by owners represent 71.0% of Vermont households and include an average of 2.47 individuals. The ACS also indicates that renter-occupied households make up the remaining 29.0% and include an average of 2.14 individuals. A weighted average of these values indicates that, on average, Vermont households include 2.3743 individuals. Using the number of residents served by public utilities and the average number of residents per household indicates that approximately 189,552.29 households are served by public water utilities. This figure is rounded to 189,552 households. See Appendix B for full details.

[24] Data from Vermont Department of Motor Vehicles.

Conclusions

Vermont residents have demonstrated that they have a strong interest in seeing improvements in water quality statewide and that the state government should play an important role in supporting and providing that improvement.[25] The Act 138 Report[26] indicates that nearly $156 million is needed annually over the next ten years for Vermont to meet its obligations under the Clean Water Act. Analysis of polling data confirms another conclusion of the report, that the ability to raise funds falls vastly short of the amount of funds needed.[27] This analysis indicates that publicly supported fundraising is estimated at only $15.89 million per year, well short of the required $156 million needed annually for ten years, though it would represent a meaningful step towards raising the necessary funds.

It is important to note that it would be necessary to ensure that the funds raised would be applied to cleaning up Vermont's water bodies. The mechanisms discussed above that would be able to raise these funds would place the collection burden on the Department of Motor Vehicles, providing this department with the revenue. One option to ensure that the revenue is spent on water quality projects would be to place it in a fund such as a "Save Lake Champlain Fund", for example. Another option would be to transfer the revenue within the Agency of Transportation and to other agencies, which operate programs to support water quality.

These data do provide some confirmation of existing conclusions on the relationship between sense of place and willingness to pay, though the confirming evidence is limited. There are some potential explanations for this discrepancy between the results found here and the predictions from the theory that people care more about water quality when they are in proximity to significant water bodies.[28] More than one body of water in Vermont is failing to meet its CWA requirements. Pollution problems, such as harmful algal blooms, persist in both Lake Carmi and Lake Memphremagog, and in the Connecticut River. The Environmental Protection Agency currently lists 24 approved TMDLs in Vermont[29] that, while concentrated in and around relatively-densely populated Chittenden County, cover a considerable portion of the state. The oldest approved TMDLs have been in place since 2001. As depicted in Figure 1, the distances in this study are measured only in relation to Lake Champlain. This means that additional water bodies, closer to respondents, may be driving acceptance levels and willingness to pay, but are not accounted for in the measurement of distance.

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[25] Koliba *et al*, 2014.
[26] ANR, 2013.
[27] ANR, 2013.
[28] B. Hannon, 1994; B.P. Kaltenborn, 1998; B.W. Eisenhauer, R.S. Krannich, and D.J. Blahna, 2000; M. Vorkinn and H. Riese, 2001; B.S. Jorgensen and R.C. Stedman, 2003; A. Zia, B. Norton, S. Metcalf, P. Hirsch, and B. Hannon, 2014.
[29] The full list, maintained by the EPA is available here: <<http://www.epa.gov/region1/eco/tmdl/approved.html#vt>>. There is also a 25th approved TMDL that applies to the New England region, generally, including Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

These datasets indicate that political identity and education are the most consistent predictors of increased acceptability of payment mechanisms and increased willingness to pay. This provides two findings about how policy can promote willingness to pay. The first derives solely from these observations of the data. Vermont, with its high proportion of registered Democrats and Progressives can rely on their political beliefs to support policies that raise money to pay for water quality programs. Additionally, greater education generally and outreach about the problem is likely to increase voter support for water quality programs.

The second finding arises when the observations about political identity, education, and sense of place are examined together. In interviews, representatives of the state agencies involved in water quality, report hearing complaints from Vermont residents who live outside of the LCB, that too much attention is paid to the LCB to the exclusion of other watersheds. This confirms that Vermont residents have begun to feel that governmental efforts to improve water quality are focused on the LCB, to the exclusion of Vermont's other impaired waters. With a lack of results related to the distance of a residence from the shores of Lake Champlain, but with water quality problems around Vermont, these data can be interpreted to suggest that efforts to raise awareness about, and address water quality concerns, should highlight the state-wide nature of water quality challenges. Willingness to pay for water quality is *not* an exclusive characteristic of LCB residents. Greater support for water quality programs across the state might be found by increasing the attention paid to other watersheds, as well as, increasing the awareness of that greater attention among voters. While programs for other water bodies, including the Connecticut River and Lake Memphremagog certainly exist, they should feature more prominently in state-wide materials, discussions, and programs. This will respond to popular misconceptions regarding the focus of water quality policy in Vermont and so could lead to an increase in Vermont residents' willingness to pay. Willingness to pay remains a complex and difficult to measure concept with multiple factors influencing each individual's level of willingness to pay. Differing policy ramifications, as well as more targeted or creative policy interventions, could emerge from further investigation of these factors, their interaction, and the effects on willingness to pay.

References

Carson, R. T., J. J. Louviere, and N. Wasi. 2009. "A Cautionary Note on Designing Discrete Choice Experiments: A Comment on Lusk and Norwood's 'Effect of Experimental Design on Choice-Based Conjoint Valuation Estimates.'" *American Journal of Agricultural Economics*, 91(4), 1056 – 1063.

Center for Rural Studies. No Date. "Vermonter Poll." Most Recently Accessed: 23 October 2014 <<http://www.uvm.edu/crs/?Page=projects/vtpoll.html&SM=projects/projectssubmenu.html>>

Diamond, P. A., and J. A. Hausman. 1994. "Contingent Valuation: Is Some Number better than No Number?" *The Journal of Economic Perspectives*, Vol. 8, No. 4 (Autumn), 45 – 64.

Eisenhauer, B. W., Krannich, R.S., & Blahna, D. J. 2000. "Attachments to special places on public lands: An analysis of activities, reason for attachments, and community connections." *Society and Natural Resources, 13*(5), 421-441.

Hannon, B. 1994. "Sense of place: Geographic discounting by people, animals and plants." *Ecological Economics, 10*(2), 157-174.

Jorgensen, B. S., & Stedman, R. C. 2005. "A comparative analysis of predictors of sense of place dimensions: Attachment to, dependence on, and identification with lakeshore properties." *Journal of Environmental Management, 79*, 316-327.

Kaltenborn, B.P. 1998. "Effects of sense of place on responses to environmental impacts: A study among residents in Svalbard in the Norwegian high Arctic." *Applied Geography, 18*, 169-189.

Kennedy, Peter. 2003. *A Guide to Econometrics: Fifth Edition*. Cambridge, MA: MIT Press.

Koliba, Christopher, Asim Zia, Steve Scheinert, and Katherine Logan. 2014. *2013 Water Quality Survey*. Burlington, VT.

Ledbetter, Stuart. 2014. "Vt. lawmakers agree to revised list of budget cuts." WPTZ News Channel 5. Updated: 13 Aug. Accessed: 26 Aug. <<http://www.wptz.com/news/vermont-new-york/burlington/panel-decides-against-budget-cuts/27458822#!bKHgm0>>.

Vermont Agency of Natural Resources (ANR). 2013. *Water Quality Remediation, Implementation, and Funding Report*. Montpelier, VT (January).

Vorkinn, M. and Riese, H. 2001. "Environmental concern in a local context: The significance of place attachment." *Environment and Behavior, 33(*2), 249-263.

Zia, A., B. Norton, S. Metcalf, P. Hirsch, and B. Hannon. 2014. "Spatial Discounting, Place Attachment and Environmental Concern: Toward an Ambit-Based Theory of Sense of Place." *Journal of Environmental Psychology* 40, 283-295.

Appendix A: Data Sources and Methods of Analysis

2013 Public Opinion Survey

During the summer, 2013, RACC researchers, at the University of Vermont, and as part of the Vermont Experimental Program to Stimulate Competitive Research (Vermont EPSCoR) funded by the National Science Foundation (NSF), collected data using a mail survey. The survey attempted to reach 5,000 randomly selected individuals across Vermont. Researchers received 422 responses, giving a response rate of 8.44%, as a base 95% confidence interval of ±4.77%.[30] The questions, sample and primary outputs have been previously released,[31] and so will not be reviewed in full here.

The key questions for this analysis will be the survey's set of questions that address willingness to pay. This survey posed four questions that asked about the willingness to pay for five different policy tolls:

- One-time development fees
- Annual development fees
- Stormwater fees embedded in vehicle registration fees
- Broad-based taxes
- Excise taxes for certain disposable and polluting products

Each question asked respondents to rank high, moderate, and low increases in these fees using a Likert-type scale, numbered from 1 to 5, but offering the choices of "Unacceptable," "Acceptable but Undesired," "Unsure," "Desired," or "Strongly Desired."[32] The questions did not specific dollar amounts that were tied to the "high," "moderate," and "low" values, as these values vary heavily in each context.

2014 Vermonter Poll

The RACC team added specific questions about Vermont residents' WTP in the 2014 Vermonter Poll, a computer-aided telephone-interviewing (CATI) poll conducted by the Center for Rural Studies at the University of Vermont. The survey was conducted between the hours of 9:00 a.m. and 9:00 p.m. beginning on March 10, 2014 and ending on March 25, 2014. A random sample for the poll was drawn from a list of Vermont telephone numbers, which is updated quarterly and included listed and unlisted telephone numbers. Cellular phone numbers were not included in the sampling frame. Only Vermont residents over the age of eighteen were interviewed. The poll

[30] Base confidence intervals assume a 50% proportion value when calculating the confidence interval. Confidence intervals for individual questions will decrease as the observed proportions move further away from 50%.
[31] Koliba, Zia, Scheinert, and Logan, 2014.
[32] Likert scales are a specific type of ordinal scale that rank an item from -2 to 2, with opposing assessments placed on opposite sides of the 0-value. While scaled from 1 to 5, the questions here could be recoded as a Likert scale simply by subtracting 3 from the coded values.

included questions on a variety of issues related to public policy in the state of Vermont. In total, 2,013 households were successfully contacted, yielding 576 complete responses; therefore, 28.6 percent of these calls resulted in a completed survey. Based on a group of this size, the results have a margin of error of plus or minus 4.5 percent with a confidence interval of 95 percent.

The question in the poll regarding willingness to pay to protect Lake Champlain water quality was prefaced with an overview on how phosphorus, nitrogen, and more intense and frequent storms will degrade water quality in the lake if no proactive measures are taken. The preface also mentioned that the Vermont government didn't have adequate money to fund these protective measures. Participants were then asked if they were willing to pay an annual fee of (a) $20, (b) $30, (c) $40, or (d) $50 as part of their water bills and the same amounts as part of their vehicle registration fees to protect Lake Champlain water quality in the medium to long run (10-50 years). If respondents answered no for (a), they were asked what the minimum amount they were willing to pay was. If respondents answered yes for (d), they were asked what the maximum amount they were willing to pay was.

Analysis: Multinomial Logistic Regression

The acceptability of policy tools and willingness to pay are recorded in the appropriate variables in the Public Opinion Survey and Vermonter Poll, respectively. The influence on the acceptability and willingness to pay can then be estimated using regression analysis. However, their scaling methods prevent estimation by Ordinary Least Squares (OLS). In the Public Opinion Poll, these variables are coded using ordinal scales.[33] In the Vermonter Poll, they are recorded as the labeled values of multinomial variables. This requires the use of models designed to address limited dependent variables. Analysis follows the more restrictive assumptions required to use a multinomial variable as a dependent variable (Kennedy, 2003),[34] allowing for parallel analyses of each dataset.

Previous research demonstrates that proximity to water affects individual's willingness to pay to keep that water clean.[35] Therefore, a measurement of how far respondents are from Lake Champlain is necessary for an accurate assessment of the acceptability of fundraising mechanisms and overall willingness to pay. Both surveys record a certain amount of geographic data about the respondents. In the case of the public opinion survey, respondents identified their residential zip codes and the initial sample includes full addresses. The Vermonter Poll, as well, includes some full addresses. Both datasets record the town in which respondents reside. Researchers used geo-referencing to identify the specific locations of respondents. When specific addresses were unavailable but town information was available, one of two procedures is

[33] Kennedy, 2003.
[34] Kennedy, 2003.
[35] Hannon, 1994; Kaltenborn, 1998; Eisenhauer, Rannich, and Blahna, 2000; Vorkinn and Riese, 2001; Jorgensen and Stedman, 2005; Zia *et al*, 2014.

followed. For the Vermonter Poll respondents, respondents are placed at the post office that serviced their general area. For Public Opinion Poll respondents, respondents are assigned the centroid of their town. Once placed, the distances to Lake Champlain are calculated and recorded for each response.[36] Distances are calculated using both Euclidian distance, which record the straight-line distance from the address to the shoreline, and roadway distance, which records the distance from the respondent's location to the shore by following the shortest path along the road network. Nevertheless, only a portion of the data could be linked to a geographic location. This includes 220 observations of the Public Opinion Poll data and 450 observations of the Vermonter Poll data. The following models are then estimated. For the Public Opinion Survey data:

$$Acceptability = f\left(\begin{matrix} Distance, Income\ Level, Age, Gender, Political\ Affiliation, \\ Lake\ Champlain\ Basin\ Residence, Religious\ Identity, and\ College\ Attendance \end{matrix}\right)$$

For the Vermonter Poll data:

$$Willingness\ to\ Pay = f\left(\begin{matrix} Distance, Residency\ Time, Age, College\ Attendance, Gender, Homeowner \\ Status, Single\ Family\ Home\ Status, Ethnicity, Political\ Affiliation \end{matrix}\right)$$

Each model is estimated using different subsets of the independent variables as a sensitivity analysis. The clearest results are included in this report.[37] This includes testing for different impacts from either directly measured distances or the natural logarithm of distance.[38] Results were clearer using the natural logarithm, and so these results are reported here.

[36] Geo-referencing and distance calculations were performed using ArcGIS. Map layers for Lake Champlain from the Vermont Center for Geographic Information (VCGI).
[37] Regressions were performed using IBM *Statistical Package for Social Science* (SPSS).
[38] That is, distance transformed by taking: ln(distance).

Appendix B: Calculation of Funds Raised through Water Utility Fee

Housing statistics from Census:[39]

Average household size, Owner occupied: 2.47 individuals

Average household size, Renter occupied: 2.14 individuals

% of occupied housing that is homeowner: 71.0%

% of occupied housing that is rental: 29.0%

Weighted averaging:

$$0.71(2.47) + 0.29(2.14) = 1.7537 + 0.6206 = 2.3743$$

Weighted average of residents per household: 2.3743 individuals per household

Number of households in Vermont to be assessed the fee:

Individuals served by public utilities (EPA, 2013): 450,054 individuals

Number of Community Water Systems (CWS): 426 water systems

Number of Households served:

$$\frac{450{,}054\ individuals}{2.3743\ individuals\ per\ household} = 189{,}552.289\ households$$

Funds raised from these households through a $20 fee:

$$189{,}552\ households\left(\frac{\$20}{household}\right) = \$3{,}791{,}040$$

[39] American Community Survey, 2013.