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VALUATION OF THE CONNECTICUT RIVER

A Cost-Benefit Analysis of Joint-State Clean Water Spending

Prepared for the Connecticut River Joint Commissions

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EXECUTIVE SUMMARY

In this report, we value the Connecticut River corridor between Vermont and New Hampshire to analyze the combined economic value the river brings to both states. This report focuses on eight metrics to value the river corridor, including community value-added, recreation, fishing, managed resources, river health, flooding, ecosystem services, and intrinsic value. We do not tabulate the value of the entire watershed or any tributaries, but focus solely on deriving the value of the Connecticut River itself. We examine tradeoffs between economic development and conservation and how different methods of development may benefit or harm other sources of the river. The Connecticut River is a major source of use and non-use values for citizens and visitors to Vermont and New Hampshire. It is important for policymakers, stakeholders, and taxpayers to recognize differing sources of value when it comes to deciding on future development or conservation actions.[1]

1. INTRODUCTION

The Clean Water Act of 1972 instituted new state and municipal mandates to mitigate the effects of major waste sources. As a result of these federal mandates, states adopted programs to fulfill the various requirements of the Act and to monitor their bodies of water. In 1988, the Department of Environmental Services established The New Hampshire Rivers Management and Protection Program (RMPP) to protect certain rivers, called Designated Rivers, for their outstanding natural and cultural resources. One of these "designated" bodies of water is the Connecticut River.[2]

In 2015, the state of Vermont passed Act 64, better known as the Vermont Clean Water Act. This piece of legislation seeks to preserve high standards of water quality in all the bodies of water throughout the state. The Vermont Clean Water Act builds on the original Clean Water Act, which Congress passed in 1972. Act 64 recognizes that many bodies of water in the state fail to meet the regulations of the original Clean Water Act, and it aims to rectify those situations as well as to monitor water segments at risk for degradation ranging from the Connecticut River to one of the state's 812 lakes and ponds.

The Connecticut River is the longest body of water in New England; it spans for 410 miles from a small pond on a spruce-fir ridge at the northern tip of New Hampshire to the beaches of Long Island Sound. Its watershed drains some 11,000 square miles of rural, wild, and urban land.[3] It also delineates the 275-mile border between Vermont and New Hampshire. The river watershed encapsulates 33 percent of the water of New Hampshire and 44 percent of the water of Vermont, and is a great economic source for both states.[4] Despite its aesthetic appeal and utility to New England, the river has faced historically severe pollution, some of which continues today. As this vital New England staple lives on, policymakers balancing sustainability and economic development must confront difficult tradeoffs and perennially contested state appropriations. Understanding the value of the river may support stakeholder decisions and improve policymaking at the local and state level.[5]

2. PURPOSE STATEMENT

The Connecticut River corridor between Vermont and New Hampshire runs 275 miles from north to south. While the river geographically belongs to New Hampshire, the extent of its watershed and the shared border make the river an important fixture in both states.

In the 1950s the Connecticut River faced an immense water pollution problem. Industrial plants such as paper mills along the river dumped countless toxins in the river, making it unusable to the public. However, in 1952 the Connecticut River Watershed Council (CRWC) formed with the goal of dealing with this problem.[6] The CRWC along with federal legislation—Clean Water Act (1972)—and the creation of the Environmental Protection Agency (1970), provided the statutory and regulatory framework to remove these toxins from the river, thereby improving the monetary value of the river to the states of New Hampshire and Vermont.

Today the Connecticut River is not only cleaner, but it is also much more valuable than it was a half century ago. However, storm surges and waste water could still damage water quality, thereby impairing its economic promise to both New Hampshire and Vermont. This report considers how such pollutants could hurt the economic value of the Connecticut River, which goes far beyond the tourism and boating to include industrial and hydroelectric purposes. No specific EPA mandate exists to clean the Connecticut River corridor, as with Lake Champlain in 2016. This report provides methodologies and multiple initial calculations that may help the Connecticut River Joint Commissions steer river stewardship and policy moving forward.

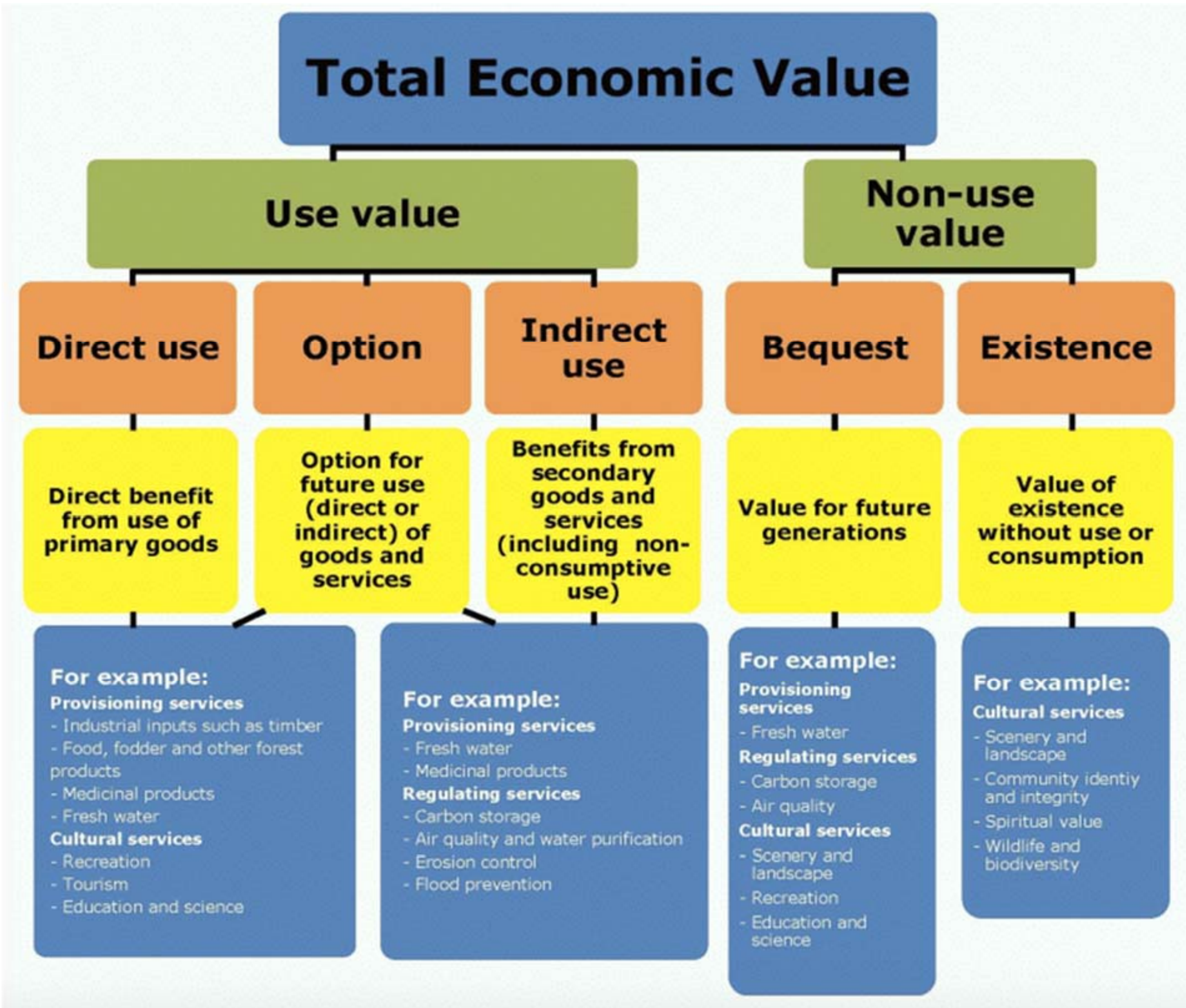
3. LITERATURE REVIEW

Originally, conservation research focused on negative anthropogenic effects that humans have on the natural world. More recently, conservation research has concentrated on understanding the use and non-use benefits that nature provides to people.[7] Ecosystems have real and quantifiable values, even though they are often unrecognized positive externalities in our society.[8]

Vermont has 7,100 miles of rivers and streams, while New Hampshire has 17,000. They provide many resources to the state including boating, swimming, fishing, tourism, and property value improvements. Regardless of the numerous benefits, Vermont and New Hampshire still deal with water treatment issues and pollution caused by the discharge of waste from agriculture runoff, construction sites, and business operations. Despite the numerous advantages of the natural resources in both states, there are consistent concerns over the increased pollution and degradation of the rivers and waterways in Vermont and New Hampshire. This raises the importance of recognizing different sources of monetary value provided from natural resources such as waterways in Vermont and New Hampshire.

In the 1960s, scholars began turning to economics as a method to reconcile the value of environmental resources.[9] However, as Loo et al. recognized, the aesthetic and intrinsic qualities of the environment are often perceived as abstract and transitory.[10] Therefore, the monetary value of a natural resource is often dismissed. Recent research has aimed at quantifying the total economic value of an ecosystem. This includes assessing the full economic value of use and non-use resources of various bodies of water.[11] Rivers impact communities in distinct ways; any assessment of their value should reflect local amenities.[12] Underestimating the value of rivers to citizens may lead to the development of water resources and rights that inadequately value the interests of the entire population.[13] Figure 1 expands on the framework behind Total Economic Value.

Figure 1: Total Economic Value Framework



Adopted from the Economics of Ecosystems and Biodiversity, 2009 Edition[14]

In order to value environmental resources, ecological economists have created a variety of techniques to identify sources of monetary value. Often the most common approach is through surveys or questionnaires designed to understand the willingness of individuals to pay (WTP) to preserve or improve a specific part of a natural environment. The methodology involves asking respondents what amount they would be willing to pay to move from the current condition to a preferable environmental condition.[15]

Unfortunately, there are quite a few biases related to WTP approaches. For instance, respondents are often more likely to overstate their willingness to pay if they believe they will not have to eventually pay with higher taxes.[16] Research in behavioral economics also identifies another source of bias due to risk aversion. Respondents to surveys often assign greater weight to losses, rather than gains.[17] For instance, Knetsch found that the same respondents would be willing to pay four times less to preserve a marsh for ducks than they would be willing to accept the loss of the same ducks.[18]

Willingness to pay approaches are often more valid through the analysis of actual expenditures, where citizens pay for goods and services to utilize a resource.[19] One approach is called the travel cost method (TCM), which relies on the assumption that the distance one is willing to travel to visit a site can be used as a proxy for how that individual places value on spending time at a river, per se.[20] The cost a visitor is willing to pay is measured based on their net travel costs plus the amount they are willing to pay above their current trip cost.[21] Then, the willingness to pay for all visitors is aggregated to arrive at a total value.

The travel cost method is considered an instrument to understand revealed preferences through examining actual behavior of individuals and their utility functions. There are many other forms of revealed preference valuation. One of the most common involves hedonic pricing models. A hedonic pricing model observes the changes in prices of goods as one moves closer or farther away from a target site. The effect is calculated through a basic linear regression approach. For instance, real estate is often used in hedonic pricing models, whereby one could observe the difference in housing prices close to the river versus houses that are farther away.[22] This can be used to determine the value that individuals place on being close to a river.

Ecological valuation methods can be very effective, but they require a large amount of work to complete the procedures. It is often the case that policy makers will simplify the analysis and rely on a benefit transfer approach to assess the value of a target site. Benefit transfer refers to the extrapolation of value estimates generated at one source to a different target site.[23] An example would be using research to assess the value of floodplains in the Mississippi River to estimate the value for the Connecticut River. The method is helpful to make comparisons and starting estimates, and will be used at points in this paper. However, it is important to note the potential inaccuracy from generalizing benefits in one location from another. Morrison and Bennet examined how benefit transfer failed to reconcile the significant differences in implicit prices of watershed values in New South Wales. Nevertheless, policymakers, economists, and scientists face time and budgetary restraints, and valuing every single mile, watershed, or river tributary by itself is not always feasible. The U.S. government and Army Corps of Engineers commonly use a benefit transfer approach, since it is intuitive for stakeholder analysis.[24]

Economic values from the protection of natural environments are meaningful and quantifiable. For this study on the value of the Connecticut River, we will group benefits and costs into seven distinct categories: community, recreation, fishing, flooding, pollution, ecosystem services, and intrinsic value. Although most economic benefits can be observed on-site, many coincidental benefits occur across the region or downstream. Therefore, all values estimated in this paper are likely underestimates, as benefits provided in one place may have positive externalities for other locations in Vermont or New Hampshire locations or even the Long Island Sound.

4. VALUATION METHODS

4.1 Community Value Added

Our research begins by assessing the annual impact of the Connecticut River on property values and incomes. We use hedonic pricing models because we want to know if living closer to the river boosts both of these and produces value compared to the counterfactual of no Connecticut River. This difference can therefore determine the premium value one is willing to pay to view, access, or live close to an environmental target site.

One could determine the real estate value by assessing the price of each house along the Connecticut River and matching it to a very similar house with identical structure, bedrooms, garage, etc. Previous studies in Vermont, such as Voight et al., assessed property values on a parcel area of land near Lake Champlain using home transfer/sale data from 800 locations.[25] The research then extrapolated these transacted properties to census blocks, and used E911 (emergency services) data to compute assumptions for the residential density and house characteristics. In order to determine which properties had a view of Lake Champlain, the research then examined ArcGIS digital elevation models to map which properties had a view of the lake. This arduous approach allowed the team to estimate the effect of being within a 100 meter buffer of the lake, and the research demonstrated that properties within this buffer of Lake Champlain led to a 30 percent premium on housing price, all else equal.

Even this process still had to make large assumptions of ceteris paribus. The study is useful in understanding potential magnitudes, but might lead to bias through a benefit transfer extrapolation to the Connecticut River. Using a benefit transfer approach for our research would lead to bias in two forms. For one, previous research has examined how there are significant valuation differences between adjacent catchments and watersheds even for the same target site.[26] This significant variation makes cross-site comparisons futile. Furthermore, differences in home price value vary based on demographic characteristics or whether the population is urban or rural.[27] Therefore, it would likely not be effective to examine a specific section of Vermont houses that border the Connecticut River, since this would lead to bias.

In order to find the value the Connecticut River adds to real estate prices in Vermont, this study focuses on ZIP codes as the unit of analysis. Although ZIP code aggregates are not as specific as individual household level data, data is available for all regions in Vermont. Household data often excludes many individuals and households from the sample. This study uses three main geographic sample specifications. The first are all the ZIP codes that touch the Connecticut River. The second sample includes all the ZIP codes that border the first specification. These areas therefore do not border the river at any point, but they are one ZIP code away from being along the river. The third specification includes all ZIP codes in Vermont that border a contiguous ZIP code, or a region from the second specification. These include all ZIP codes in Vermont that are two ZIP codes away from the river. The samples were selected manually by observing the ZIP code map of Vermont. Figures A1 through A3 in the appendix demonstrate geographically the different ZIP code specifications. This study excludes several ZIP codes in northern New Hampshire with large areas in order to more accurately measure the effect the Connecticut River on property values across contiguous ZIP codes. Table 1 analyzes descriptive statistics for the three ZIP code specifications in Vermont while Table 2 does the same for New Hampshire.

Table 1: Descriptive Statistics for ZIP Code Specifications (VT)

	(1) ZIP Codes Bordering River	(2) One ZIP Code Away from River	(3) Two ZIP Codes away from River
Population	3,561	1,053	1,054
	(4,077)	(1,373)	(719)
Area (in sq. miles)	50	36	32
	(44)	(27)	(14)
Population Density	78	35	33
	(50)	(30)	(15)
Occupied Units	1,507	443	452
	(1,749)	(570)	(313)
Median Year Built	1,969	1,973	1,975
	(11)	(8)	(7)
Median Value	187,070	217,991	215,041
	(66,738)	(71,756)	(86,754)
Median Gross Rent	823	915	887
	(144)	(308)	(218)
Average Household Income	64,452	71,379	68,166
	(17,665)	(19,817)	(16,817)
Average Family Income	76,964	82,293	81,597
	(24,745)	(25,504)	(22,328)
Per Capita Income	28,235	31,438	30,478
	(6,541)	(9,790)	(8,457)
Real Estate Value Per Sq. Mile	5,562,335	3,449,085	2,903,177
	(3,915,766)	(2,950,503)	(1,329,617)
Observations	23	34	37

Standard deviations in parentheses;
all values in 2015 dollars.

Data for both states are from the 2015 five-year estimates from the American Community Survey.[28] On average, ZIP codes that border the river are larger in population and area compared to ZIP codes further from the river in Vermont. While the first two ZIP codes in New Hampshire, the more populous state, have similar populations, the ZIP codes along the Connecticut River in Vermont tend to have over 2,000 more residents than contiguous codes and over thirty more people per square mile. Income characteristics are also reported as well, which can be used as a helpful control. Areas with higher incomes will likely be correlated with higher property value. Therefore, controlling for per capita income can help correct for an upward bias in home prices. Most home construction across the ZIP codes occurred in the early to mid-1970s for both states.

Table 2: Descriptive Statistics for ZIP Code Specifications (NH)

	(1) ZIP Bordering River	(2) One ZIP Away from River	(3) Two ZIPs away from River
Population	3,381	3,900	2,052
	(3,272)	(5,619)	(1,891)
Area (in sq. miles)	40	63	41
	(20)	(34)	(21)
Population Density	103	65	69
	(109)	(91)	(67)
Occupied Units	1,543	1,985	1,331
	(1,386)	(2,406)	(922)
Median Year Built	1971	1974	1974
	(7)	(11)	(9)
Median Value	212,605	180,670	231,390
	(98,583)	(43,812)	(63,655)
Median Gross Rent	933	877	926
	(276)	(231)	(177)
Average Household Income	78,558	71,663	75,702
	(31,741)	(16,556)	(15,957)
Average Family Income	91,758	83,606	88,330
	(38,096)	(19,120)	(19,043)
Per Capita Income	32,332	30,047	33,304
	(11,804)	(6,955)	(7,555)
Real Estate Value Per Sq. Mile	6,996,521	4,303,928	5,881,415
	(6,800,234)	(5,006,811)	(6,167,871)
Observations	21	20	19

Standard deviations in parentheses;
all values in 2015 dollars

A few variables had to be constructed before statistical analysis. Comparing median home prices between ZIP code specifications is likely biased since the urban ZIP codes along the Connecticut River likely have lower median home prices with a population of lower socioeconomic status. This would have shown that living farther from the river results in a higher home value. However, the value of the land is more important, and can be calculated by multiplying the average home price within each ZIP code by the number of households.[29] After finding the aggregate value real estate within each ZIP code, it is also possible to determine the value per square mile by dividing the aggregate real estate value within each ZIP code by the size of area. Log transformations were also completed in order to deal with heteroskedasticity and normalize the positive skew often observed with income and real estate pricing.

A simple ordinary least squares (OLS) linear regression model was implemented to examine the effect of the Connecticut River on real estate value, population, and income. Unfortunately, this study is only presenting information to serve as a benchmark, and does not prove causality. Regardless, real economic data synthesis is an important step for policymakers attempting to understand economic value of environmental resources.

In order to examine the economic impact of ZIP codes close to the river, a variety of dependent variables were examined. Equation (1) displays the basic model that will be tested:

$$(1)\ y_i = \alpha + \beta County\_Specification_i + \delta_i + \varepsilon_i$$

With dependent variable *y* of ZIP code *i, County_Specification* is an indicator variable that equals zero if the ZIP code is in the first specification by bordering the river, one if the ZIP code is in the contiguous specification (one ZIP code away from the river), and two if the county is adjacent to a contiguous county (two ZIP codes away from the river). The equation also includes a set of controls for income (δ_i), which is used in some of the regressions.

Table 3 presents the results in Vermont from six different regressions, on six different dependent variables, while Table 4 shows this information for New Hampshire. In Vermont, all tests were highly statistically significant and large in magnitude. The results for the Green Mountain state can be summarized as follows. In the first regression, the density of a ZIP code is predicted to decrease by over 20 people per square mile as one moves farther away from the river. The second regression (second column) predicts that each ZIP code farther away from the river leads to a drop in $78 million ZIP code real estate value. The third regression finds similar results, where the land value per square mile decreases by $1.4 million per square mile for ZIP codes farther away from the river. For instance, if a ZIP code bordering a river was worth $5 million per square mile, one would estimate the eastern bordering inland ZIP code in Vermont would have a value of $3.6 million per square mile, and the inland bordering ZIP that is two ZIP codes from the river would be predicted to have a value of $2.4 million per square mile. The log transformation in the fourth regression (fourth column) also shows how this is statistically significant using percentages, where ZIP codes farther away from the river decrease by 22 percent on average.[30]

Similar significant results were found for income in Vermont as well. The fifth regression estimates the effect of aggregate income based on its geographic ZIP code specification. ZIP codes on the Connecticut River have over $33 million in higher income. For instance, a ZIP code along the river is expected to generate over $30 million more in income than an adjacent zone that does not border the river. Even after considering heteroskedasticity with a log transformation, ZIP codes not bordering the river were estimated to have 33 percent lower total income (column 6). Obviously the river corridor is not the only cause for higher incomes.

Table 3: Regression Results (VT)

	(1)	(2)	(3)	(4)	(5)	(6)
	ZIP Code Density	ZIP Land Value	Land Value per sq. mile	Percent Change in Value	Aggregate ZIP Income	Percent Change Income
ZIP Specification	-20.71***	-77.98***	-1.395***	-0.220**	-33.59***	-0.338**
	(5.053)	(25.63)	(0.356)	(0.0913)	(11.48)	(0.129)
Per Capita Income		0.00315	0.000142***	4.22e-05***		
		(0.00206)	(3.11e-05)	(8.09e-06)		
Constant	68.72***	125.1*	1.050	13.81***	87.30***	17.50***
	(8.528)	(67.59)	(0.971)	(0.324)	(19.46)	(0.218)
Observations	94	94	94	94	94	94
R-squared	0.197	0.156	0.288	0.193	0.137	0.063

Robust standard errors in parentheses, clustered around ZIP Codes.
*** p<0.01, ** p<0.05, * p<0.1
Note: The coefficients of specifications 2, 3, and 5 are in millions of dollars.

While regression outputs for New Hampshire properties show the same negative sign, few were statistically significant, even at the 10 percent level. This says that moving farther from the river could reduce property values, but not with enough confidence to suggest that the reduction is not attributable to the chance of our data sample. However, regressions five and six in Table 4 are significant at the ten percent level, meaning that a ZIP code along the river nets over $18 million more than a ZIP code not along the river (at the ten percent level). This represents a 23 percent income reduction moving across each contiguous ZIP code away from the river.

These results were estimated using linear or log-linear approximations. It is important to note that the actual estimation is likely non-linear, since housing prices or total income per ZIP code never fall to zero. Regardless, these estimates are useful at providing guidelines for estimating the community value-added effect of the river.

In terms of real-estate value added, the ZIP codes bordering the river in Vermont are worth $2.8 million more per square mile.[31] With 1,150 square miles in the ZIP code specification that borders the Connecticut River, the river adds $3.2 billion in value added to real estate prices per year in that state. This assumes that no other factors affect the real estate between the ZIP code specifications, which is likely untrue due to differences in land, infrastructure, and established communities. Regardless, it is a helpful comparison in order to understand the magnitude, and correlation between ZIP code real estate prices and distance from the river. We do not calculate this value for the 844 square miles of ZIP codes area we examined along the New Hampshire side of the border due to our non-significant regression result. Fewer observations and less variation between aggregate home values in New Hampshire help explain our non-significant regressions. However, the sign and large magnitude of our coefficient on ZIP land value suggests that the river indeed adds additional property value to the Granite state as well.

In terms of annual income, one could assume that all ZIP codes in both states have similar means at generating equal incomes, especially ones that border each other. This is not the case in reality, whereby the ZIP codes along the river earn almost double compared to neighboring ZIP codes. There are many reasons why ZIP codes closer to the Connecticut River earn more money, such as access to Interstate 91, more urban infrastructure, or distance to major employers. Residents of higher socioeconomic status self-select into living in aesthetic locations along the river as well. However, one possible reason could be the impact of added value from businesses along the river providing tourism and cultural access to the Connecticut River. In Vermont, ZIP codes bordering the river generate over $70 million more in annual income compared to the other ZIP code specifications. With 23 ZIP codes bordering the river, the Connecticut River is estimated contribute to $1.6 billion in added annual income.[32] For the 21 ZIP codes we examined in New Hampshire, the Connecticut River contributed an estimated $37 million in added annual income.[33] This amounts to $782 million in additional income for the state annually. Obviously this does not explain causation, but correlation. Our results demonstrate that ZIP codes of both states that border the river have significantly higher annual income and higher property values in Vermont.

The analysis below does not account for the value of existing commercial property along the river, which ranges from marinas to farms. However, unlike residential properties, whose value increases from the amenities of the river, aesthetic location less directly impacts the value of a production plant or a farm. A more thorough analysis may still consider such locations. While many commercial plants no longer actively engage in manufacturing, some industrial plants and large buildings take advantage of the river and add value to the state coffers.

Table 4: Regression Results (NH)

	(1) ZIP Code Density	(2) ZIP Land Value	(3) Land Value per sq. mile	(4) Percent Change in Value	(5) Aggregate ZIP Income	(6) Percent Change Income
ZIP Specification	-17.57 (14.20)	-19.360 (27.94)	-0.64 (1.04)	-0.14 (0.14)	-18.64* (11.37)	-0.23* (0.12)
Per Capita Income		0.0014311 (0.001724)	0.000142* (0.000065)	0.0000187* (0.000011)		
Constant	96.59*** (21.07)	184.35** (69.94)	2.97 (2.12)	14.70*** (0.41)	110.63*** (20.30)	18.15*** (0.17)
Observations	60	60	60	60	60	60
R-squared	0.0249	0.0095	0.0319	0.051	0.0185	0.044

Robust standard errors in parentheses, clustered around ZIP Codes.
*** p<0.01, ** p<0.05, * p<0.1
Note: The coefficients of specifications
2, 3, and 5 are in millions of dollars.

4.2 Tourism and Recreation

Approximately 97 percent of the United States population participates in some form of outdoor recreation every single year.[34] As tourism for recreation purposes has increased in America, it is important to understand the value individuals place on natural resources.[35]

Previous research in Vermont has used a variety of techniques to try to quantify the effect of tourism and recreation. Sonter et al. recently used geo-tagged photos uploaded to Flickr to estimate visits by in-state and out-of-state visitors in Vermont. They found that visits to conserved land in Vermont contributed around $1.8 billion to the tourism industry in Vermont between 2007 and 2014.[36] Sonter examined the effect on conserved lands, which is a similar environment to the Connecticut River.

Previous literature has also just focused on just valuing the impact of tourism and recreation to rivers. Shrestha, Stein, and Clark found that the average visitor would pay over $74 to visit the Apalachicola River conservation region in Florida.[37] The research was completed using the travel cost method to analyze recreation demand.

Previous research in New Hampshire has also used a variety of techniques to try to quantify the effect of tourism and recreation. Studies from the Institute for New Hampshire Studies at Plymouth State University analyze the state of tourism and recreation in New Hampshire annually in what they call a “travel barometer” by analyzing visitor counts and spending, rooms and meal sales, employment in tourism sector, business travelers, entertainment and amenities, Saturday traffic counts, weather, and leading indicators.[38] They found that 2015 was the best year for tourism in New Hampshire in the past two decades.[39] As the literature above described, rivers and bodies of water are important contributors to tourism and recreation revenues in the area.

In New Hampshire, outdoor recreation generates over $4.2 billion in annual consumer spending, and this attributes to $239 million in annual tax revenues.[40] This is estimated to support 49,000 jobs in New Hampshire and $1.2 billion in wages and earned income. Using data from the flow rate of the Connecticut River, Loo et al. estimated the recreational value of waterways, such as the Connecticut River. The research developed a hedonic pricing model to examine how angling expenditures changed based on historic river flow.[41] The research found that the Connecticut River Watershed contributes $175 million in recreational fishing expenditures per year. The research questions further river diversions, since they would lead to a larger reduction in economic productivity in the recreation sector.[42] If future stream flow continues to decrease at the current rate, the loss of large bodied sport fish, such as trout, could lead to large disruptions and negative consequences for angling based recreation in the entire watershed.[43]

The Connecticut River serves as a source of hydroelectricity, which can conflict with the recreational gratification of Vermont and New Hampshire citizens. Recreation that the river provides includes boating, swimming, angling, and many other leisure activities. Vermonters spend nearly a third more than the average visitor on outdoor recreational activities during their travels within the state, and Vermont and New Hampshire residents participate in more outdoor recreation activities than residents in neighboring states.[44] Among the most popular activities are hiking (44 percent), kayaking and canoeing (37 percent), cross-country skiing (26 percent), snowshoeing (16 percent), and overnight backpacking (nine percent).[45] Additionally, outdoor recreation is growing faster in New England than any other region in the country.[46] New Hampshire certainly shares this outdoor enthusiasm, and the Outdoor Industry Association asserts that outdoor recreation generates nearly 50,000 jobs in the Granite State[47]. Both states attract significant numbers of visitors to skiing locations, which are mostly located at the margins of the watershed and are related to the presence of the Connecticut River.[48] The participation in recreation is not just limited to locals, but also attracts travelers to the region.

It is clear that aquatic recreational activities of the Connecticut River generate revenue for both states. River recreation in Vermont is a $109 million business, producing $5.5 million in tax revenues (measured in 2004 dollars).[49] Across the river, New Hampshire's water-based recreation amounts to $1.2 billion per year (in 2003 dollars).[50] On average, visitors to the Connecticut River specifically tend to spend more per person per day ($102 in 2000 dollars) than similar people who travelled to the New England region as a whole ($96) or to the state of New Hampshire ($89).[51] Vermont visitors spent an estimated $1.04 million in the Upper Valley in 2000.[52]

Due to the revenue that the Connecticut River provides to the state, it is important to consider maintaining the beauty of the river and attraction that this geographic landmark has on visitors. According to the Connecticut River Joint Commissions, the Connecticut River Valley comprises 10 percent of the outdoor recreation travel to the New England region in 2000, with

22 percent of that recreation travel occurring on the Vermont side the river and the remainder on the New Hampshire side.[53] If the total estimated spending value of outdoor recreation visitors was $1.04 million, then the Connecticut River generates $104,000 in tourist expenditures (10 percent of the $1.04 million estimate), and $22,880 went to Vermont (22 percent of the river revenue) while $81,120 went to New Hampshire.[54] Though this number is small, this is just the money spent by travelers on either side of the river from outdoor recreation. The economic impact that these recreational resources have on the state have been found to be linked to the cleanliness of the river. In fact, 92 percent of outdoor recreation business respondents stated that constant improvements to the cleanliness of the Connecticut River water is important to their business.[55]

The recreation/tourism value of the Connecticut River can be determined by first finding ten percent of the combined $1.31 billion in aquatic-related recreational activity to the states annually.[56] This number, $131 million, represents the share of recreational activity specifically attributable to the Connecticut River, of which $28.82 million (22 percent) belongs to Vermont and $102.18 million (78 percent) belongs to New Hampshire.[57]

4.3 Fishing

In New England, Loo et al. demonstrated the economic importance of fishing in the entire Connecticut River Watershed. Using data from the flow rate of the Connecticut River, fishing intensity, and expenditures from anglers in Connecticut, they approximate the recreational value of the Connecticut River.[58] The research found that the Connecticut River Watershed contributes $175 million in recreational fishing expenditures per year. And these expenditures likely have a multiplier effect, which leads to increased economic activity due to angling based tourism.[59] If future stream flow continues to decrease at the current rate, the loss of large bodied sport fish, such as trout, could lead to large disruptions and negative consequences for angling based recreation in the entire watershed.[60]

When exploring the value of fishing, travel costs and travel spending measures of valuation are futile because the majority of fishers are local residents that are not tourists travelling to New Hampshire or Vermont. Instead, the data related to flow rate, fishing intensity, and expenditures made by fishers are better heuristics to showcase the recreational value of rivers in economic terms while avoiding the weaknesses of the most commonly used tools such as the contingent valuation method.[61] Using Loo et al. estimates, recreational fishing expenditures were estimated at $175 million. It was also estimated that this revenue generates $206.8 million in supply chain revenues every year that provide 4,626 jobs to Vermont, New Hampshire, Massachusetts, and Connecticut.[62]

Employment from the fishing industry of the river include direct jobs like recreation guides, food, lodging, retail, and boat charters in addition to indirect jobs created from the heightened economic activity from the fishing based tourism.[63] Investments overseeing the health of the Connecticut River, like flow restoration can have large potential pay-offs because fishing and other wildlife activities are dependent upon river flows across New Hampshire, Vermont, Massachusetts, and Connecticut. Fishing is just a small portion in terms of the huge impact that wildlife has on the economic value that the ecosystem of the Connecticut River brings to Vermont.

Wildlife-related recreation expenditures totaled $554 million in New Hampshire in 2011 based on the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.[64] According to the Fish and Wildlife Task Force in 2012, wildlife related activities generated $386 million to the economy of Vermont.[65] These estimates are not as impactful on this project since they don't relate to the Connecticut River like earlier data. Nonetheless, the huge amount of revenue that wildlife activities generate is a signal that the investment in maintaining the health of the Connecticut River is would potentially assist the economies of Vermont and New Hampshire in the long run. With five states sharing the fishing recreation value in Vermont, the state likely captures 20 percent of all fishing expenditures. Therefore, the total value of fishing recreation to both states is estimated to be approximately $35 million annually, or 20 percent of recreational fishing expenditures estimated by Loo et al ($175 million). However, with the prospect of extended droughts and increased variation in river flows, difficult choices will occur in the future between dam management and river flows.[66]

4.4 Managed Resources

The next value factor we evaluate are managed resources along the Connecticut River. This section includes the value of hydroelectric dams and water withdrawals from reservoirs.

4.4.1 Dams

The first, largest, and most easily quantifiable of these managed resources is the hydroelectric impoundments along the river, the value of which covers both states. There are eleven hydroelectric dams along the portion of the Connecticut River. Two of these dams, the Lyman Falls and the Wyoming Dam have been breached and therefore have no hydroelectric value to the state.[67] There are also other dams that are not used for hydroelectricity. Some of these non-hydroelectric dams include Moose Falls Flowage and Murphy Dam. Other dams are managed by the U.S. Army Corps of Engineers for flood control. These dams may provide added recreation value from the reservoirs or added value from flood control; however, the value added will be excluded from this section, which focuses on hydroelectricity.

The nine fully functional hydroelectric dams range from the Canaan Dam in Canaan, Vermont, which is the lowest-producing dam on the river, to the 15-Mile Falls Project, which is comprised of three dams and, when run together, is one of highest energy producing projects in all of New England.[68] The simplest method for valuing these dams on an annual basis is to take valuations that have been determined by public tax assessments or during transactions. Mindful of differing property tax rate between the two states, this report finds both the Vermont and New Hampshire annual tax revenue from the dams (outlined in Table 6). To construct an additional relevant measure of valuation, we estimated the electricity generation from each dam per year and multiplied it by the average electricity rates in Vermont. The rate we use is 14.24 cents per kilowatt-hour, which comes from the US Energy Information Administration.[69] Table 6 presents the results from both metrics used to assess the value of dams.

Table 6. Hydroelectric Connecticut River Dams

Name	Location	Annual Output	Vermont Assessed Value/ Annual Taxes[70]	New Hampshire Assessed Value/ Annual Taxes	Value of Electricity Annually
Canaan Dam	Canaan, VT/Stewarts-town, NH	7.3 Gigawatt-Hour[1]	$3,123,400* $49,849 taxes annually	$3,123,400** $68,746 taxes annually	$1,039,520
Lynman Falls Dam	Bloomfield, VT/ North Stratford, NH	0 GWh	$0	$0	$0
Wyoming Dam	Guildhall, VT/ Northumberland, NH	0 GWh	$0	$0	$0
Gilman Dam	Lunenburg, VT/ Dalton, NH	25 GWh[1]	$1,876,000* $30,000 taxes annually	$300,000 $6,600 taxes annually[71]	$3,560,000
15-Mile Falls Project	Waterford, VT/ Grafton County, NH	662.95 GWh[1]	$86,000,000 $1,520,000 taxes annually	$200,000,000 $3,788,000 taxes annually[72]	$94,404,080
Dodge Falls Dam	Ryegate, VT/ Bath, NH	26 GWh[1]	$1,240,000* $22,000 taxes annually	$1,240,000** $23,486 taxes annually	$3,702,400
Wilder Dam	Hartford, VT/ Lebanon, NH	158.47 GWh[2]	$32,400,000 $750,000 taxes annually	$44,900,000 $1,263,000 taxes annually	$22,565,985
Bellows Falls Dam	Bellows Falls, VT/ North Walpole, NH	248.9 GWh[2]	$108,360,000 $2,015,000 taxes annually	$20,640,000 $384,000 taxes annually	$35,441,508
Vernon Dam	Vernon, VT/ Hinsdale, NH	168.85 GWh[2]	$30,500,000 $567,000 taxes annually	$75,000,000 $1,440,000 taxes annually	$24,043,900
Total	-	**1,297.46 GWh**	**$284,139,400 $4,953,849 taxes annually**	**$345,203,400 $6,973,831 taxes annually**	**$184,757,393/year**

The 15-Mile Falls Project includes the Moore Dam, Comerford Dam, and McIndoe Falls Dam combined. Sources: (1) Low Impact Hydropower Institute,[73] (2) TransCanada[74], *VT Grand Lists, **Assessed values for Canaan and Dodge Falls dams duplicated from VT side due to lack of data.

Turning to annual tax revenue, the Wilder Dam contributes $750,000 in annual taxes to the town of Hartford and about $1.2 million to the town of Lebanon, NH in annual taxes.[75] This represents nearly six percent of the total tax revenue for Hartford, but less than one percent of Lebanon tax revenue.[76] Another example is the Bellows Falls dam. In 2012, the total value of the dam was assessed at $129 million.[77] The share from Vermont includes 84 percent of the total value, which is $108 million.[78] With a 1.86 percent implied tax rate, the dam provides over $2,000,000 in annual tax revenue. Furthermore, the Vernon Dam was recently assessed at $30.5 million for the state of Vermont and $75 million for New Hampshire.[79] Similarly, the dam generates hundreds of thousands in tax revenue dollars every single year. The 15-Mile Falls Project includes three TransCanada Dams (Moore, Comerford, and McIndoe Falls). The Comerford and McIndoe dams were valued at $48 million in 2012.[80] And the Moore dam is valued at nearly $37 million.[81] Together, this represents the $86 million reported in Table 6 above.

In total, the real value of assessed dams along the Connecticut River is equal to $284 million in Vermont and over $345 million in New Hampshire, combining for nearly $12 million in tax revenue annually to both states combined. Furthermore, these dams provide millions in tax revenue to the state every year from electricity production. Another important facet is the value of the electricity the river generates every year. The table above indicates that New Hampshire and Vermont citizens pay nearly $200 million annually for hydroelectricity from the Connecticut River. It is important to consider the costs saved from using hydroelectricity versus coal or natural gas. Once constructed, generating hydroelectricity produces no fossil fuels, and clearly reduces the carbon dioxide emissions in both states.

Our analysis is a crude estimate because it does not take negative environmental impacts into the equation, as hydroelectric dams cause increased methane production and a rise in water temperature. Contaminants, sediment, and toxic substances can also accumulate due to the slowed water flow. Nonetheless, it is clear that there is an immense value in the electricity generated by the dams of the Connecticut River and the tax revenue they kick off annually to both states.

4.4.2 Water Withdrawals

The next managed resource is reservoirs. While the majority of the water supply for both states comes from the tributaries of the Connecticut River, there are many reservoirs on the Connecticut River itself. Three reservoirs are part of the 15-Mile Falls Project, and each of these has over one billion cubic feet of water.[82] There are also reservoirs at other hydroelectric plants along the river, in the Gilman Hydro Plant and Dodge Falls Hydro Plant.

The methodology to determine the value of water withdrawals to the state is similar to that of the dams, as you multiply the average cost per gallon of water by the amount of water withdrawn. The 2008 Municipal Water Rate Census in Vermont reports the average cost of 5,000 gallons of water to be worth $41.85.[83] This represents a value of $8.37 per 1,000 gallons. According to a report on water withdrawals and use in, the Upper Connecticut and Middle Connecticut Watersheds account for 2.85 million gallons per day in withdrawals.[84] This would generate

$23,855 in daily revenues and $8.7 million per year, a collective value because the water serves both states. However, it is important to note how this only takes into account two watersheds along the river, while most water withdrawal occurs along tributaries to the Connecticut River, such as the West River or White River.

4.5 River Health

The Connecticut River serves as a perfect example of the trade-offs required for policy makers and resource managers when it comes to the complexities of prioritizing competing needs. As previous sections have detailed, the river generates economic value for real estate, income, recreation, consumptive activities, and electricity. All of these economic activities can be taxed, and benefit state coffers. Nonetheless, governments also face trade-offs with the competing needs to conserve a resource. One could choose to develop the bank of a river, which might boost economic value in the short term; however, there is a tradeoff of increased river pollution, erosion, loss of flood mitigation, and depreciation of intrinsic or cultural value. These discrete differences need to be understood. Protecting a river from economic development can also create monetary value, especially from preventing pollution.

Keeler et al. examined how water quality and clarity contribute to benefiting many coincidental environmental services including recreation and human health.[85] For Lake Champlain, Voight et al. estimated that a one-meter increase in water clarity represented more than a 30 percent average increase in seasonal home value.[86] Voight used a linear regression model to estimate that a one-meter increase in water quality led to a ten percent decrease in lodging room expenditures for just the month of August. The economic effects of a boost in water quality, leading to higher visitation, produced increased labor income and economic output.

These evident economic implications from water pollution were applied to the waters of New Hampshire in a 2007 report by Nordstrom, "The Economic Impact of Potential Decline in New Hampshire Water Quality: The Link between Visitor Perceptions, Usage and Spending."[87] Using data from residents of New Hampshire, 400 public and quasi-public water access points to over 12,000 miles of river, the report concluded the annual economic loss in water-related sales revenue in 2007 dollars due to decreased water quality was $126,602,188.[88]

Pollution is not just relevant for recreation, but also important to consider due to federal and state fines. Although there are only a few recent examples of enforcement penalties on the Connecticut River against Vermont, it is helpful to observe methods of enforcement by the Environmental Protection Agency (EPA) on similar bodies of water in neighboring states to estimate the potential cost to Vermont if environment issues occur. On December 1, 2016, the Massachusetts Department of Environmental Protection (MassDEP) executed a Consent Order with a $91,831 penalty for Southbridge Recycling and Disposal Park for solid waste, wetlands and air quality violations at the Southbridge Landfill near the Quinebaug River.[89] Later that month on December 30, 2016, MassDEP also issued a Consent Order with a $9,475 Penalty at a water discharge facility in Norfolk contributing to point source pollution.[90] Directly related to the Connecticut River, on November 24, 2016, MassDEP entered a consent Order with a $14,089 penalty against the town of Montague Water Pollution Control Facility in Montague.[91] This violation occurred due to discharge of sewage from the Water Pollution Control Facility of Montague to the Connecticut River. Collectively, these cases showcase the potential cost the region for polluting. Potential costs and fees in the past have ranged from $9,475 up to $91,831. Therefore, it is clear that mitigating pollution can prevent an economic burden for both states.

Focusing on Vermont, the EPA website allows for state-by-state observation of enforcement actions for the past fiscal year. Using this data, there were five enforcement cases that occurred in 2015 in the state of Vermont due to private companies violating the Clean Water Act. In June, the Davey Oil Company was found to not have a fully implemented Spill Prevention Control and Countermeasure (SPCC) plan, leading to a penalty of $85,100 in total compliance costs. In August, the Kocher Dump Superfund Site created environmental damages valued at $174,000 in penalties for improper waste dumping. Also in August, the Swan Valley Cheese of Vermont LLC was fined $130,000 after a release of ammonia and other dangerous pollutants from their facilities. In March, Dorr Oil Company Inc. was penalized at $50,500 for deficiencies in their SPCC plan for oil pollution prevention regulations. Earlier that same month, St. Albans Gas and Light Company received a penalty of $41,694 due to contributing pollution to a superfund site. In sum, these five cases total to a valued $566,394 in environmental damages, which is comparable with the data of past years that also averaged out to around $500,000 in penalties. Thus, if the status quo persists and no further actions are taken by Vermont to deal with water pollution, than an annual average of $500,000 in penalties will occur. These penalties reflect the valued damage to the water quality of Vermont and serve as a cautionary tale for additional penalties that polluters might face in New Hampshire—in 2008 even the Keene wastewater treatment facility faced a $58,000 fine for negligence.[92] Over the ten years between 1999 and 2009, New Hampshire logged $11,240,000 in fines for pollution, equivalent to $1.12 million per year.[93]

4.6 Flooding

When discussing the benefits of rivers, it is also important to consider the costs. Rivers can destroy economic value through flooding. Floods cost over $7 billion in damage and lead to or cause up to 80 fatalities on average each year in the United States.[94] Inland flooding is also a potential risk that is altered by many community factors when it comes to floodplain management.[95] Hurricane (Tropical Storm) Irene is estimated to have caused $1.3 billion in damages to New Hampshire and Vermont along the Connecticut River watersheds.[96] Keeping river corridors undeveloped, and allowing the natural process of a river to occur can reduce erosion and flooding risks; however, these conservation techniques often contradict many standard forms of development.

Watson et al. estimated the economic value of flood mitigation in the floodplains and wetlands near Middlebury, Vermont.[97] The analysis indicated that flood mitigation services from wetland protection provide over $126,000 in annual avoided damage. Furthermore, the wetlands reduced the flooding cost of Hurricane Irene by over 84 percent in Middlebury. These large economic magnitudes highlight the importance of considering floodplain management when it comes to land use changes.[98]

Freely flowing rivers can reduce the impacts of severe storms and flooding, however floodplains have undergone widespread loss due to human influence in river geomorphology.[99] Other studies on New England flood prevention have looked into stakeholder-engagement when it comes to evaluating alternatives for addressing community flooding vulnerabilities.[100] Loos and Rogers examined ecosystem based adaptation techniques, which use natural infrastructure or capital to improve the resilience of the river to future flooding. Running workshops with stakeholders in the Connecticut River watershed, they found that there were strong preferences for some ecosystem based adaptation techniques, which are often considered socially infeasible.[101]

Hurricane Irene is estimated to have cost Vermont $700 million in damages, with over 800 homes, 300 bridges, and 2,400 roads damaged.[102] The same storm cost New Hampshire about $11 million according to NPR.[103] Flooding damages can be mitigated extensively through the use of natural flood protection in river corridors. River corridors are the meander belt of a river and buffer of 50 feet around the belt. If the river has access to a meander area within its corridor, the dangers of flood erosion can be reduced dramatically.[104] Even if Hurricane Irene was a once in 100 year storm, paying $7 million in flooding damages annually would outweigh many of the other benefits water resources provide to Vermont.

4.7 Ecosystem Services

The Connecticut River is the largest watershed east of the Mississippi River, and the lands conserved along the Connecticut River Watershed provide valuable natural goods to New Hampshire and Vermont such as carbon sequestration, wildlife habitats, nutrient cycling, biodiversity, and pollution removal.[105] The New Hampshire Trust for Public Land believes that every $1 invested in land conservation returns over $11 in economic value in ecosystem services.[106]

In New England, river watersheds have constantly dealt with the burdens of nitrogen pollution and eutrophication due to non-point runoff. Berg, Mineau, and Rogers focused on examining the financial burdens on the Great Bay Estuary in New Hampshire. Using hydrologic, biophysical, and economic multiplier models, the research suggests that the net present value of increased conservation of the estuary is worth up to $3.5 million.[107] Talberth et al. examined avoided cost methods in Sebago Lake, Maine. They found that investing in green infrastructure to improve ecosystem services could save up to 71 percent of the cost of water filtration infrastructure.[108]

Forestry, agriculture, and commercial fishing industries depend on river ecosystem services such as water quality and nutrient cycling. In New Hampshire, it is estimated that forestry, agriculture, and fishing related processes generate $2.5 billion in output annually and support over 18,000 jobs.[109]

Another important aspect of economic value is wildlife. MacDonald elicited citizen support for improvements in environmental quality. Using a willingness to pay method in the River Murray, he found that Australians were willing to pay over A$10 billion for better quality in water bird habitats.[110] Surprisingly, respondents who lived in the Australian Capital Territory were willing to pay more than those who lived closer to the river. This is important to consider, since when it comes to valuing the wilderness of the Connecticut River, it is not only those in the direct vicinity of the river who are willing to support higher taxes to improve the health of the river.

The Connecticut River provides 70 percent of all fresh water entering the Long Island Sound, and is home to federally threatened and endangered species including the shortnose sturgeon, the piping plover, the puritan tiger beetle, dwarf wedgemussel, small whorled pogonia, and Jesup's milk-vetch.[111] The river is also home to bald eagles, peregrine falcons, and ospreys, which nest along its shores.[112] Recently, the Connecticut River was named the first National Blueway under President Obama in order to protect and popularize the most famous rivers in the country.[113] Ken Salazar, the Secretary of the Interior under Obama, announced that the "The Connecticut River Watershed is a model for how communities can integrate their land and water stewardship efforts with an emphasis on 'source-to-sea' watershed conservation."[114] Salazar also recognized that rivers like the Connecticut River, "are the lifeblood of our communities and power our economies."[115]

The extent of ecosystem services a river has makes valuing ecosystem resources almost impossible. Due to the degree of ecosystem services, and lack of peer-reviewed research along the Connecticut River, this report was unable to determine a fair value for the aggregate of ecosystem services along the Connecticut River. However, this is not to degrade the value that the Connecticut River corridor and wetlands provide through carbon sequestration, nutrient cycling, water purification, biodiversity, and wildlife habitats. Previous research has indicated that many citizens are willing to pay large aggregate sums to protect rivers, even for citizens who do not live nearby the river itself.[116] Therefore, one must consider these natural services in the decision making process of river development or conservation.

4.8 Intrinsic Value

Intrinsic values refer to non-use values of an environmental resource, which is the passive value the river possesses as an end-in-itself, and not from an instrument (such as value to the ecosystem or the economy). Instrumental values are often discussed from an environmental or cultural perspective. For instance, the Declaration of Independence has an instrumental value that one might try to pay to obtain the document, but also its existence has a historical intrinsic value for the fact that it is part of the culture of America. Furthermore, it has a bequest value, or a value for future generations. The Connecticut River is one of the fourteen American Heritage Rivers designated by President Clinton in 1998, due to its historical and cultural significance.[117]

It is important to consider the cultural resources of the Connecticut River, which are rooted in the natural and cultural history of Vermont. The history of the Connecticut River is one that dates back hundreds of years with settlement, industry, transportation, and commerce. All of which helped establish the Connecticut River Byway, filling the riverside with vital cultural river towns, historical buildings, antique theaters, and a wide range of festivals. The first step in assessing the intrinsic value is to create a list of every place of historical and cultural significance relating to the river. As seen in Table 7, a list of several of the most important cultural sites along the Connecticut River is provided.[118] The list includes everything from covered bridges, to Native American rock carvings, to a secret cave where Tories met in secret during the Revolutionary War. These sights are invaluable and irreplaceable to not just the state of Vermont, but to the natives of the state and cultural tourists who come to this region to explore the beautiful landmarks and rich history of New England. It is the unique placement of the Connecticut River that has spurred the creation of these cultural sites over time, and it is going to be the Connecticut River that continues to provide locals and travelers access to these sites. The continued maintenance of these cultural sites is an important method for ensuring the intrinsic value of these sites remains constant, continuing to invite tourism and protect the integrity of authenticity in the historic footprint of Vermont along the Connecticut River.

Table 7. Cultural and Historical Resources along the Connecticut River in Vermont

Cultural Site	Location	Description of the Site
Fort Dummer – Fort Dummer State	Brattleboro, VT	British fort built in 1724
Moore and Thompson Paper Mill Complex	Bellows Falls, VT	Major late 19th century industrial paper mill
Adams Gristmill	Bellows Falls, VT	Historical industrial building along the river
Rockingham Art and Museum Project	Bellows Falls, VT	Museum that hosts a series of festivals along the river throughout the year
Bellows Falls Petroglyph Site	Bellows Falls, VT	Site with pre-contact Native American petroglyphs
Tory's Cave	Springfield, VT	Secret Tory meeting place during the Revolutionary War
Barnet (Village)	Bradford Falls, VT	Historic, walkable town center and village green alongside the river
Old Constitution House	Windsor, VT	Where delegates met to form the Republic of Vermont in 1777
Fort at No. 4	Charlestown, NH	Northernmost British settlement along the river during the French & Indian War
Samuel Morey Memorial Bridge	Orford, NH and Fairlee, VT	Beautiful arched bridge with a 432-foot span and 85-foot arches
Wildner-Holton House	Lancaster, NH	One of the first two-story houses built in New Hampshire
Park Hill Meeting House	Westmoreland, NH	Beautiful colonial community church (1764)

Source: The Connecticut River Valley and Shoreline Travel Information. A selection of some, but not all, of the culturally and historically relevant resources along the river. [119]

5. CONCLUSION AND SUMMARY TABLE

The analysis undertaken in this report recognizes that there are several crucial sources of value that contribute to making the Connecticut River an asset to New Hampshire and Vermont. These values are summarized in Table 8 below. An aggregate value was not calculated since it is important to view each source of a value by itself. For instance, growth in development (and a subsequent boost in property value) may come at a cost of developing flood plains that would increase flooding in future storms. Furthermore, the development might impact the value of recreational resources or intrinsic value of the resource itself while revenue from pollution or dams mean environmentally disruptive processes are taking place on the river.

Table 8: Summary of sources of value and economic projections on an annual basis for the Connecticut River

Source of Value	Value Provided to VT	Value Provided to NH	Total
ZIP Code Property Value	$3.2 billion in value added to real estate prices	Additional value (non-significant)	At least $3.2 billion/year
ZIP Code Aggregate Income	$1.6 billion per year	$782 million per year[120]	$2.4 billion/year
Recreational Resources	$29 million per year	$102 million per year	$131 million/year
Fishing	$35 million per year (total both states)		$35 million/year
Hydroelectricity	$185 million (total both states)		$185 million/year
Hydroelectric Dam Appraisal Value	$5 million per year (taxes)	$7 million per year (taxes)	$12 million/year
Reservoirs	Over $8.7 million per year (total both states)		$8.7 million/year
Pollution Fines	Up to $500,000/year	Up to $1.12 million/year	$1.62 million/year
Flooding	Potentially Significant Costs		-
Ecosystem Services	Potential Monetary Conservation Benefits		-
Intrinsic Non-use Value	Historical, Cultural, Generational		-

The table indicates how property value and aggregate income or expenditure within ZIP codes bordering the river provide the largest sources of value. Even though regressions for the impact of the river on New Hampshire housing value resulted in non-significance, the river likely adds aesthetic value and recreational amenities to riverfront homeowners in the Granite state that policymakers should still take into account. Regardless, the causal assumptions in the property value scenario are not certain, and the value might not be derived directly from the river. Therefore, managed resources, such as hydroelectricity clearly provide a large direct annual value to both states. It is essential to consider potential costs through flooding, reduced ecosystem services, and pollution that could wipe out the value the river generates for property, recreation, hydroelectricity, or fishing. In terms of intrinsic value, the analysis from this report is unable to provide quantitative benefits for the value added per year of cultural and other historical resources directly attributed to the river. With proper river conservation techniques, Vermonters, New Hampshire residents, and travelers alike can continue to enjoy the resources of the Connecticut River and the state can receive the economic support it provides to various sectors and industries along the river.

APPENDIX: FIGURES AND TABLES

Figure A1. ZIP codes that Border the Connecticut River (Specification 1)

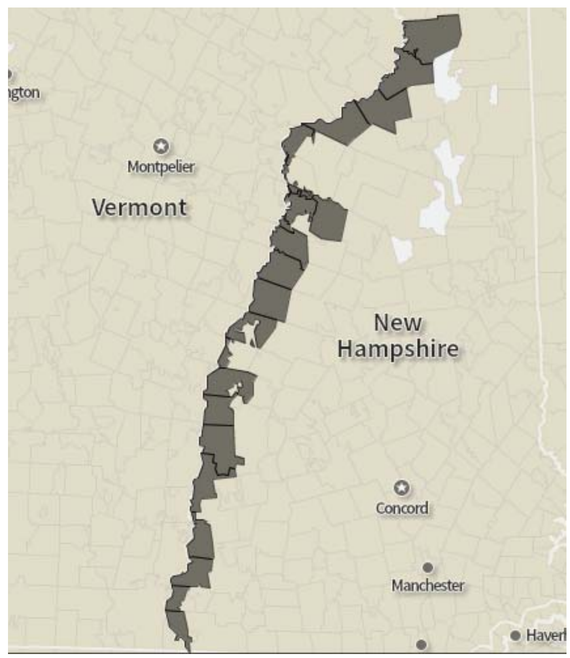
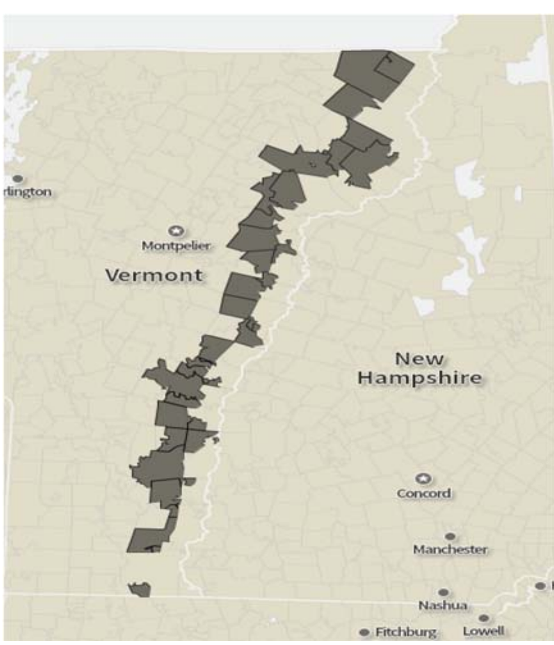


Figure A2. ZIP codes that are contiguous to the Connecticut River Border ZIP Codes (Specification 2)



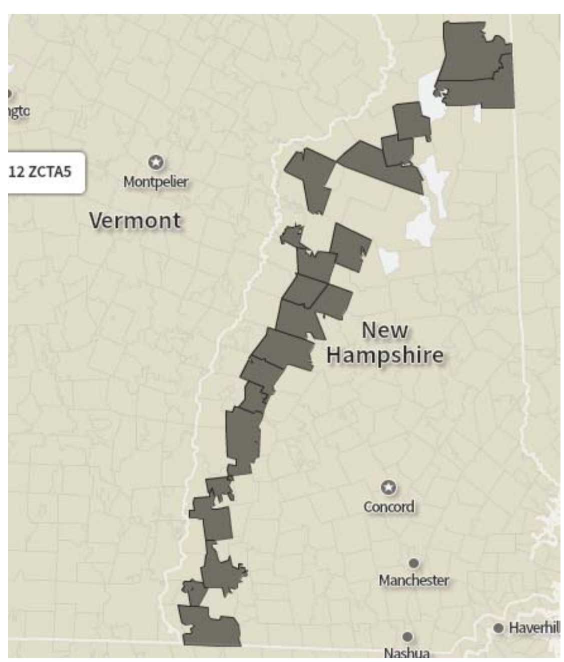


Figure A3. ZIP codes that border a contiguous ZIP code (Specification 3)

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[30] Using a log-linear model makes all interpretations be in terms of percent
[31] This was calculated by multiplying the coefficient in the third regression by two to find the average difference between the river and non-river (furthest) zip codes (1.39 * 2 = 2.8). Since the coefficients are in millions, we had to then multiply the result by 1,000,000.
[32] This would assume that individuals in these ZIP codes live and work within the same ZIP code.
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[55] Ibid.
[56] Ibid. If the Connecticut River valley represents 10 percent of outdoor recreation value in both states, then it represents about 10 percent of the aquatic recreation in both states. The combined recreation figure of $1.31 billion comes from $1.2 billion in activity attributable to New Hampshire and $109 million attributable to Vermont. Our approach differs from the previous report (Bernstein and Kosmidis) which finds the annual value of recreation to Vermont by finding 22 percent (VT's share) of activity in just that state.
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