The Impact of Wetlands Rules on the Prices of Regulated and Proximate Houses: A Case Study

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Abstract

Federal, state and local wetlands protection laws that restrict landowners' ability to develop their properties in certain ways could decrease the value of the affected properties. However, the regulations could also give benefits to nearby neighbors who no longer need worry about increased development in their area. Given that some properties may decline in value, while others increase, the impact on individual properties must be determined empirically.

This study uses a data set from Newton, Massachusetts to examine the impact of wetlands laws on the regulated properties, as well as on proximate properties. Looking at house sales data from 1988 through 2005, the hedonic technique is used to estimate the effect of wetlands regulations on single family home prices and finds that having wetlands on a property decreases its value by 4% relative to non-regulated properties. Homes that are contiguous to regulated houses do not experience any change in price. Thus it seems unlikely that neighbors are receiving any benefit from knowing that further development is restricted in their immediate vicinity.

JEL Classification Codes: Q51, Q53, R2

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Introduction:

Environmental regulations are put in place to protect human health as well as the health of various other species. These regulations can impose costs on various individuals and groups, but the laws are expected to give benefits as well. It is possible that those individuals who bear the costs are not the same as those who receive the benefits. In particular, federal, state and local wetlands protection laws that can restrict landowners' ability to develop their properties in certain ways could decrease the value of the affected properties. However, the regulations could also give benefits to nearby neighbors who no longer need worry about increased development in their area. In addition, the decreased supply of developable land should increase prices if demand remains strong in the area. Given that some properties may decline in value, while others increase, the impact on individual properties must be determined empirically.

There is little empirical evidence about the impact of wetlands regulations on residential properties. Guttery, Poe and Sirmans (2000) look at the impact of regulations in Louisiana on multifamily housing units, and find that properties that are regulated experience a decline in value of 10.5% relative to non-regulated properties. Other studies (cited below) look at the impact of proximity of wetlands on house values, and obtain mixed results. Netusil (2005) studies properties that are directly impacted, and finds no statistical effect; however her sample size is very small.

This leaves open the question of what is the impact of wetlands regulations on a single family residence, as well as what is the impact on nearby non-regulated houses. It is important to consider both questions, since wetlands regulations impact some properties in a town, but not others. In this way the regulations differ from other types of land use controls such as large lot zoning which are generally consistent throughout the town.

This study uses a data set from Newton, Massachusetts to address these two questions. Looking at house sales data from 1988 through 2005, the hedonic technique is used to estimate the effect of wetlands regulations on single family home prices and finds that having wetlands on a property decreases its value by 4% relative to non-regulated properties. Homes that are contiguous to regulated houses do not experience any change in price. Thus it seems unlikely that neighbors are receiving any benefit from knowing that further development is restricted in their immediate vicinity.

It is important to remember that when using the hedonic method to estimate the costs and benefits, we can only measure the private impacts on local homeowners. Our estimates will not include any costs or benefits born by anyone, or anything, else. Thus any public benefits or benefits to the ecosystem are not calculated here (see Brander, Florax and Vermaat (2006) for a survey of studies that value other aspects of wetlands).

This paper begins with a brief discussion of wetlands regulation in the United States, and then presents a review of the wetlands literature. The hedonic model is developed, and the data used to estimate the model are discussed. The estimation results follow.

Background:

The federal government regulates wetlands in the U.S. in an effort to preserve them as much as possible. The U.S. Environmental Protection Agency (EPA) and the Army Corps of Engineers (Corps), under the Clean Water Act (CWA), enforce these regulations. The CWA requires that landowners receive permission from the Corps before conducting dredging or filling activities on any land defined as a "wetland" or other waters of the U.S. States and localities can have stricter requirements on landowners in this aspect, and many do. Prior to issuing a building permit, landowners can be required to undergo an environmental review outlining the impact on the local area and its habitats if the wetlands were to be altered. Under wetlands regulations, it is more than human health and well-being that is considered; the ecosystem, including fish and wildlife, also must be considered (Guttery, Poe and Sirmans (2000)). The current regulations have been successful in slowing the draining of wetlands.

> According to a report issued by the National Wetland Inventory (*Status and Trends of Wetlands in the Coterminous United States 1986 to 1977*, U.S. Fish and Wildlife Service), the rate of wetland loss in the United States has decreased to an estimated annual loss of 58,500 acres (an 80 percent reduction compared to the previous decade). The Natural Resource Conservation Service's Natural Resource Inventory (NRI), reporting on the health of America's private lands, also shows significant reduction in wetland losses. The NRI found an average annual net loss of 32,600 acres of wetlands on nonfederal lands from 1992 to 1997 (a 58 percent reduction compared to the previous decade) (U.S. EPA 2000 National Water Quality Inventory).

As discussed in Kiel (2005), it is expected that land that has been regulated in this way should decrease in value, all else held constant, since its use is now restricted. If the owner wants to develop the property, either to build on it or to expand the existing structures, then they must go through the permitting process. This process on average takes 788 days (Sunding and Zilberman (2002)). Anyone who is considering purchasing the property will take this additional time, and the possibility that the use will be denied, into consideration and will incorporate these costs into the price they are willing to pay.

(Netusil (2006) refers to this as the 'development effect'). The empirical question is how much will the price of the property fall?

When considering the costs and benefits of wetlands regulations, the costs and benefits to the rest of society must be added to those felt by the individual who is directly impacted by the laws. In the case of wetlands regulations, it is therefore important to estimate the costs or benefits to the owners of the neighboring properties. If having regulated property contiguous to your property is perceived as a benefit, in that the property will not be developed or that the wetlands will not be disturbed, then the unregulated properties should increase in value (Netusil refers to this as the 'amenity effect'). In addition, if having regulated property in your neighborhood decreases the supply of developable land, then the non-regulated properties should increase in value (Beaton (1991)). The extent of the increase in value is an empirical question, and one that needs to be answered in order to calculate fully the private costs and benefits to an area that has regulated properties.

This study can only estimate the private costs and benefits of wetlands regulations as incurred by local homeowners. Any social benefits, such as increased water quality, flood control, or ground-water recharge cannot be captured by this study. Additionally, nonuse values cannot be estimated, although those values may be quite large (Stevens et al. 1995). This study can, however, look both at the impact on individuals whose properties are regulated and at those who are not directly impacted by the regulation, but who can benefit from it simply by being close to someone whose property is restricted.

Literature Review:

Surprisingly, given the extent of wetlands regulations in the U.S., there are only a few studies of the impact of the restrictions on residential properties. Other types of restrictions such as coastal area building restrictions have been studied (e.g. Frech and Lafferty (1984) and Parsons and Wu (1991)). The impact of wetlands on multifamily housing units was examined by Guttery, Poe and Sirmans (2000) who found that the sales prices of the units affected by the wetlands regulations fell by 10.5% relative to unregulated properties, a signal of the development effect. Their study is one of only two to control for wetlands on the property site itself. However they do not test for the amenity effect.

To study the effect of wetlands regulations on single family homes, Lupi, Graham-Tomasi and Taff (1991) used residential sales data from 1987 through 1989 in Ramsey County, Minnesota. Using the hedonic method described below, the authors included information on the house's structural characteristics, whether or not the house was next to a lake, the total lake acreage in the property's survey section, and the total wetland acreage in the property's survey section. The wetland data includes only wetlands over 2.5 acres, so not all will be included. In addition, the wetlands are only identified at the survey section level, but since more precise data were not available the authors felt it was the best alternative. Wetland acres per section were found to have a statistically significant and positive effect on property values, suggesting that having wetlands near the property yields positive benefits. They also report that the impact is larger in areas with lower wetland acreage. However, their study does not control for whether the property itself had wetlands on it, so we cannot determine if there was any development impact on the regulated property.

In another study of Ramsey County, Doss and Taff (1996) test whether distance to a wetland, and the type of wetland, impact house prices. In a regression where the house's assessed value is the dependent variable, independent variables include lot size, number of bathrooms, living area, age of the house, distance to the nearest lake and distance (and distance squared) to the nearest wetland, of which there are four different types. They are able to include distance because they employ the National Wetlands Inventory data base. The minimum distance is one meter, which is likely to be on the property itself, but their variable does not allow the impact to differ if it is on the property versus on a neighboring property. The authors find that home owners in Ramsey County prefer scrub-shrub wetlands, followed by open-water wetlands, and then forested wetlands. Again, the study does not control for the existence of wetlands on the property itself, but amenity benefits appear to exist. If there is a development impact, their measure of benefits may be incorrectly estimated.

Mahan, Polasky, and Adams (2000) estimated the value of wetland amenities in Portland, Oregon using sales data from June 1992 through May 1994. Included in their explanatory variables are the log of the distance to the nearest wetland, the size of the nearest wetland, and indicators for the type of the nearest wetland. The authors divide the Portland market into five areas since "[M]any residents perceive the segments as being distinctly different in character" (page 105-06). The econometric impact of this segmentation on the estimation of a single hedonic regression is not discussed further (see assumptions discussed below).[1] The wetlands variable is created using the National Wetlands Inventory, so again we cannot separate the wetlands that are on the property from those that on neighboring properties. The estimated coefficient on the log of distance is negative and statistically significant; increasing the distance to the nearest wetlands decreases the value of the house, all else held constant. Increasing the size of the nearest wetland increases the value of the house. Thus wetlands are seen as a positive amenity. Again, the authors do not control for the existence of wetlands on the property itself so the value may be combining both the development and amenity impacts.

Using a similar, but smaller, data set, Bin (2005) uses a semiparametric method to estimate a hedonic regression. He reports that being closer to an open water wetland increases property values, while being closer to an emergent vegetation wetland decreases property value. Thus he claims that whether or not wetlands are a positive or negative amenity depends on the type of wetland. Bin also includes indicators for five different sections of Portland and does not control for existence of a wetland on the property itself.

In a third study of Portland, Netusil (2005) includes environmental characteristics of the property itself (including wetlands, streams and tree canopy) along with characteristics of the surrounding area. She also controls for the two types of environmental zoning that Portland has created: the protection zone and the conservation zone, as well as other types of zoning. The five quadrants of Portland, as used by other researchers, are included, as are various interaction terms. The coefficient on having a wetland on the property is not statistically significant, so the existence of a wetland does

[1] In a later section of the paper, the authors estimate five separate hedonic equations, the results of which are used to estimate demand curves for wetlands size. However, since the authors were "unable to obtain meaningful second-stage results…. It is unclear whether separate markets truly exist…" (page 112).

not impact the sales price. However, since the environmental zoning for the property is also controlled for, and being affected by zoning is "a consequence of an amenity located on the property" (page 237), the zoning and wetlands measures are likely highly correlated and thus statistical insignificance of one is not unexpected. In addition, there are only 10 properties in the sample that have wetlands on them.

Netusil also finds that having a wetland within 200 feet of the property, and having a wetland within 200 feet to ¼ mile of the property, does not affect the property value, but again the number of affected properties is very small. Only when a wetland is ¼ to ½ of a mile from the property is price impacted, and it is lowered. Thus having a wetland farther away from the house is a negative externality. The author does not discuss whether theory would predict these results, or why her results are different from those of Mahan et al.

Glaeser and Ward (2006) look at house sales data from 2000-2005 in eastern Massachusetts. Their regression includes house characteristics such as number of rooms and lot size, town characteristics such as distance to Boston and average acres per lot, and year fixed effects. They also include an index of regulations that is the sum of three dummy variables, each of which takes on a value of one if the town has a rule that exceeds the states standard for wetlands, septic systems and subdivisions. The estimated coefficient on their index variable ranges from 0.071 to 0.101 and is statistically significant, thus the inclusion of such a regulation increases the price of a house by seven to ten percent. This approach assumes that the impact of each of the three types of regressions is the same; however wetlands regulations will impact only some of the homes in the town where as septic rules are the same for all homes. Their results do not allow us to consider the development or amenity effect of wetlands regulations.

Although they do not study house prices directly, there are two papers that examine the impact of wetlands regulations, as well as other types of land use controls, on residential development. The first, by Glaeser, Schuetz, and Ward (2006), examines 187 communities in eastern Massachusetts from 1980 through 2002. They test whether having stricter wetlands regulations than the state requires impacts the number of total housing permits issued by the town, controlling for septic regulations, subdivision regulations, and city and year fixed effects. The estimated coefficients on wetlands are not statistically significant.

The second study, by Sims and Schuetz (2007) uses the same data set to study the impact of land use regulations on the conversion of land to residential use. They find that wetlands regulations slow the conversion of forest and agricultural land to residential use by only 1.1 – 1.4% over the 1985-1999 period. They cannot, given their data set, examine the impact of the regulations on particular parcels, but rather the aggregate impact of regulations on development in each town.

Model:

In order to estimate the impact of a wetlands designation on a single-family home and on the neighboring homes, the hedonic house price method is used[2]. Hedonics is a revealed preference approach that uses house values to measure the value of an

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[2] Although the difference-in-difference approach would be preferred, this would require housing sales data prior to 1972 when the Federal wetlands regulations were enacted. Data from the late 1960s has not been found for a town where properties that contain wetlands could be identified, thus the hedonic approach is used.

environmental good. The concept is based on an idea from Griliches (1971) and Rosen (1974) that many characteristics affecting the quality of life are considered when buying a house, and that consumers' preferences regarding the characteristics will be represented in the price that they are willing to pay for the house. Such characteristics include the number of bedrooms, lot size, local school quality, and local environmental quality. Hedonic regressions can be used to measure the consumer's willingness to pay for a house with a certain level of environmental quality, holding all other characteristics of the house constant. Thus the measurement of the price of a non-marketed good can be obtained.

Following Rosen (see Freeman (2003) for an excellent discussion), the hedonic model is based on individuals who, when demanding a house, maximize their utility and suppliers of housing who maximize their profits. When a house is offered for sale and is purchased, we assume that both the buyer and the seller are satisfied with the outcome. Thus the hedonic function depends on the interaction of the demand and supply sides of the housing market.

The hedonic method requires that the housing market be in equilibrium, that the characteristics of the house are known by both the buyer and the seller, that there is no discrimination in the market, and that the market is a single market. If any of these assumptions are not correct, then the reported sales price of the house may not fully reflect the house's characteristics (see Kiel (2006) for a more complete discussion of these assumptions).

In order to determine the impact of wetlands designation on house prices, an indicator of the designation will be included in the regression. The impact of having a neighboring property designated will be measured by including information on the number of contiguous properties that are designated as wetlands. Thus the hedonic equation to be estimated is:

$$Ln(Price) = \beta_0 + \beta_1(HouseCharacteristics) + \beta_2(NeighborhoodCharacteristics) + \beta_3(PriceIndex) + \beta_4(Wetland) + \beta_5(\#ResWet) + \varepsilon$$

where HouseCharacteristics includes items such as number of bedrooms, NeighborhoodCharacteristics includes local controls, PriceIndex controls for changes in the prices of housing due to market changes, Wetland indicates whether the property itself has designated wetlands on it, and #ResWet is the number of contiguous properties that are residential and have designated wetlands on them.

Theory suggests that β_4 will be negative; because the property is restricted in how it can be developed, it will have a lower price, all else held constant. This is the development effect. The coefficient on the neighboring residential properties (β_5) is likely to be positive; because your neighbors are restricted in how they can develop their property, you know that the property next to you will stay as it is into the future and wetlands are seen as a positive externality. This is the amenity effect.

Data:

This study examines the impacts of wetlands regulations on single family houses and the neighboring units in Newton, Massachusetts (see Figure 1). Newton was chosen because it is a well-established residential suburb of Boston that is fairly densely populated (4,643.6 people per square mile (2000 Census)). It has seen a slight increase in population between 1990 and 2000 (1.5%) relative to growth in the state (5.5%), and has a homeownership rate of 69.5% (2000). Housing is expensive in Newton with a median value of owner-occupied units of $438,400 (2000) and a lower poverty rate (4.3%) than the rest of the state (9.3%). The Newton public school system is considered one of the top in the state and sends nearly 88% of its students on to higher education (Newton city website).

According to the City of Newton website, Newton covers over 18 square miles, and 19.6% of the area is open space of which 55% is publicly owned. The city has 14 lakes and ponds, and 22 streams and brooks, and is bordered by the Charles River. It has 268 acres of wetlands, which is 2.3% of the city's total area (City of Newton, Massachusetts Recreation and Open Space Plan Update 2003-2007, 2003). The wetlands are scattered across the city, and are located in areas where the average income is relatively high and in areas where it is relatively low (see Figure 2). Newton's wetlands include deep marsh, open water, shallow marsh meadows, and shrub and wooded swamps.

The federal regulations on wetlands were discussed above; state and local governments can enact laws that are more strict than the federal laws if they so choose. Massachusetts law (Chapter 131, Section 40 of the Massachusetts General Laws) passed in 1972 states that any wetland, which includes any freshwater wetland, any estuary, creek, river, stream, pond, lake, or certified vernal pool; land under any of the water bodies listed, land subject to flooding; and any riverfront areas in the Commonwealth of Massachusetts, plus a 100-foot buffer zone around any fresh water or coastal resource listed above is subject to jurisdiction (Massachusetts Office of Coastal Management web site). Any development of the regulated areas requires the owner to notify the city or town as well as the Massachusetts Department of Environmental Protection in order to obtain their permission to proceed.

Newton adopted its own wetlands protection laws in 1985. These laws are stricter than the state laws in that the areas that are covered under the definition "areas subject to inundation and flooding" are larger. The state regulations require boundaries based on a 100-year flood line as determined by the Federal Emergency Management Agency. Newton however supplements the FEMA maps with local data (Dain, 2005).

Data on the sales of single family homes in Newton from January 1988 through June 2005 were purchased from The Warren Group, a private vendor. The original data set contained 12,656 observations. After deleting observations that were in the top or bottom four percent of the house price distribution[3], those recorded as having no bedrooms or bathrooms, those with recorded ages less than zero, as well as duplexes, townhouses and two family properties, 11,341 observations were left (see Table 1 for variable descriptions and descriptive statistics).

Properties that were located on designated wetlands were identified by the City of Newton's Planning Department. This information was used to create a variable called 'Wetland' which is equal to one if the property has been designated as containing wetlands and 0 if it is not. In order to identify wetlands that are neighboring the properties that sold, another variable is created: 'Rnwet' that measures the number of residential neighboring properties with wetlands. Properties identified as residential include those with houses, apartments, and condominiums, as well as those with the land

[3] This removed observations that might have been outliers such as not being at arm's length or being miscoded.

use types “undevelopable” or “potentially developable” that are completely surrounded by residential properties.

In order to assign a value to the “Rnwet” variable to a property that was identified as having wetlands, the property was first located on the Newton Assessor’s website (http://www.ci.newton.ma.us/assessors2003/Search.asp). Using the map on this website, the addresses of all contiguous properties to the property in question were recorded. The data were searched for all of the contiguous properties in the list of the properties in Newton with wetlands. For any of the contiguous properties in the list, they were identified as being residential, the number of each type was added up, and recorded the appropriate number in the “Rnwet” column of the sales data spreadsheet. This process was repeated for all 308 properties in the original sales data set that contain wetlands.

The map of the Newton sales data, as well as the list of all properties in Newton with wetlands, was then used to identify properties with wetlands that were not in the sales data set but may have been a neighbor to a property that was in the sales data set. To do this, a wetland was first located on the GIS map and all of the streets nearby that may have been affected by the wetland were identified. The list of all wetlands properties was searched for these streets and all of the addresses of the properties with wetlands on each street were recorded. If these properties were not part of the sales data set, each one was located on the Newton Assessor’s website and the addresses of all contiguous properties were recorded. If any of these contiguous properties were in the sales data set, a “1” was added to the “Rnwet” column of these properties. For these properties that were in the sales data set, all contiguous properties were checked and any additional neighbors with wetlands that were not part of the sales data set were identified. This process was repeated for all wetlands properties in Newton, as identified by the City.

There are 256 properties with designated wetlands in our final sample (see the means and standard deviations in Table 1). These properties are more expensive, younger and have more bedrooms and bathrooms than does the entire sample. Of those properties that have wetlands, 99 do not have any residential neighbors that are similarly designated, and 97 have only one such neighbor (Figure 3). A total of 349 properties that do not have designated wetlands on them have neighbors with wetlands.

In order to control for changes in the Newton housing market over time, a deflator was used. The model was estimated with the Consumer Price Index for all urban consumers in the Northeast, as reported by the Bureau of Labor Statistics. The model was also estimated using a series of indicator variables for the year in which the house was sold. The results are similar, so only those using the latter approach are reported.

Results:

The regression results can be found in Table 2 and Table 3. In Table 2 whether or not the house has designated wetlands on its property is controlled for. The age and age squared of the house have atypical signs and suggest that houses in Newton increase in value as they get older, but at a decreasing rate. The number of bedrooms and bathrooms and the size of the lot on which the house is located all increase the value of the house, as expected. Included in the regression are indicator variables of the style of the house itself. The categories are cape cod, colonial, contemporary, old style, ranch, split level, Tudor and Victorian, with the omitted category being cottage. These styles are defined by the Newton city appraiser's office. All styles increase the price of a house, relative to the cottage style, and all are statistically significant.

The neighborhood characteristics are controlled for by village indicator variables. Newton is divided into 14 villages, each with its own small 'center.' However, there are no official village boundaries, so zip codes were chosen to represent the villages. There are 10 zip codes in Newton and the school district lines (for 15 elementary schools) are similar to the village lines so that this variable also indicates what grade school the residents can attend. The excluded zip code is 02468 (Waban). The coefficients on the remaining zip codes are all negative and statistically significant at the 10% level except for the 02467 (Chestnut Hill) zip code; thus each zip code has lower prices than Waban all else constant.

The included variables explain almost 70% of the variation in the dependent variable. The coefficient on Wetland is -0.035 and it is statistically significant at the 10% level. This suggests that having the property contain designated wetlands does matter in Newton in this time period and that it decreases the sales price by 3.5%. This result differs from that reported by Netusil who found that wetlands on the property had no statistical impact on the value of the property and it contradicts the results reported by Mahan et al and Bin who found that wetlands were a positive amenity, although they were looking at the proximity of wetlands, not the existence of them on the property itself. The result here is similar in sign, although not magnitude, to that found by Guttery, Poe and Sirmans who reported a 10.5% decrease in price for multifamily homes in Baton Rouge, Louisiana.

Table 3 presents the results when Wetlands and RNWET (the number of contiguous neighboring properties that are also designated as wetlands) are both included. The coefficient on Wetland is now -0.04 and it is statistically significant at the 7% level. Thus it appears that in Newton having your property designated as a wetland (after controlling for neighboring properties' designation) decreases the value of the property by 4 % all else held constant. The coefficient on Rnwet is 0.006 but is not statistically different from zero. The results found here contradict the findings of Mahan et al and Bin; wetlands near your property are not seen as a positive amenity. However, having them on your property is a negative externality.

It is possible that including Rnwet as a numerical variable is not appropriate. The model was therefore estimated including five indicator variables (Neigh0, …. Neigh5). Neighx takes on a value of one if the number of contiguous properties with wetlands is x, and is equal to zero otherwise. The results show that Wetland remains statistically significant and has an estimated coefficient of -0.04. Neigh1 through Neigh4 are not statistically significant, but Neigh5 is positive and is significant. However, only 11 observations have 5 contiguous properties and so concerns about small sample size arise.

These results indicate that there is a development effect but not an amenity effect of wetlands in Newton. Thus there are costs to the property owner of having wetlands on the property itself, and those costs may not be balanced by the benefits of having neighbors with wetlands.

Conclusions:

This study looks at the impact of wetlands designation on residential property values. In theory, the designation should have a development effect that would decrease the value of the property. In studying residential sales in Newton, Massachusetts from 1988 through 2005, I find that the wetlands designation does decrease property values by 4%. This is similar in sign, if not in magnitude, to the result reported by Guttery et al in their study of multifamily units in Louisiana.

However, this paper also controls for having neighboring properties that are designated as wetlands which is a simultaneous test of the amenity effect. Only Netusil has done this by including proximity to wetlands as an explanatory variable, but her sample size was very small and was confounded by potential multicollinearity. This study finds that having neighbors with wetlands designations does not impact property values, which suggests that the amenity effect is not present in the case of wetlands designation, at least in Newton.

These results present a puzzle. Why have other researchers who control only for proximity to wetlands, not for the presence of wetlands on the property itself, generally found that the regulations increased value (which suggests an amenity effect exists)? There are several possibilities. The first is that the types of wetlands found in Newton are not perceived as positive (or negative) externalities if they are on neighboring properties. Doss and Taff report that home owners in their study appear to have preferences over different types of wetlands which may hold true in Newton as well.

A second possibility is that home buyers are unaware of the regulations on neighboring properties as the time of purchase. Buyers may research regulations on their own properties but not concern themselves with regulations on adjoining properties. If owners are unaware of the characteristics being controlled for in the hedonic model, then we would expect the variable to be statistically insignificant.

Whether these results are unique to Newton must be the subject of further research. However, recall that this approach only examines the costs and benefits to homeowners. Even if the owners do not experience benefits from having wetlands in their area, benefits to the larger society or to the ecosystem itself may justify the costs to those owners of regulated properties.

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Figure 1: Newton Map

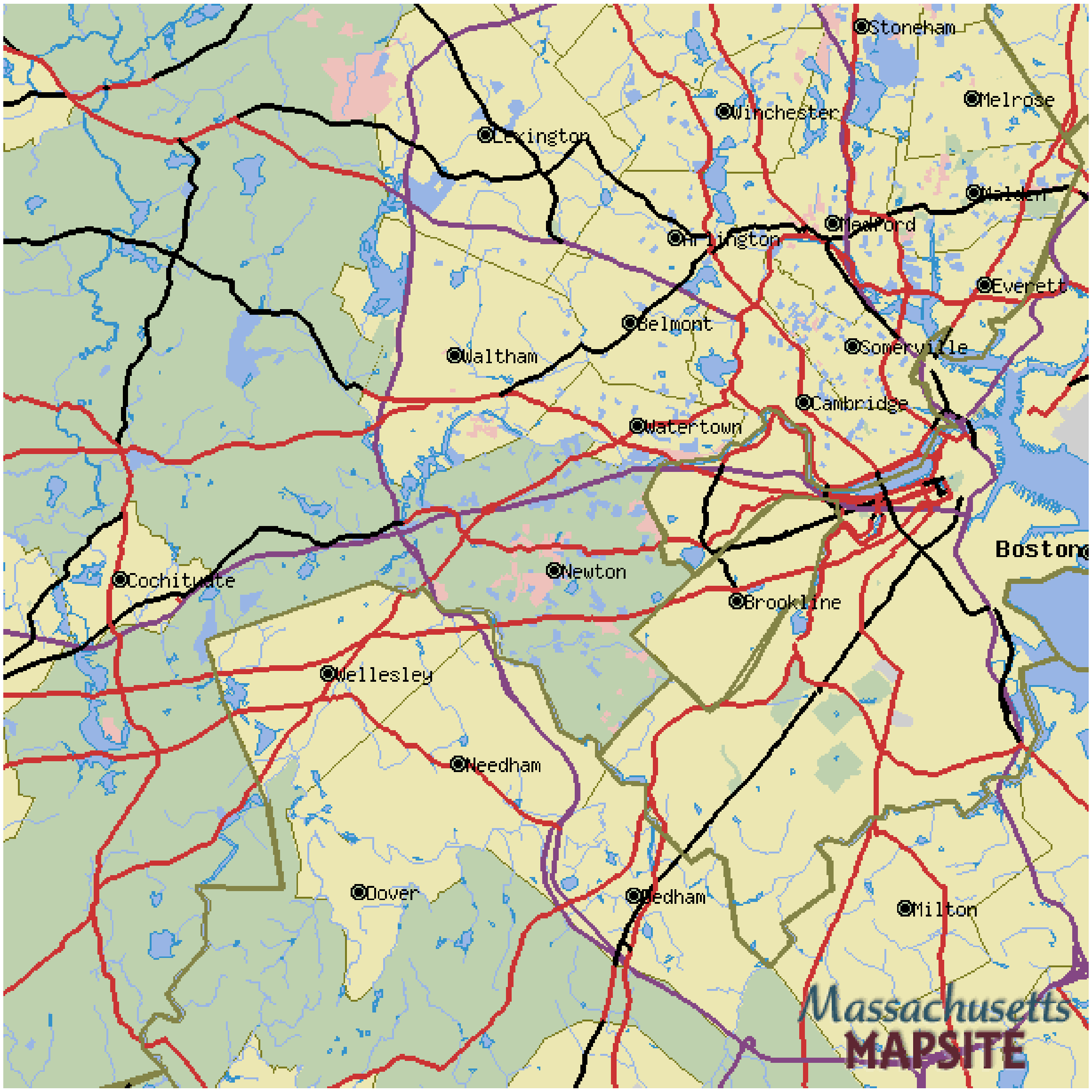


Figure 2: Wetlands in Newton

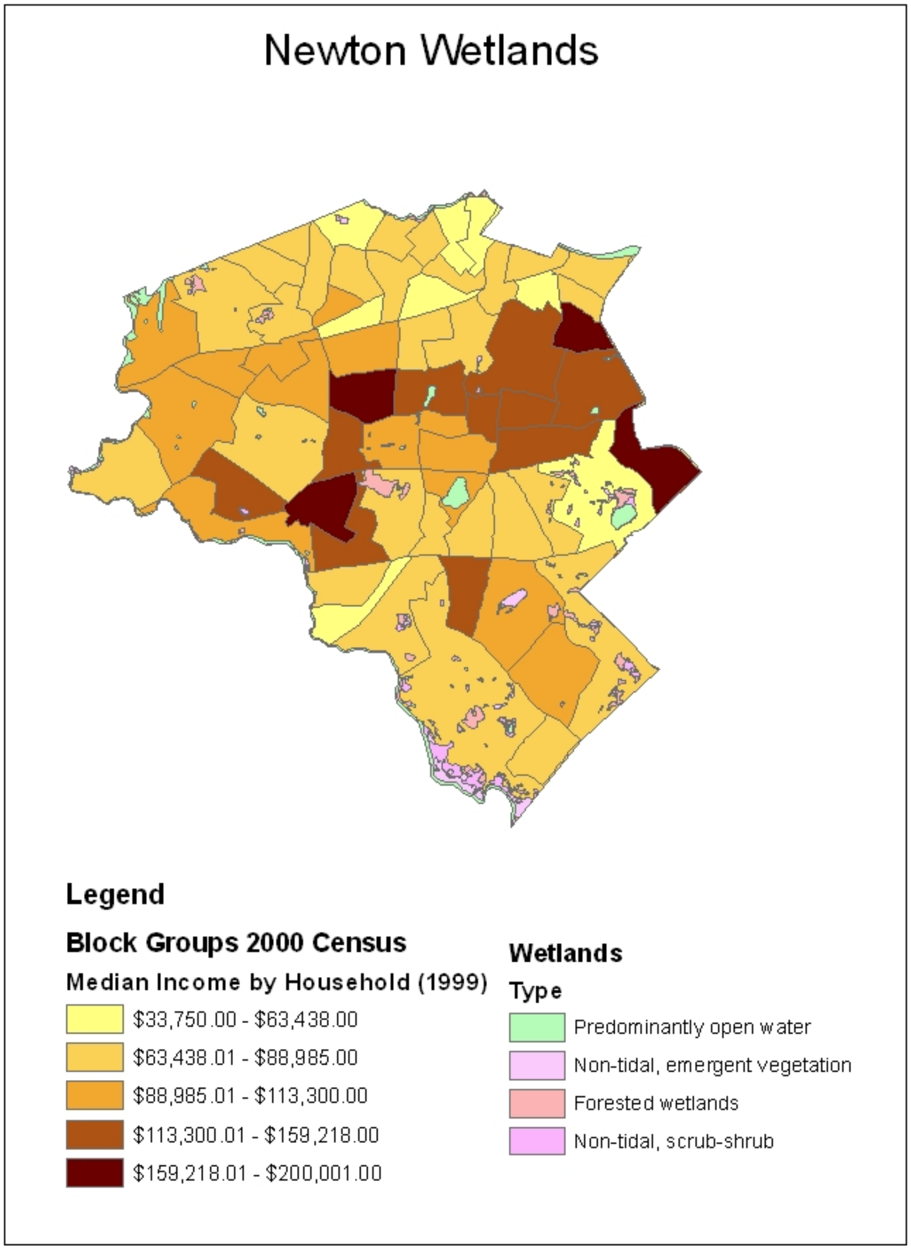
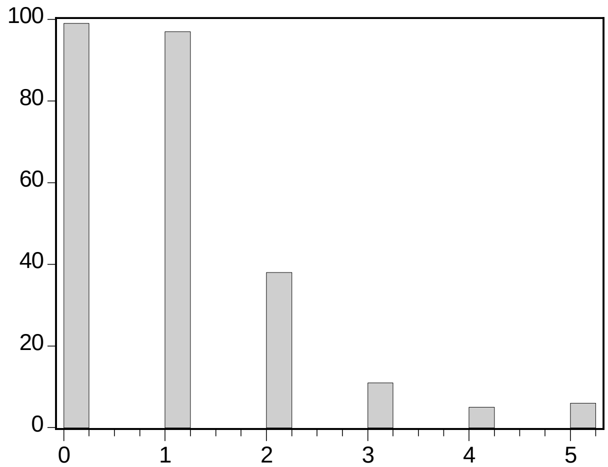


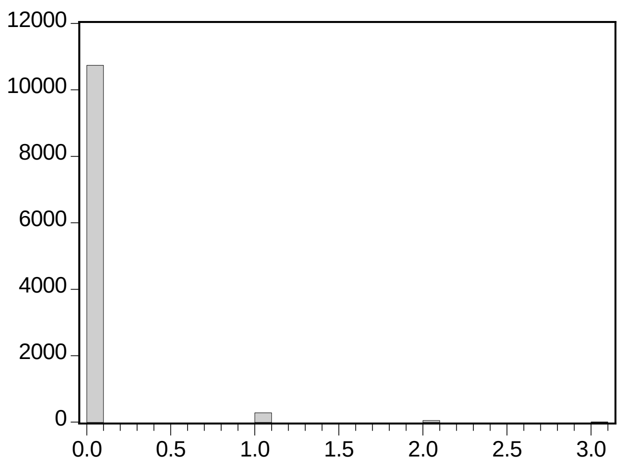
Table 1: Variable names, descriptions and descriptive statistics

Variable	Description	Mean (std dev) All properties	Mean (std dev) Wetlands properties
Price	Sales price of house	435,986.10 (217,325.20)	458,015.80 (235,800.80)
Age	Age of house	67.01 (31.39)	52.598 (35.615
Bathrooms	# of bathrooms	2.43 (0.97)	2.67 (1.086
Bedrooms	# of bedrooms	3.69 (1.088)	3.71 (1.23
Lotsize	Size of lot (in sq ft)	10,888.63 6,439.05)	15,599.49 (12,536.31
Capecod	=1 if house is Cape Cod style	0.148 0.121)	0.117 (0.322)
Colonial	=1 if house is Colonial style	0.44 (0.496)	0.375 (0.485)
Contemporary	=1 if house is Contemporary style	0.016 (0.125)	0.070 (0.256)
Cottage	=1 if house is Cottage style	0.015 (0.121)	0.039 (0.194)
Oldstyle	=1 if house is Old style	0.12 (0.325)	0.055 (0.228)
Ranchc	=1 if house is Ranch style	0.126 (0.332)	0.168 (0.375)
Splitlevel	=1 if house is split level	0.048 (0.214)	0.113 (0.318)
Tudor	=1 if house is Tudor style	0.05 (0.217)	0.012 (0.108)
Victorian	=1 if house is Victorian style	0.09 (0.286)	0.051 (0.220)
Wetland	=1 if property has designated wetlands on it	0.023 (0.148)	
Rnwet	# of residential neighboring properties with wetlands on them	0.059 (0.134)	1.00 (1.124)
# observations		11,341	256

Figure 3: Histogram of number of neighbors with wetlands



Series: RNWET	
Sample 1 12704 IF PRICE>136800 AND PRICE<1175250 AND BEDROOMS>0 AND BATHROOMS>0 AND AGE>=0 AND DUPLEX<1 AND TOWNHSE<1 AND TWOFAMILY<1 AND WETLAND=1	
Observations 256	
Mean	1.000000
Median	1.000000
Maximum	5.000000
Minimum	0.000000
Std. Dev.	1.123719
Skewness	1.511920
Kurtosis	5.565217
Jarque-Bera	167.7221
Probability	0.000000



Series: RNWET	
Sample 1 12704 IF PRICE>136800 AND PRICE<1175250 AND BEDROOMS>0 AND BATHROOMS>0 AND AGE>=0 AND DUPLEX<1 AND TOWNHSE<1 AND TWOFAMILY<1 AND WETLAND=0	
Observations 11085	
Mean	0.037618
Median	0.000000
Maximum	3.000000
Minimum	0.000000
Std. Dev.	0.225037
Skewness	7.022866
Kurtosis	60.60983
Jarque-Bera	1624033.
Probability	0.000000

Table 2: Regression Results

Dependent Variable: LNPRICE
Included observations: 11340
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.79945	0.027356	431.3310	0.0000
AGE	0.001931	0.000381	5.068091	0.0000
AGESQ	-1.03E-05	2.09E-06	-4.937934	0.0000
BATHROOMS	0.127039	0.004178	30.41010	0.0000
BEDROOMS	0.036320	0.003528	10.29570	0.0000
YR89	-0.026244	0.015046	-1.744233	0.0811
YR90	-0.068030	0.015651	-4.346677	0.0000
YR91	-0.114103	0.014753	-7.733985	0.0000
YR92	-0.099082	0.014750	-6.717452	0.0000
YR93	-0.064396	0.014900	-4.321914	0.0000
YR94	-0.008476	0.014400	-0.588592	0.5561
YR95	0.004257	0.015902	0.267693	0.7889
YR96	0.084935	0.014688	5.782464	0.0000
YR97	0.152063	0.015039	10.11149	0.0000
YR98	0.271782	0.014215	19.11911	0.0000
YR99	0.345521	0.014865	23.24387	0.0000
YR00	0.520334	0.014607	35.62186	0.0000
YR01	0.610748	0.015629	39.07833	0.0000
YR02	0.649928	0.015720	41.34463	0.0000
YR03	0.709779	0.015757	45.04480	0.0000
YR04	0.824838	0.014071	58.62173	0.0000
YR05	0.851618	0.020440	41.66376	0.0000
LOTSIZE	1.63E-05	8.42E-07	19.34723	0.0000
CAPECOD	0.154345	0.016334	9.449192	0.0000
COLONIAL	0.278520	0.015529	17.93500	0.0000
CONTEMPORARY	0.339083	0.039674	8.546805	0.0000
OLDSTYLE	0.061973	0.016217	3.821524	0.0001
RANCHC	0.148429	0.017156	8.651642	0.0000
SPLITLEVEL	0.281078	0.019213	14.62936	0.0000
TUDOR	0.456207	0.019366	23.55662	0.0000
VICTORIAN	0.349348	0.019129	18.26268	0.0000
NONANTUM	-0.092188	0.012287	-7.503181	0.0000
CENTRE	-0.064818	0.009139	-7.092209	0.0000
VILLE	-0.117794	0.011089	-10.62306	0.0000
HIGHLANDS	-0.121275	0.010559	-11.48560	0.0000
LOWERF	-0.184592	0.014561	-12.67685	0.0000
UPPERF	-0.230334	0.016190	-14.22734	0.0000
WEST	-0.118688	0.010047	-11.81292	0.0000
AUBURN	-0.141012	0.011774	-11.97676	0.0000
CHILL	-0.012673	0.013503	-0.938483	0.3480

WETLAND	-0.034837	0.021043	-1.655520	0.0978

R-squared	0.698608	Mean dependent var	12.86917
Adjusted R-squared	0.697541	S.D. dependent var	0.480995
S.E. of regression	0.264529	Akaike info criterion	0.181880
Sum squared resid	790.6563	Schwarz criterion	0.208404
Log likelihood	-990.2591	F-statistic	654.7600
Durbin-Watson stat	1.348838	Prob(F-statistic)	0.000000

Table 3: Regression Results

Dependent Variable: LNPRICE
Included observations: 11340
White Heteroskedasticity-Consistent Standard Errors & Covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.79932	0.027372	431.0713	0.0000
AGE	0.001935	0.000381	5.074010	0.0000
AGESQ	-1.03E-05	2.09E-06	-4.942818	0.0000
BATHROOMS	0.127117	0.004185	30.37446	0.0000
BEDROOMS	0.036286	0.003529	10.28331	0.0000
YR89	-0.026275	0.015046	-1.746264	0.0808
YR90	-0.067932	0.015651	-4.340471	0.0000
YR91	-0.114035	0.014755	-7.728691	0.0000
YR92	-0.099046	0.014747	-6.716536	0.0000
YR93	-0.064305	0.014896	-4.316921	0.0000
YR94	-0.008479	0.014399	-0.588869	0.5560
YR95	0.004432	0.015906	0.278640	0.7805
YR96	0.084917	0.014687	5.781733	0.0000
YR97	0.152174	0.015037	10.11986	0.0000
YR98	0.271938	0.014215	19.13088	0.0000
YR99	0.345438	0.014868	23.23379	0.0000
YR00	0.520359	0.014607	35.62444	0.0000
YR01	0.610886	0.015628	39.08833	0.0000
YR02	0.649902	0.015716	41.35373	0.0000
YR03	0.709799	0.015760	45.03764	0.0000
YR04	0.824795	0.014070	58.62011	0.0000
YR05	0.851655	0.020440	41.66561	0.0000
LOTSIZE	1.63E-05	8.46E-07	19.23412	0.0000
CAPECOD	0.154184	0.016365	9.421677	0.0000
COLONIAL	0.278500	0.015561	17.89776	0.0000
CONTEMPORARY	0.338739	0.039682	8.536263	0.0000
OLDSTYLE	0.061818	0.016253	3.803529	0.0001
RANCHC	0.147995	0.017181	8.613668	0.0000
SPLITLEVEL	0.280635	0.019217	14.60329	0.0000
TUDOR	0.456195	0.019390	23.52729	0.0000
VICTORIAN	0.349453	0.019152	18.24619	0.0000
NONANTUM	-0.092190	0.012289	-7.501951	0.0000
CENTRE	-0.064865	0.009146	-7.091981	0.0000
VILLE	-0.117917	0.011100	-10.62349	0.0000
HIGHLANDS	-0.121578	0.010599	-11.47044	0.0000
LOWERF	-0.184364	0.014558	-12.66412	0.0000
UPPERF	-0.230385	0.016198	-14.22261	0.0000
WEST	-0.118597	0.010046	-11.80591	0.0000
AUBURN	-0.140992	0.011771	-11.97779	0.0000
CHILL	-0.012673	0.013503	-0.938542	0.3480

WETLAND	-0.040697	0.022470	-1.811143	0.0701
RNWET	0.006339	0.008867	0.714873	0.4747

R-squared	0.698621	Mean dependent var	12.86917
Adjusted R-squared	0.697528	S.D. dependent var	0.480995
S.E. of regression	0.264535	Akaike info criterion	0.182013
Sum squared resid	790.6218	Schwarz criterion	0.209183
Log likelihood	-990.0112	F-statistic	638.7737
Durbin-Watson stat	1.348924	Prob(F-statistic)	0.000000