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The Relationship of Property Values and Wetlands Proximity in Ramsey County, Minnesota

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Table of Contents

Tables

Figures

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Cheryl R. Doss and Steven J. Taff [1]

Introduction

Wetland policies necessarily take into account the value that society places on wetland services. While there is little argument that public financial and nonfinancial investments ought not exceed the public benefits that are created, there is substantial lack of agreement about how these benefits ought to be measured and how they are related to particular wetlands. In this paper, we attempt to measure the relative valuation placed on different types of wetlands, as expressed by individuals making purchase decisions in an urban housing market.

In an earlier study, Lupi et al. examined the impact of nearby wetlands (specifically, the number of wetland acres in the survey section in which a house is located) on Ramsey County housing prices. That study made use of 1987-89 sales and property characteristics data, as well as wetland data from the Minnesota Protected Waters Inventory (PWI). The data did not allow the researchers to determine an exact relationship between the distance to a wetland and the property value. Nor did it permit any distinctions to be made among wetland types. In addition, only wetlands greater than 2.5 acres in size and included in the PWI were considered. That study found that willingness-to-pay for additional wetland acreage was positive at lower levels of existing

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wetland acres per section and negative at higher levels.

The recent release of location-specific National Wetlands Inventory (NWI) data permits a reexamination of wetlands valuation issues. Here, we do this indirectly: How much do people pay to live near wetlands? We can think of at least three senses of proximity that could be researched:

- Do people pay more if they are closer to rather than farther from a wetland?
- Do people pay more to live near "lots of" rather than "fewer" wetlands, whatever the distance?
- Do people pay more to live nearer a "big" wetland rather than several smaller wetlands?

The present study address the first sense of proximity. We measure the distance from each property to the edge of the nearest wetland of each type. This technique does not permit us to measure the extent of wetlands near the property, although the two are related. As the distance to the nearest wetland gets larger, the area swept by this radius expands as well. Once the minimum distance was determined using the methods described, we were not able to infer anything about the extent of wetlands beyond this distance, although there might be wetlands just beyond this distance that might still be considered "nearby."

In the present study, we can place an economic value on "living closer to" a given wetland type, and we can infer an underlying wetland type preference ordering from these proximity valuations. We cannot, however, speak confidently about any given wetland's "worth," or about the aggregate value of wetlands as a class, because our measure of analysis is distance, not areal extent.

Study overview

Using hedonic pricing analysis, we investigate whether people pay different amounts to live near four different types of wetlands: forested, emergent vegetation, scrub shrub, and open water. We do not attempt to place an economic value upon wetlands *per se*. Rather, we examine the relative values placed upon wetlands of different types, as expressed through housing purchase decisions. We find that people clearly express preference for open-water and scrub-shrub wetlands over emergent-vegetation or forested wetlands. These preferences are demonstrated by a positive willingness-to-pay to move closer to wetlands of the former types (measured at mean distances) and a positive willingness-to-pay to move farther from wetlands of the latter types.

Hedonic valuation

Hedonic pricing analysis is based on the notion that economic goods, such as houses, can be thought of as aggregates of different characteristics. It is the combination of characteristics that determine what a person is willing to pay for the good. Because these characteristics are not sold separately in markets (in the housing market, for example, it is not possible simply to buy a bedroom or a preferred location or a brick veneer), they do not have individual prices. Hedonic models are used to disentangle the implicit prices of each characteristic from the single observed purchase price for the property as a whole.

Rosen (1974) and Palmquist (1991) provide a theoretical basis for hedonic price estimation. Such models assume that the market is in equilibrium and that buyers and sellers of houses are matched so that supply equals demand. Sellers are assumed to receive their marginal reservation price, and buyers are charged their marginal willingness-to-pay for the final unit of each characteristic.

The models further assume that there is a continuous range of choices; i.e., that any combination of attributes is possible. Anyone who has ever searched for a house to purchase knows that this assumption is not completely correct. Home buyers normally have to choose among several houses, each of which has some, but not all, of the desired characteristics. However, the housing market in Ramsey County does offer a wide selection of houses at any given time. Thus, the assumption that the range of choices is continuous seems reasonable.

The hedonic framework assumes that households are characterized by diminishing marginal utility. In housing markets, this means that a buyer is willing to pay less for each additional bedroom or additional unit of another housing characteristic than for the first. We expect that a household maximizes its utility subject to a budget constraint. Unlike many common economic models, hedonic models cannot assume that the budget constraint is linear. Since differentiated products may be sold in separate, although interrelated, markets, the prices of characteristics need not be linear. On the production side, the seller is assumed to maximize profit by choosing the number of units to supply and the characteristics of the house. Although individuals may not be able to determine all of the characteristics of the house, especially the locational characteristics, they do have some control over the structural characteristics and may make changes in the house if they think that it will improve the market value.

A bid function that indicates the household's willingness to pay for different combinations of house characteristics, holding the level of utility and income constant, can be estimated using regression analysis. The resulting hedonic function itself is merely an empirical measure of an assertion about the influence of wetland distances on house prices. Its coefficients are the best linear unbiased estimates of the relationship, given the specified functional form. The interpretation of the slope of the hedonic function, which we use as a measure of value, requires more economic theory. Ultimately, we are required to believe that market decisions reflected in observed housing prices reflect underlying preference relationships in a precise way. We are also limited in the set of utility forms that are consistent with the asserted form of the regression model.

The hedonic function tells us the marginal prices of the characteristics, not the average prices. If, for example, the hedonic function (or, more precisely, the slope of the hedonic function) shows that a home buyer is willing to pay $10 to live ten meters closer to a lake, it does not imply that the person would be willing to pay $500 to live 50 feet closer to the lake. Since we do not know the exact shape of the hedonic price function -- we only know its value at the point where it meets the bid and offer functions -- we do not know the size of the difference between the regression line and the hedonic price function at points farther away from the estimated point.

Wetland characteristics

Forested wetlands include both wooded swamps and bogs. The soil is waterlogged to at least within a few inches of the surface. It may support a spongy covering of mosses. They support trees such as tamarack, black spruce, balsam, red maple, and black ash. Scrub-shrub wetlands have soil that is usually waterlogged during the growing season and is often covered with as much as six inches of water. They support trees including alders, willows, buttonbush, dogwoods, and swamp-privet.

Open-water wetlands include shallow ponds and reservoirs. The water is usually less than ten feet deep and is fringed by a border of emergent vegetation.

Emergent vegetation wetlands include seasonally flooded basins or flats, inland fresh meadows, and inland fresh marshes. They vary from being well-drained during much of the growing season to having up to three feet of water covering the soil. The vegetation includes grasses, sedges, rushes, and other marsh plants such as cattails and wildrice.

These four types of wetlands each have different visual appearances. The forested wetlands are the least open; they least resemble lakes or open water. They tend to be located along rivers and streams. The scrub-shrub wetlands are somewhat more open and they tend to have a wide variety of types of vegetation. The vegetation is not all at the same level, some is tall and some is short, presenting a varied visual pattern. Open-water wetlands are the most open of the four types. They may also provide homes for the largest amount of waterfowl. Emergent vegetation wetlands are fairly open, but all of the vegetation is at the same level, providing a less visually interesting pattern. Since these four types of wetlands are different in their appearance and as habitats for wildlife, we would expect that people would have different preferences for each of them.

Property characteristics

The housing structure and location attributes used here were compiled by Lyons and

Loveridge (1993) from Ramsey County property tax assessor records. (The assessments were made in 1990.) The complete set of attributes used in the present study is itemized in Tables 1 and 2. These attributes include both continuous variables, such as the number of rooms in the house, and zero/one variables, such as the variable for fireplaces where a "1" is assigned if the house has one and a "0" otherwise. If a house is in the St. Paul School District, it was assigned a "0." All other properties were assigned a "1" in the appropriate school district variable, and a "0" otherwise.

The "value" variable is the 1990 assessed value for the property. We are confident that this assigned value is a reasonably good proxy for the (preferred) market value, for two reasons. The first is that Minnesota law requires that all properties be assessed at their market value, and Ramsey County has a competent professional staff to ensure that assessments are continually updated to reflect changing market conditions. The second reason is that the two are closely related, as demonstrated by our analysis of data generated in the course of the study reported in Lupi et al. That study obtained both assessed value and actual sales prices for 18,000 transactions over a three-year period. The correlation coefficient between the two was 0.83, with the assessed values almost uniformly below actual sales price. For the purposes of this study, we do not need to assume that the assessed values are identical to the market values. We need assume only that there is no systematic bias related to wetland proximity. The distribution of the property values used in the present study is graphed in Figure 1.

From Lyons' original data set of 120,006 residential, currently occupied properties, we excluded 13,876 multi-family properties. The process for recording house locations in the geographic analysis program employed here (described below) eliminated another 481 properties. We were left with 105,568 single-family, currently occupied residential properties.

Figure 1: Distribution of 1990 assessed values for single-family homes in Ramsey County

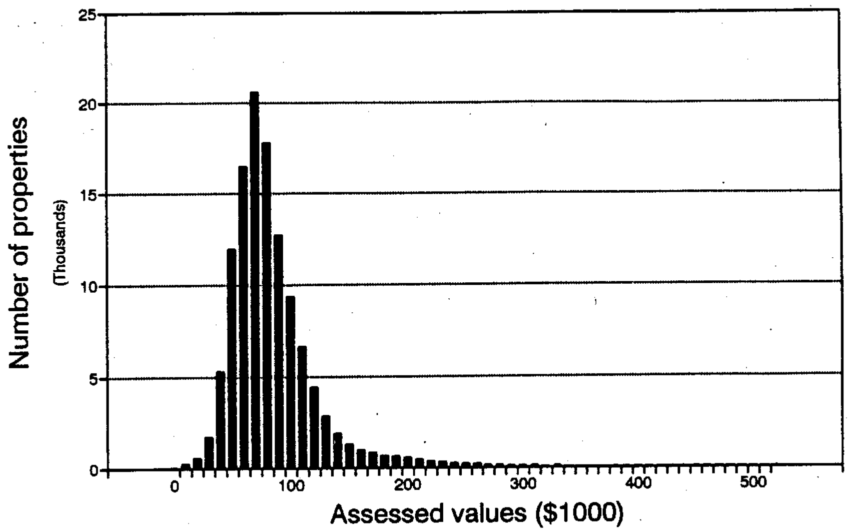

Table 1: Property Characteristics: Continuous variables used in all regressions

Variable	Mean	Minimum	Maximum	Standard Deviation	Appendix Name
Value ($)	87,567	4,000	1,914,000	43,522	VALUE
Lot area (sq. ft.)	12,484	600	4,965,270	33,728	LOTAREA
Rooms not bedrooms or bathrooms	7.3	0	39	1.81	LIVRMS
Bedrooms	3.0	0	16	0.91	BEDRMS
Bathrooms	1.4	0	13.25	0.55	BATHRMS
Living area (sq. ft.)	1,393	230	13,624	582	LIVAREA
Garage Area (sq. ft.)	386	0	2,496	211	GARGAREA
Age (years)	45.9	1	143	27.0	AGE
Distance to lake (x10m.)	119.2	1	255	70.0	DIST1
Fireplaces	0.5	0	9	0.71	FIREPL

Table 2: Property characteristics: Zero/One variables used in all regressions

Variable	Number of Houses (variable = "1")	Appendix Name
Corner lot	16,501	LOCCORN
St. Anthony-New Brighton School District	331	SDSTANTH
Mounds View School District	16,846	SDMNDV
North St. Paul-Maplewood-Oakdale School District	9,027	SDNOSTP
Roseville Area School District	12,444	SDROSEV
White Bear Lake School District	11,235	SDWBLAKE
Hilly topography	12,202	HILLY
Mississippi River view	134	RIVER
Lake view	2,228	LAKE
Homesteaded	100,142	HOMESTD

Note: St. Paul School District = "0" (n=55,685)

Wetland distances

We developed a system to measure the proximity to wetlands using wetland locations and classifications from the recently completed National Wetlands Inventory. Wetland boundaries and classifications based upon 1976-82 air photos are available in digitized format. Minimum mapping units are approximately 0.5 acres. Locational accuracy does not exceed 40 feet.

We aggregated Cowardan wetland system, subsystem, and class designators to the six major wetland types used by the Minnesota Department of Natural Resources: lakes, riverine wetlands, forested wetlands, scrub-shrub wetlands, emergent-vegetation wetlands, and open-water wetlands.[2] (Category assignments are shown in Appendix 1.)

Only wetlands within Ramsey County boundaries were analyzed in this study. Figure 2 and Table 3 show their location and distribution. To the extent that price decisions for properties located within the county were influenced by nearby wetlands outside the county, our results may be biased. We expect that this was not a serious factor in either estimating or interpreting wetlands distance effects.

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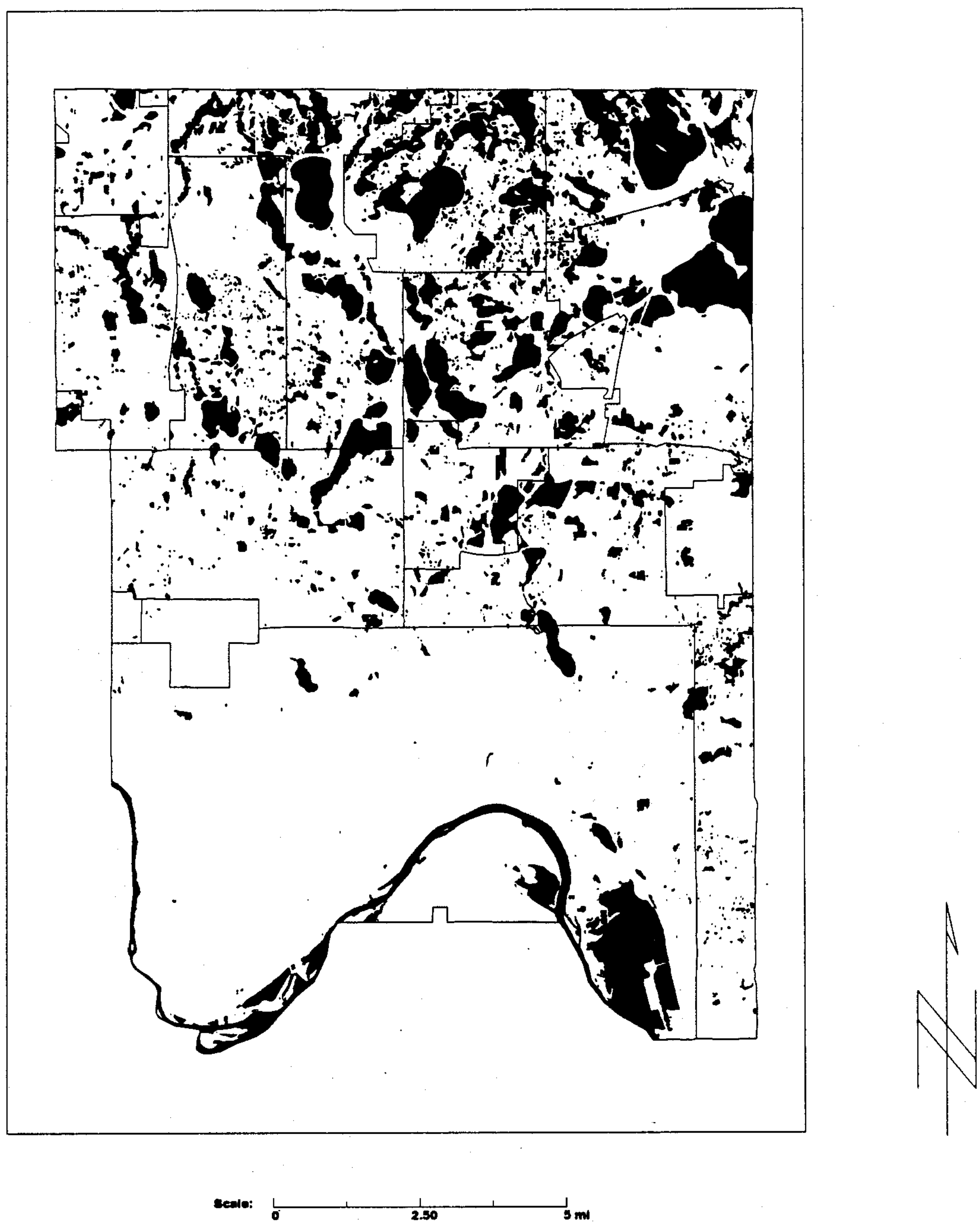
[2] The Cowardan system does not completely correspond to the older and more familiar USFWS "Circular 39" classification system. Forested wetlands, as used in this study, largely correspond to Circular 39 type 7, "wooded swamps," and type 8, "bogs." Scrub-shrub wetlands correspond to type 6, "scrub swamps." Emergent-vegetation wetlands cover four Circular 39 wetland types ranging from type 1, "seasonally flooded wetlands or flats," to type 4, "inland deep freshwater marshes." Finally, open-water wetlands to type 5, "inland open fresh water."

These correspondences should not be taken too literally. The two classification systems were developed for different purposes, and complete cross-equivalence should not be expected.

Table 3: Distribution of wetland types in Ramsey County

Wetland Type	Hectares	Acres	Percent of County
Lakes and lacustrine	3,516	8,685	6.68
Riverine	25	62	.05
Forested	550	1,359	1.04
Scrub shrub	639	1,578	1.21
Emergent vegetation	2,328	5,750	4.42
Open water	482	1,191	.92

Figure 2: Wetlands classified under National Wetlands Inventory, Ramsey County, Minnesota



For distance calculations, we employed the EPPL7 (Environmental Planning and Programming Language), a raster-based geographic information system (GIS) developed by the State of Minnesota. In raster systems, all data are arranged in a grid of cells, each of which is identified by its row and column number. In EPPL7, a cell is associated with one (and only one) value from 0 to 255, representing whatever the user specifies. However, grids can be overlaid in layers or levels, permitting each cell location to take on different values in different levels. Cell size is configurable by the user, depending upon the effective resolution of the data and upon the user's needs.

Each value in an EPPL7 grid cell is independent of all others; there is no concept of class membership as there is in polygon-based GIS programs. Consequently, one cannot ask the program to simply calculate distances from each house to the nearest wetland. Nevertheless, such calculations were feasible, given manipulations such as those described below. The essence of the procedure was to assign each known property location (cell) a number which represents the closest distance to a wetland cell of a given type.

Along with the individual structural characteristics discussed above, each property in our housing data set is associated with both a unique identification code and a latitude-longitude location (NAD83, Ramsey County, projection). The identifier and location were imported into EPPL7 as a vector/point file. Because EPPL7 only recognizes 256 unique cell values, while we had over 100,000 unique property identifiers, we had to read the locational data into three sequential vector-point files, with the cell for a given house location taking on, respectively, the last two, the middle two, and the first two digits of the property identification number. For example, the cell location for property number 12,736 was labeled 36 in the first file, 27 in the second, and 01 in the third. By overlaying the three identification levels and appropriately concatenating corresponding cell values, the full property number could be restored when necessary.

We specified an EPPL7 grid cell size of 10 square meters, even though the housing location data would have been accurate to a smaller scale, because the recorded accuracy of the wetlands data is of that magnitude. For those few cells that contained two or more houses -- house locations were calculated at the center of the property, so such overlap occurs only for 481 relatively small properties -- the last one entered overwrote the previous entries. (the bias resulting from this step is small, given the large size of the data set.)

The next task was to associate each property location with a wetland distance number. For each of four wetlands types (forested, scrub shrub, emergent vegetation, and open water), successively, all cells for that wetland type were labeled "1" and all other cells -- other type of wetland or non-wetland -- were labeled "0." This permitted use of the RADIUS command in EPPL7, which assigns consecutive numbers to cells radially around each cell that has a value of "1", up to a limit of 255. Upon completion, every wetland cell displays concentric rings of increasing values around it, up to any cell where the process encountered either another wetland cell of the same type or a cell already assigned a number. The final value in any given cell is thus the number of cells between it and the "nearest" wetland. (Remaining cells with value "0" were all relabeled "255," resulting in a truncated distance distribution, albeit a truncation at 2,540 meters, presumably an irrelevant distance.) The distribution of wetland distances among all properties is shown in Figure 3.

We then had three raster files that together assigned a property number to a precise location, plus four files that each contained a set of cell values denoting distance of each cell to the nearest cell of the given wetland type.[3] The OUTTABLE procedure in EPPL7 was used to merge all these files into a single table that contained the (concatenated) property identification numbers and the closest distance to each wetland type. Finally, this file was combined with the separately created housing characteristics file for use in the regression analysis that underlies the hedonic valuation procedure.

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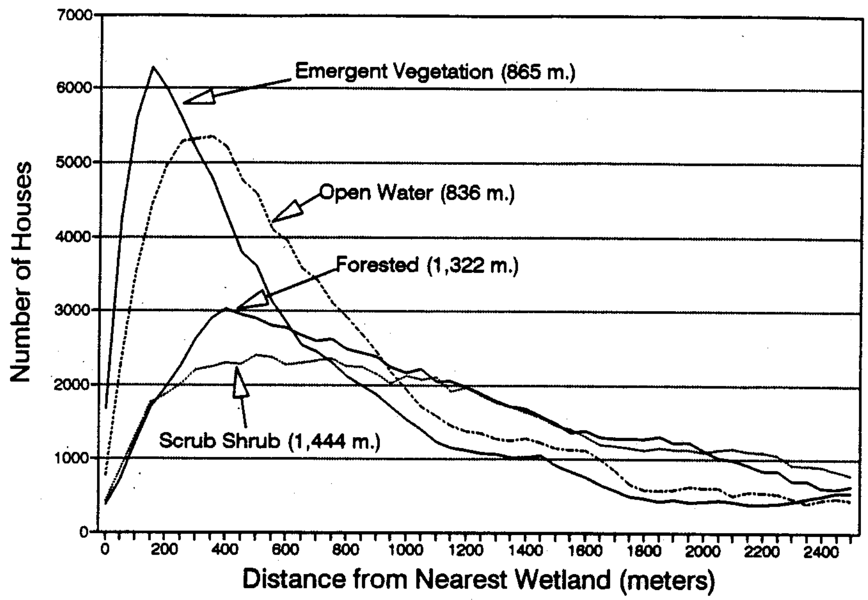
[3]Actually, to circumvent inherent memory limitations in the EPPL7 program, we had to divide each house location file into ten subfiles, each of which were then re-compiled into a master house-distance file.

Table 4 shows that the four distance variables are fairly strongly correlated with each other. Correlation coefficients range from .6113 (open water and forested) to .8048 (emergent-vegetation and forested). This is not at all surprising, given the proximity (and even nesting) of the wetland types evident in Figure 2. The table also provides our first indication of wetland proximity preferences. All correlation coefficients between property value and wetland distance are negative: houses farther away from wetlands have lower assessed values. None of these value-distance correlations, however, is as strong as any of the inter-wetland correlations.

Table 4: Correlations among distance variables and assessed value

	Scrub shrub	Emergent vegetation	Open water	Property value
Forested	.7812	.8048	.6113	-.1996
Scrub shrub		.7535	.6782	-.2955
Emergent vegetation			.7429	-.1539
Open water				-.2305

Figure 3: Distribution of wetland distances (means in parentheses)



Estimating distance effects

Any set of data can be fit by an infinite number of regression models. Which model is most appropriate depends on how the estimated coefficients are to be interpreted. For our purposes, we want to be able to answer two basic questions: (1) Do people pay more to live near wetlands? (2) Does it matter which type of wetland? For this, we require a form for the hedonic function that can be either positive or negative in slope (and perhaps both) within the relevant range of up to 2.5 km. from the wetland.

In this paper, we report four of those specifications fit to the full data set, plus two fit to those houses with all four wetland types within 1000 meters. We explain each model and then summarize all six, to see what overall story they may tell. Our results indicate that people do pay more (but not a lot more) to live nearer to some -- but not all -- types of wetlands.

Overall results

With very few exceptions, we can reject the zero null hypothesis at the .01 level for all non-distance coefficient estimates, and we can claim with a high degree of confidence that there is a relationship between property value and distance to wetlands. (All model results are reported in Appendix 2.) The R^2 for all models is above .80. The structural variables had similar results in all models reported here. None of this is particularly surprising, given the extremely large number of observations used.

Lot area always has a positive coefficient: the price increases as the lot area increases. The same is true for living area, which is the number of square feet of space in the house. However, bedrooms and living rooms (the number of rooms in the house excluding bedrooms and bathrooms) both have large negative coefficients: the value of the house decreases as the number of rooms increases. This suggests that, holding the total area of the house constant, people prefer fewer larger rooms to many smaller rooms. In addition, many of the newer houses in the suburbs have fewer rooms than older houses in the city, although the area of the total house may be larger.

As might be expected, the number of fireplaces, garage area, and deck area all have positive coefficients -- they increase the value of the house -- while age and location on a corner have negative ones. In all of the models, the coefficient for the distance from a lake was negative, which indicates that people are willing to pay more to live nearer to a lake. This result agrees with common expectations about property values near lakes.

Model 1: Linear

In this specification, we assert that distances enter into the formation of property prices in a strictly linear manner. (In the six models reported here, all variables other than lake and wetland distances are linear in the coefficients.) The relevant (and generalized) portion of the model is:

$$\text{value} = \ldots + b_i \text{ distance}_i + e,$$

where the i subscript refers to which of the four wetland distances is being considered. We assume that the error term is i.i.d. with zero mean, so

$$E\text{ (value)} = \ldots + b_i \, E(\text{distance}_i).$$

Full parameter estimates for all models are presented in the appendix. Here we report only the parameter estimates for the wetland distance variables. Recall that distances are measured in 10m. increments.

Table 5: Model 1 (linear) coefficient estimates

Wetland type	Coefficient b_i
Forested	11.0
Scrub shrub	-22.5
Emergent vegetation	72.7
Open water	-22.0

These coefficients determine the shape of the hedonic functions for each wetland type, shown in Figure 4. In the figure, a positive slope at any given distance indicates that the average homeowner prefers to live farther from a wetland of that type. The converse holds for negatively sloped hedonic functions. Even this simple linear formulation offers dramatic evidence of the difference among the wetlands. We find that property owners would prefer to live closer to open-water and scrub-shrub wetlands and farther away from forested and emergent-vegetation wetlands.

Because willingness-to-pay -- our measure of value -- is simply the slope of the hedonic function at any given distance, these linear specifications yield constant willingness-to-pay at the level of the estimated coefficient. For example, at any given distance from an existing open-water wetland, the average Ramsey County property owner would be willing to pay $22.50 to be 10 meters closer to that wetland (or to have an open-water wetland created 10 meters closer than is the present nearest open-water wetland). Recall that the coefficient, with its sign, is to be interpreted as the amount the owner would pay for one more unit of distance. Consequently, reported negative coefficients are interpreted as positive preferences.

Model 2: Quadratic

This specification adds a squared distance term to permit the hedonic function to be either convex or concave, depending upon the signs of the coefficients. For example, we might suspect that people would be willing to pay a higher amount to move ten meters closer to a wetland if that move resulted in their living right next to the wetland than they would be willing to pay to move the ten meters closer if they are now 1,000 meters away.

The basic model, given the same assumptions about the error term as before, is:

$$E(\text{value}) = \ldots + b_i\, E(\text{distance}_i) + c_i\, E(\text{distance}_i)^2$$

Again, we report the full model estimation in the appendix and report only the distance variable coefficient estimates here.

The hedonic functions are shown in Figure 4. Again, wetland type matters, but here distance matters as well. This is seen more easily in Figure 5, which plots the slopes of each of the hedonic functions. Depending upon distance, closer proximity to each of the wetland types might be positively or negatively valued. Forested and open-water wetlands start out positive and end up negative. The converse holds true for scrub-shrub and emergent-vegetation wetlands.[4]

To calculate a single estimate of the value for each wetland type, we measure the slope of the hedonic function in Figure 4 (or the height of the willingness-to-pay function in Figure 5) at the mean distance to the nearest wetland of each type. Substituting these into the appropriate willingness-to-pay functions, we find average WTP for wetland proximity[5]:

As was the case with the linear model, on average, property owners place a positive value on living closer to open water and scrub-shrub wetlands, and a negative value on living closer to forested and emergent-vegetation wetlands. (Here, as in the previous model, the magnitude of the expressed valuations is not large, relative to the value of the properties themselves. We discuss this in a later section.)

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[4] The use of a quadratic specification leaves open the problem of interpreting the hedonic function should it prove to be convex, as is, for example, the function for scrub-shrub wetlands in Model 2. The interpretation of the downward sloping portion is straightforward: as distance increases, total valuation increment decreases, and willingness-to-pay increases. Looking strictly at slope of the hedonic function in that range, we would then argue that scrub-shrub wetlands are positively valued. But what does it mean when the slope shifts from negative to positive? A homeowner who happens to be located closer to the wetland than this point would prefer to live even closer to the wetland. But a homeowner who happens to live just a little farther past the zero point would prefer to move still farther away. There are thus two equilibrium positions, one at each end of the distance distribution. A home "fairly near" the wetland would like to be even nearer, but once past a certain point, the wetland takes on negative value and further distancing is preferred.

One way to avoid this problem would be to specify only linear hedonic functions: interpretations would always be unambiguous. Such functional forms of course result in horizontal WTP functions, so valuation is constant over the entire distance distribution. Another way would be to constrain the quadratic to be concave.

[5] Because the WTP function is linear in this specification (and in Model 1), the WTP for the mean distance is identical to the mean WTP for all properties. This equality (and computational convenience) of course does not hold for any specification, such as an inverse function, that yields a non-linear WTP function.

Table 6: Model 2 (quadratic) coefficient estimates

Wetland type	Coefficient b_i	Coefficient c_i
Forested	117.9	-0.41
Scrub shrub	-76.2	0.22
Emergent vegetation	-52.7	0.50
Open water	17.4	-0.18

Table 7: Model 2 (quadratic) willingness-to-pay estimates

Wetland type	Mean distance (meters)	Mean WTP (dollars per 10m.)
Forested	1,306	10.9
Scrub shrub	1,418	-13.6
Emergent vegetation	868	33.8
Open water	799	-11.8

Model 3: Closest linear

We next consider the possibility that people may only react to the wetland type that is closest to them. Models 3 and 4 are fit only to those properties that are closest to a wetland of a given type. For example, the estimates for forested wetland effects are made using only the 8,652 properties that have this type as their closest wetland.

A set of dummy variables was created to reflect which of the four wetland types was closest to each property. A single "minimum distance" variable (DMIN) for each property was defined as the smallest of the four measured wetland distances. It reflects the notion that purchase price decisions might be influenced by having "a wetland" nearby, with no distinction made among different wetland types. Four "type dummy" variables (D3DUM-D6DUM) take on the value "1" if the closest wetland (within 2.5 km) is one of the type under consideration and "0" otherwise.[6] (Matrix singularity is avoided by the fact that several thousand properties are more than 2.5 km from all wetlands; hence, the four variables for these properties are each set to zero.)

This approach indicates identically sloped hedonic functions for each wetland, but the type dummies indicate a different intercept for each wetland type. The model to be fit is:

$$E(\text{value}) = \ldots + b_i\, E(\text{dummy}_i) + c\,(\text{min.distance}) + d\,(\text{min.distance})^2 .$$

Disregarding the intercept terms for the moment, the specification yields an upward-sloping minimum distance function for all of the wetland types:

$$36\,(\text{min.distance}) + .09\,(\text{min.distance})^2$$

[6]When the minimum distance variable was created, it could have been the case that two or more distances were the same. This would not affect the type of measurement interpretation of the minimum distance variable DMIN itself, but the selection process could bias the assignment of wetland category associated with each DMIN. The dummies were created by sequential IF, ELSE IF statements in the SAS programming language. Only one category is selected through the use of ELSE IF statements, the first it happens to encounter as it works through the variables.

In a sample run, 68 of the first 1,000 observations had two or more distances the same. Many of these duplicate distances were "255," or over 2.5 km, and some other wetland type was closer to the house. Consequently, we judge that the problem of duplicates is nonzero, but not substantial. The result is to assign a few more observations to wetland types in the following order: forested, scrub shrub, emergent vegetation, and open water.

The willingness-to-pay is $47.60, evaluated at the mean minimum distance 64.3 (x 10m.). The intercepts themselves are clearly different, as shown in Table 8 and Figure 4, but all are positive.

One might interpret different intercepts as somehow reflecting underlying preference orderings. The larger the intercept, the stronger the preference, even though the owner would prefer to live farther away. Under this interpretation, property owners prefer wetland types in this decreasing order: scrub-shrub, open-water, emergent-vegetation, and forested.

Model 4: Closest interaction

In this model, we further explore the valuation decisions made by those who "know best," in the sense that they have a particular wetland type closest to their property. Here we allow both the intercept and the shape of the function to vary. As before, the dummy variable takes on the value "1" if that wetland type is the closest of the four (and within the 2.5 km. radius). Here, we allow both the intercept and the slope to vary by multiplying the type dummy variables by the appropriate distances. These interaction terms therefore take on zero value for those wetland types that are not the closest to the property, and their estimated coefficients reflect only the distance effects for that type. The model to be fit is:

$$E(\text{value}) = \ldots + b_i\, E(\text{dummy}_i) + c_i\, E(\text{distance}_i) + d_i\, E(\text{distance}_i \times \text{dummy}_i)\ .$$

For those who "know more" about wetland type i, the model becomes (with $\text{dummy}_i = 1$):

$$E(\text{value}) = \ldots + b_i + (c_i + d_i)\, E(\text{distance}_i).$$

For these property owners, their willingness-to-pay (the slope of the hedonic function) to live 10 meters farther from the closest wetland is simply $(c_i + d_i)$.

The intercept terms for scrub-shrub and emergent-vegetation and the interaction term for emergent-vegetation were not significantly different from zero at the .05 level, so they were valued at zero. Only open-water wetlands show a negatively sloped willingness-to-pay. The willingness-to-pay values, which are constant in this linear specification, are, in the order of decreasing valuation: open water, emergent-vegetation, scrub-shrub, and forested.

Table 8: Model 3 (closest linear) intercept estimates

Wetland type	Number of properties	Intercept estimate
Forested	8,652	4,718
Scrub shrub	4,535	11,300
Emergent vegetation	44,066	5,427
Open water	46,220	7,046

Table 9: Model 4 (closest interaction) coefficient estimates

Wetland type	Coefficient c_i	Coefficients $(c_i + d_i)$
Forested	-7,605	97.9
Scrub shrub	-1,608	91.2
Emergent vegetation	-1,258	78.4
Open water	-6,632	-31.0

Model 5: Quadratic on closer properties

Is it plausible to assert that people hold preferences over wetland proximity from as far as 2.5 km., the furthest distance measured here? While EPPL7 permits us to measure such distances, and regression analysis permits us to fit functional forms over the entire range, it might prove useful to examine only those properties that are much closer to wetlands.

Consider the 42,647 properties that lie 1,000 m. (our definition of "close") or closer to all four wetland types. Table 10 compares the means and standard deviations for selected variables in this set to those in the total property set. The properties in this "closer set" tend to be larger in lot size and floor space, newer, closer to lakes, and more expensive. None of this is surprising, given the distribution of wetlands and historical development of Ramsey County: most of the remaining wetlands lie in the northern, more recently developed, half of the county. Table 11 compares mean wetland distances for the two data sets.

Using the same quadratic functional form as Model 2 (quadratic) on this subset of houses, we get a new set of coefficient estimates (Table 12). The resulting hedonic and willingness-to-pay functions are graphed in Figure 6. Wetland-type preference orderings were generated as before, by evaluating the willingness-to-pay functions at the respective mean distances. The results are shown in Table 13, which again pairs the closer and whole property sets.

The major change brought about by considering only closer houses is a shift in both the sign and the ranking of the emergent-vegetation wetland type. Proximity to this type goes from negatively desired (positively signed) in the whole set, to positively desired in the closer set, moving it ahead of forested wetlands.

Table 10: Comparison of selected variable means: Whole set and closer set

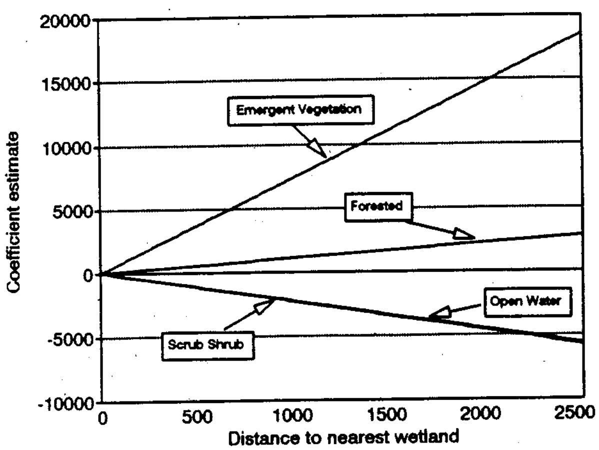
	Whole Set (n = 105,568)	Closer Set (n = 32,423)
Assessed values ($)	87,567	104,947
Lot area (sq. ft.)	12,484	19,912
Bedrooms (no.)	3.0	3.1
Bathrooms (no.)	1.4	1.5
Living area (sq. ft.)	1,393	1.536
Age (years)	45.9	27.7
Distance to nearest lake (m.)	1,190	909

Table 11: Mean distances to wetlands

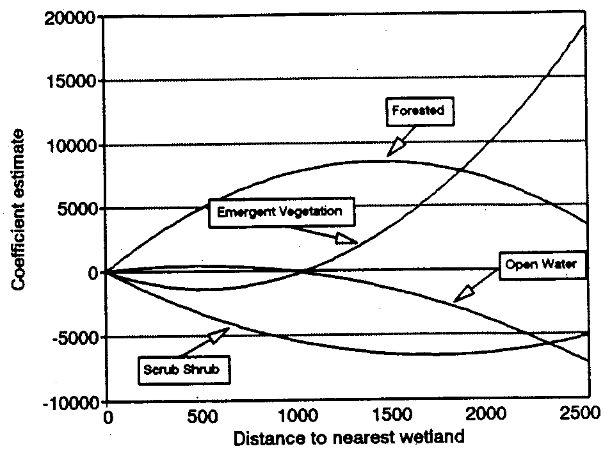
	Mean distance (meters)	
Wetland type	Closer set	Whole set
Forested	502	1,306
Scrub shrub	502	1,418
Emergent vegetation	359	868
Open water	359	799

Figure 4: Estimated hedonic functions: Whole data set

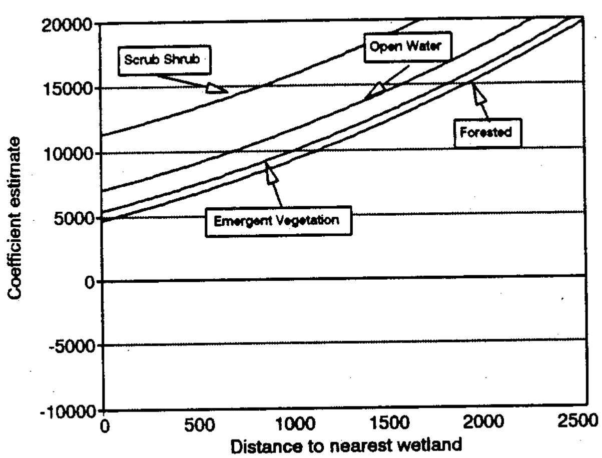
Model 1: Linear



Model 2: Quadratic



Model 3: Closest linear



Model 4: Closest interaction

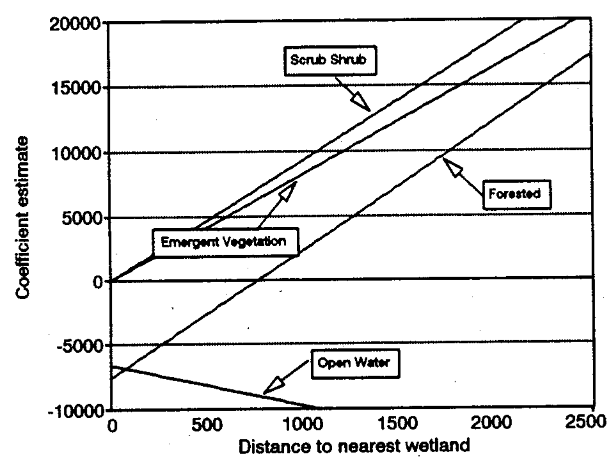
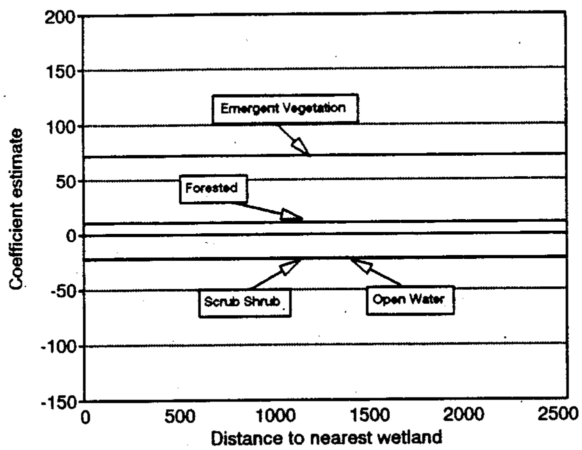
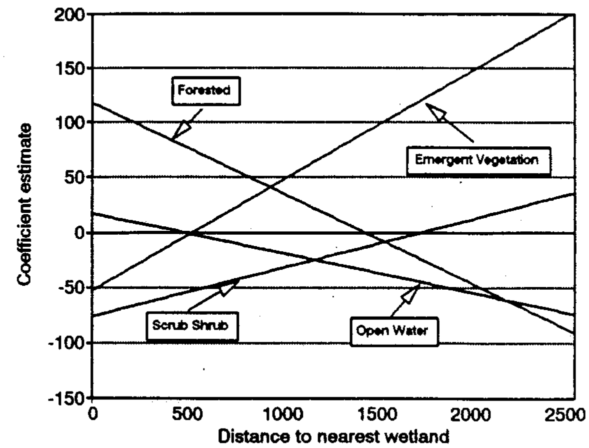


Figure 5: Estimated willingness-to-pay functions: Whole data set

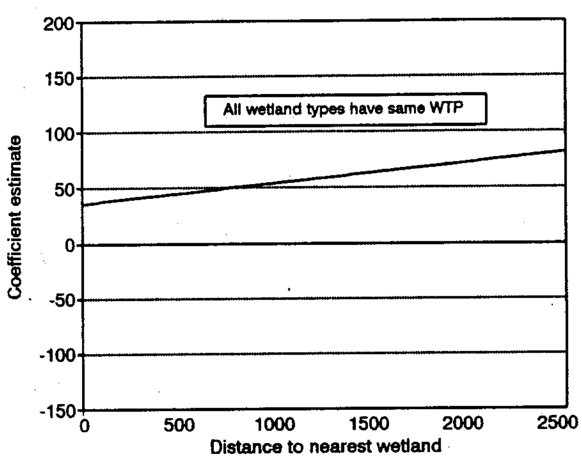
Model 1: Linear



Model 2: Quadratic



Model 3: Closest linear



Model 4: Closest interaction

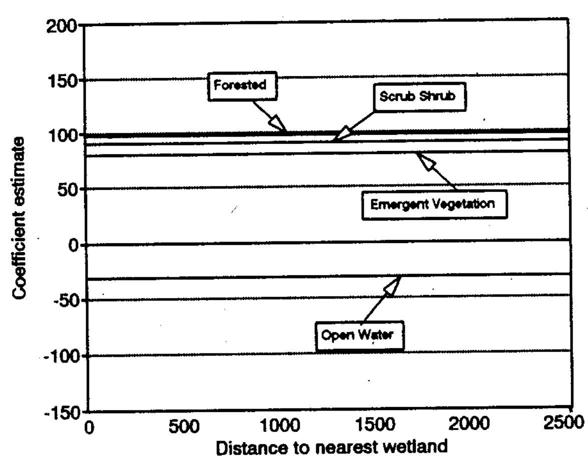


Table 12: Quadratic models' coefficient estimates: Whole set and closer set

Wetland Type	Coefficient for distance		Coefficient for distance squared	
	Closer Set	Whole Set	Closer Set	Whole Set
Forested	69	118	-0.4	-0.4
Scrub shrub	-178	-76	1.0	0.2
Emergent vegetation	-201	-53	3.7	0.5
Open water	-94	17	0.4	-0.2

Table 13: Quadratic models' willingness-to-pay estimates: Whole set and closer set

Wetland Type	Willingness-to-pay to be 10m. farther	
	Closer set	Whole set
Forested	31.9	10.9
Scrub shrub	-80.6	-13.6
Emergent vegetation	-17.8	33.8
Open water	-68.9	-11.8

Model 6: Inverse on closer properties

Our final hedonic function specification is justified by an expectation that as people live farther and farther from a wetland, their willingness-to-pay to live closer might approach zero. An inverse specification such as the following captures this effect:

$$E\ (\text{value}) = \ldots + b_i\ E\ (1/\text{distance}_i)\ .$$

This form forces the hedonic function (and the willingness-to-pay function) to be monotonically increasing or decreasing over the whole range, with an asymptote at the horizontal axis. (The function at $\text{distance}_i = 0$ is, of course, undefined, but in our framework the minimum distance is 1 x 10m.) This form forces the most desired distance from the wetland to be at the minimum distance: it asserts that closer is better.

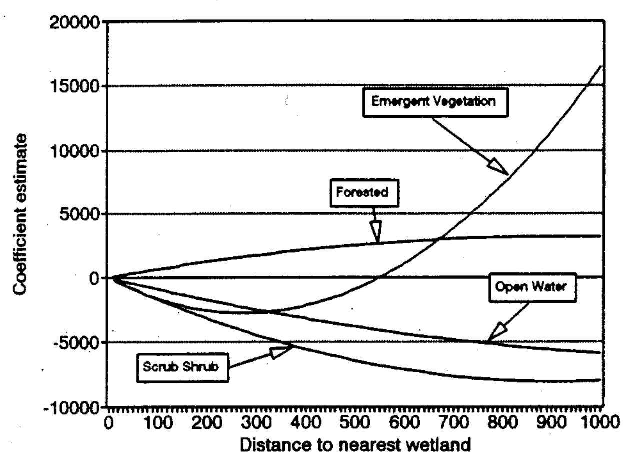
Table 14 shows the estimated coefficients and willingness-to-pay values for this function, fit to the closer data set. (The willingness-to-pay function is $-b_i\ (1/\text{distance}_i^2)$.) Because the hedonic function, as fitted, is essentially flat over a large portion of its range, all WTP values are low when evaluated at the mean distances. Emergent vegetation and scrub shrub wetlands lead the way in this final formulation.

Table 14: Model 6 (closer inverse): Estimated coefficients and willingness-to-pay values

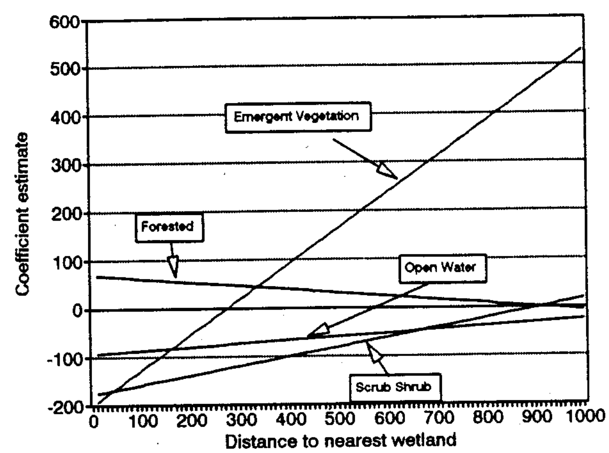
Wetland type	Coefficient b_i	Willingness-to-pay
Forested	-6,058	2.4
Scrub shrub	14,218	-5.6
Emergent vegetation	3,671	-5.8
Open water	3,613	-2.8

Figure 6: Estimated hedonic functions and willingness-to-pay functions: Quadratic and inverse models on closer data set

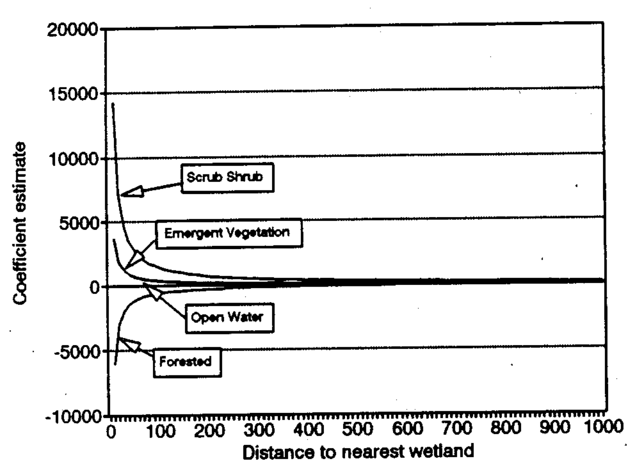
Closer quadratic: Hedonic function



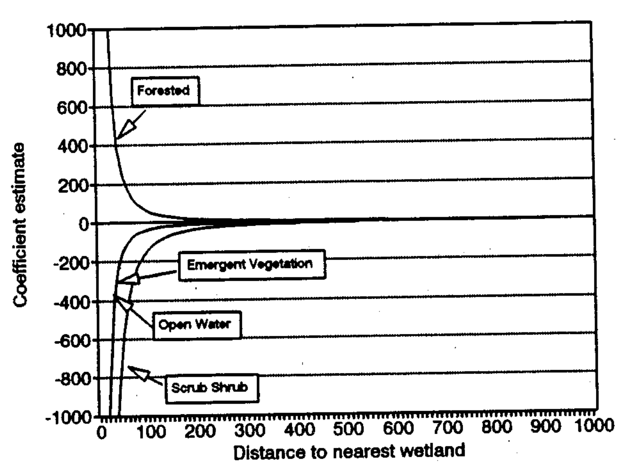
Closer quadratic: WTP function



Closer inverse: Hedonic function



Closer inverse: WTP function



Summary rankings

One needs to be careful in interpreting both the hedonic function and the willingness-to-pay function when "distance away from" a wetland is the good in question. They do not directly measure a "demand for" the wetland, a "value for" the wetland, or the "value of" an additional wetland. As such, the magnitudes of the value effects estimated here are difficult to transfer directly into a policy debate. However, the <u>relative</u> valuations estimated here are potentially useful, we contend, because they allow us to assign valuation rankings to the four wetland types. These rankings are valid both with respect to order -- "wetland type x is preferred to wetland type y" -- and perhaps with respect to proportion -- "proximity to wetland type x is valued at twice the amount of type y."

Table 15 summarizes all willingness-to-pay to live 10m. farther from a particular wetland type. The values range from -$80 to +$100. While these are "significant" in a statistical sense, they aren't very large in any real property market sense. Even a distance of 200 m. -- "the next block" -- is associated with a WTP of only -$1,600 to +$2,000. This seems small relative to an average house price of $88,000 in our data set.

While the six models are based upon different notions of how housing price decisions are made (with respect to wetland distance), they yield (when interpreted as above) reasonably similar rankings of preferences, as shown in Table 16. Scrub-shrub and open-water wetlands clearly emerge with higher rankings than emergent-vegetation and forested wetlands. If these proximity valuations are somehow suggestive of "public valuation," then the higher ranking wetland types ought to be favored in public wetland investment and protection decisions, all else equal, at the expense of the other two types.

Table 15: Summary of willingness-to-pay estimates (evaluated at mean distances)

	Willingness to pay to be 10m. farther from wetland			
Model	Forested	Scrub shrub	Emergent vegetation	Open water
Linear	11.0	-22.5	72.7	-22.0
Quadratic	10.9	-13.6	33.8	-11.8
Closest linear	47.6	47.6	47.6	47.6
Linear interaction	97.9	91.2	78.4	-31.0
Closer quadratic	31.9	-80.6	-17.8	-68.9
Closer inverse	2.4	-5.6	-5.8	-2.8

Table 16: Summary willingness-to-pay rankings

	Rank of willingness-to-pay estimate			
Model	Forested	Scrub shrub	Emergent vegetation	Open water
Correlations	3	1	4	2
Linear	3	1	4	2
Quadratic	3	1	4	2
Closest linear	4	1	3	2
Linear interaction	4	3	2	1
Closer quadratic	4	1	3	2
Closer inverse	4	2	1	3

Further research

The approach used in this study has provided insights into how people value different types of wetlands. It is clear that people do not consider all types of wetlands to be the same. This suggests that the policy debate about wetlands needs to address these differences, rather than simply using one category of wetlands.

A logical next research step is to ask the second of the proximity questions listed at the top: "Do people pay more to live near lots of "wetlands?" A plausible approach would be to count the wetland acreage (again distinguishing by types) at varying distances from each property. Estimated coefficients on these "areal extent" variables (each associated with a different radial distance) could be used to examine possible tail-off in valuation with distance. More significantly, revealed willingness-to-pay estimates could be more straightforwardly linked to the value of a wetland, or, more precisely, the value of an additional acre of a wetland of a given type within a given distance of the property.

Unfortunately, we have not yet been able to devise a technique by which EPPL7 could be manipulated to measure "acres of wetlands within a given radius" for each of the 105,000 properties. The task might be more suited to a polygon-based GIS. We are currently exploring these possibilities.

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Appendix 1: Assignment of NWI categories to six major types used in this report

Lakes

L1UBG
L1UBGd
L1UBGx
L1UBH
L1UBHh
L1UBHhx
L1USCh
L2UBF
L2UBG
L2UBGd
L2UBGh
L2UBGx
L2UBH
L2USAh
L2USC
L2USCh

Forested

PFO/SS1B
PFO/SS1Bd
PFO/SS1C
PFO/SS1Cd
PFO1/EMB
PFO1/EMBd
PFO1/EMBg
PFO1/EMC
PFO1/EMCd
PFO1A
PFO1B
PFO1Bd
PFO1C
PFO1Cd
PFO1Ch
PFO1Cx
PFO2Bg
PFO5G

Scrub Shrub

PSS/FO1B
PSS/FO1C
PSS/FO1Cd
PSS1/EMB
PSS1/EMC
PSS1/EMCd
PSS1A
PSS1B
PSS1Bd
PSS1Bdg
PSS1C
PSS1Cd
PSS6C

Emergent Vegetation

PEM/FO1B
PEM/FO1C
PEM/FO1Cd
PEM/PSS1C
PEM/SS1Bd
PEM/SS1Bg
PEM/SS1C
PEM/SS1Cd
PEM/SS1Fd
PEM/UBF
PEM/UBFd
PEMA
PEMAd
PEMB
PEMBd
PEMBdg
PEMBg
PEMC
PEMCd
PEMCx
PEMF
PEMFd
PEMFx

Open Water

PABF
PABG
PUB/ABF
PUB/EMF
PUB/EMG
PUBF
PUBFd
PUBFx
PUBG
PUBGd
PUBGh
PUBGx
PUBH
PUBHhx
PUBHx
PUBKGx
PUSC
PUSCx

Riverine

R2UBH
R2UBHx
R2USC

Appendix 2: Full model parameter estimates

Model 1: Linear

Dependent Variable: VALUE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	24	1.6227227E14	6.7613446E12	18933.969	0.0000
Error	105543	3.7689541E13	357101289.51		
C Total	105567	1.9996181E14			

Root MSE	18897.12384	R-square	0.8115
Dep Mean	87566.99505	Adj R-sq	0.8115
C.V.	21.58019		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	28466	493.39872426	57.693	0.0000
LOTAREA	1	0.068364	0.00178181	38.367	0.0000
LIVRMS	1	-1916.368217	81.17130100	-23.609	0.0001
HOMESTD	1	4271.012740	269.11036874	15.871	0.0001
BEDRMS	1	-3658.353091	101.92718558	-35.892	0.0001
BATHRMS	1	9366.653126	187.66184668	49.912	0.0000
LIVAREA	1	49.804233	0.22104757	225.310	0.0000
FIREPL	1	7087.654739	103.18667397	68.688	0.0000
GARGAREA	1	13.131351	0.29706607	44.203	0.0000
AGE	1	-291.991737	3.16049599	-92.388	0.0000
LOCCORN	1	-272.100137	160.70742447	-1.693	0.0904
SDSTANTH	1	-3770.379483	1056.6170934	-3.568	0.0004
SDMNDV	1	8069.852087	236.15862618	34.171	0.0001
SDNOSTP	1	703.849003	256.95343396	2.739	0.0062
SDROSEV	1	4085.003667	241.41725323	16.921	0.0001
SDWBLAKE	1	1494.175508	239.35191203	6.243	0.0001
TOPHILLY	1	2569.703586	192.37499451	13.358	0.0001
RIVER	1	47350	1650.2946707	28.692	0.0001
LAKE	1	44526	448.34404967	99.313	0.0000
DIST1	1	-54.328232	3.57314812	-15.205	0.0001
D1SQR	1	0.123539	0.01325673	9.319	0.0001
DIST3	1	10.971951	1.39644868	7.857	0.0001
DIST4	1	-22.472525	1.37063832	-16.396	0.0001
DIST5	1	72.713187	1.48572051	48.941	0.0000
DIST6	1	-21.984359	1.63269960	-13.465	0.0001

Model 2: Quadratic

Dependent Variable: VALUE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	28	1.6291984E14	5.8185655E12	16578.100	0.0000
Error	105539	3.7041977E13	350979042.83		
C Total	105567	1.9996181E14			

Root MSE	18734.43468	R-square	0.8148
Dep Mean	87566.99505	Adj R-sq	0.8147
C.V.	21.39440		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	28956	534.11204972	54.213	0.0000
LOTAREA	1	0.065220	0.00177023	36.843	0.0001
LIVRMS	1	-1993.137247	80.56596507	-24.739	0.0001
HOMESTD	1	4053.525589	266.96047728	15.184	0.0001
BEDRMS	1	-3527.868183	101.23234225	-34.849	0.0001
BATHRMS	1	9381.551001	186.09675732	50.412	0.0000
LIVAREA	1	49.728826	0.21962039	226.431	0.0000
FIREPL	1	6992.004511	102.54707495	68.183	0.0000
GARGAREA	1	12.596898	0.29486915	42.720	0.0000
AGE	1	-278.936151	3.16252307	-88.201	0.0000
LOCCORN	1	-280.091195	159.34512154	-1.758	0.0788
SDSTANTH	1	-2941.929110	1049.8081636	-2.802	0.0051
SDMNDV	1	7550.508356	241.59131217	31.253	0.0001
SDNOSTP	1	304.775294	257.88839853	1.182	0.2373
SDROSEV	1	4520.992197	243.02101546	18.603	0.0001
SDWBLAKE	1	1629.048542	239.47551376	6.803	0.0001
TOPHILLY	1	2366.623860	191.53028250	12.356	0.0001
RIVER	1	46333	1636.3055487	28.315	0.0001
LAKE	1	44113	445.60410808	98.995	0.0000
DIST1	1	-50.305109	3.64659282	-13.795	0.0001
D1SQR	1	0.087619	0.01354982	6.466	0.0001
DIST3	1	117.934909	4.09798508	28.779	0.0001
DIST4	1	-76.151659	4.03763138	-18.860	0.0001
DIST5	1	-52.707944	4.22293432	-12.481	0.0001
DIST6	1	17.423346	4.08837193	4.262	0.0001
D3SQR	1	-0.412653	0.01515741	-27.224	0.0001
D4SQR	1	0.218832	0.01398673	15.646	0.0001
D5SQR	1	0.504987	0.01459387	34.603	0.0001
D6SQR	1	-0.183266	0.01533763	-11.949	0.0001

Model 3: Closest linear

Dependent Variable: VALUE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	26	1.6156282E14	6.2139548E12	17079.278	0.0000
Error	105541	3.8398988E13	363830059.64		
C Total	105567	1.9996181E14			

Root MSE	19074.32986	R-square	0.8080
Dep Mean	87566.99505	Adj R-sq	0.8079
C.V.	21.78256		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	21498	703.69358488	30.551	0.0001
LOTAREA	1	0.066893	0.00179903	37.183	0.0001
LIVRMS	1	-1675.756937	81.83332096	-20.478	0.0001
HOMESTD	1	4711.035386	271.48541230	17.353	0.0001
BEDRMS	1	-3856.915568	102.91215366	-37.478	0.0001
BATHRMS	1	8961.294163	189.32488795	47.333	0.0000
LIVAREA	1	49.485230	0.22320853	221.700	0.0000
FIREPL	1	7621.654310	103.51095194	73.631	0.0000
GARGAREA	1	13.263695	0.29970237	44.256	0.0000
AGE	1	-293.388430	3.13386328	-93.619	0.0000
LOCCORN	1	-434.820971	162.18301809	-2.681	0.0073
SDSTANTH	1	-6015.418183	1062.4599163	-5.662	0.0001
SDMNDV	1	7231.669717	229.18741400	31.554	0.0001
SDNOSTP	1	626.387594	248.28614492	2.523	0.0116
SDROSEV	1	3540.847294	228.96684145	15.464	0.0001
SDWBLAKE	1	1613.289444	235.62015402	6.847	0.0001
TOPHILLY	1	2338.899121	194.66369088	12.015	0.0001
RIVER	1	47692	1665.1156860	28.642	0.0001
LAKE	1	44163	452.97323325	97.496	0.0000
DIST1	1	-49.551069	3.70587978	-13.371	0.0001
D1SQR	1	0.089512	0.01379761	6.487	0.0001
DMIN	1	35.976434	4.17408467	8.619	0.0001
DMINSQR	1	0.092266	0.01729267	5.336	0.0001
D3DUM	1	4717.874520	581.66518934	8.111	0.0001
D4DUM	1	11300	627.87856268	17.997	0.0001
D5DUM	1	5427.040966	564.78154207	9.609	0.0001
D6DUM	1	7045.737593	553.21321845	12.736	0.0001

Model 4: Closest interaction

Dependent Variable: VALUE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	32	1.6279026E14	5.0871956E12	14443.228	0.0000
Error	105535	3.7171552E13	352220131.94		
C Total	105567	1.9996181E14			

Root MSE	18767.52866	R-square	0.8141
Dep Mean	87566.99505	Adj R-sq	0.8141
C.V.	21.43219		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	32279	994.05219647	32.472	0.0001
LOTAREA	1	0.066614	0.00177099	37.614	0.0001
LIVRMS	1	-1955.260053	80.71508429	-24.224	0.0001
HOMESTD	1	4026.157320	267.38428268	15.058	0.0001
BEDRMS	1	-3523.324783	101.44979444	-34.730	0.0001
BATHRMS	1	9331.969682	186.45855050	50.048	0.0000
LIVAREA	1	49.872206	0.21976088	226.939	0.0000
FIREPL	1	6881.671941	102.79625501	66.945	0.0000
GARGAREA	1	12.880231	0.29529710	43.618	0.0000
AGE	1	-284.852012	3.15607108	-90.255	0.0000
LOCCORN	1	-274.866380	159.61762850	-1.722	0.0851
SDSTANTH	1	-3388.192509	1050.2219109	-3.226	0.0013
SDMNDV	1	8233.697082	236.58013859	34.803	0.0001
SDNOSTP	1	669.004503	256.73172606	2.606	0.0092
SDROSEV	1	4349.479119	240.53917427	18.082	0.0001
SDWBLAKE	1	1635.200245	239.42424332	6.830	0.0001
TOPHILLY	1	2645.130319	191.29645822	13.827	0.0001
RIVER	1	47516	1639.5249087	28.982	0.0001
LAKE	1	44431	445.88016056	99.648	0.0000
DIST1	1	-58.052124	3.62023931	-16.035	0.0001
D1SQR	1	0.140004	0.01346249	10.400	0.0001
D3DUM	1	-7604.877927	879.63018503	-8.646	0.0001
D4DUM	1	-1607.747345	925.76770571	-1.737	0.0824
D5DUM	1	-1258.183667	859.41698075	-1.464	0.1432
D6DUM	1	-6631.681194	892.98561799	-7.426	0.0001
D3INT	1	84.721534	4.21772658	20.087	0.0001
D4INT	1	107.383522	8.38438727	12.808	0.0001
D5INT	1	-2.414771	3.70379039	-0.652	0.5144
D6INT	1	31.143419	3.51541295	8.859	0.0001
DIST3	1	13.159401	1.54358751	8.525	0.0001
DIST4	1	-16.244696	1.45538901	-11.162	0.0001
DIST5	1	80.769527	2.05508382	39.302	0.0000
DIST6	1	-62.125489	2.75777260	-22.527	0.0001

Model 5: Quadratic on closer properties

Dependent Variable: VALUE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	27	5.4503515E13	2.0186487E12	4203.847	0.0000
Error	32395	1.555578E13	480190761.92		
C Total	32422	7.0059294E13			

Root MSE	21913.25539	R-square	0.7780
Dep Mean	104947.40564	Adj R-sq	0.7778
C.V.	20.88023		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	46607	1359.4400559	34.284	0.0001
LOTAREA	1	0.049530	0.00234913	21.084	0.0001
LIVRMS	1	-2322.241390	161.53863232	-14.376	0.0001
HOMESTD	1	1362.182852	733.40051803	1.857	0.0633
BEDRMS	1	-4441.312769	218.42242030	-20.334	0.0001
BATHRMS	1	7415.274438	370.27304273	20.027	0.0001
LIVAREA	1	53.077625	0.43826504	121.109	0.0000
FIREPL	1	4920.530365	195.51506050	25.167	0.0001
GARGAREA	1	13.942812	0.57354666	24.310	0.0001
AGE	1	-306.988859	7.83308451	-39.191	0.0000
LOCCORN	1	245.264618	332.87647121	0.737	0.4612
SDMNDV	1	10434	524.26375017	19.902	0.0001
SDNOSTP	1	4778.815041	619.44854905	7.715	0.0001
SDROSEV	1	7553.752460	525.78046062	14.367	0.0001
SDWBLAKE	1	4820.942809	562.65080452	8.568	0.0001
TOPHILLY	1	2211.378737	333.82086147	6.624	0.0001
RIVER	1	-10178	7309.9438113	-1.392	0.1638
LAKE	1	42458	685.23828812	61.961	0.0000
DIST1	1	-160.392553	7.40734433	-21.653	0.0001
D1SQR	1	0.546837	0.02892296	18.907	0.0001
DIST3	1	68.693530	20.31721914	3.381	0.0007
DIST4	1	-178.461364	19.71869476	-9.050	0.0001
DIST5	1	-200.653701	23.63129239	-8.491	0.0001
DIST6	1	-93.684141	20.09853185	-4.661	0.0001
D3SQR	1	-0.365708	0.19177978	-1.907	0.0565
D4SQR	1	0.979606	0.18429636	5.315	0.0001
D5SQR	1	3.651011	0.34027688	10.730	0.0001
D6SQR	1	0.354041	0.22051576	1.606	0.1084

Model 6: Inverse on closer properties

Dependent Variable: VALUE

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	23	5.4357362E13	2.3633636E12	4876.509	0.0000
Error	32399	1.5701932E13	484642500.61		
C Total	32422	7.0059294E13			

Root MSE	22014.59744	R-square	0.7759
Dep Mean	104947.40564	Adj R-sq	0.7757
C.V.	20.97679		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	35998	1144.8552021	31.443	0.0001
LOTAREA	1	0.049723	0.00236558	21.020	0.0001
LIVRMS	1	-2272.057463	162.21769429	-14.006	0.0001
HOMESTD	1	1276.419558	736.74933636	1.733	0.0832
BEDRMS	1	-4590.715210	219.08913547	-20.954	0.0001
BATHRMS	1	7540.710264	371.72414937	20.286	0.0001
LIVAREA	1	53.423618	0.43935918	121.594	0.0000
FIREPL	1	4998.085829	196.16636287	25.479	0.0001
GARGAREA	1	13.864940	0.57579552	24.080	0.0001
AGE	1	-310.982414	7.81564053	-39.790	0.0000
LOCCORN	1	364.428769	334.56100394	1.089	0.2760
SDMNDV	1	10613	506.13845582	20.969	0.0001
SDNOSTP	1	4511.295003	596.08015551	7.568	0.0001
SDROSEV	1	7698.789545	514.74333670	14.957	0.0001
SDWBLAKE	1	5250.559088	544.86468647	9.636	0.0001
TOPHILLY	1	2468.545081	334.47143391	7.380	0.0001
RIVER	1	-11731	7344.0829986	-1.597	0.1102
LAKE	1	42996	686.56120026	62.626	0.0000
DIST1	1	-140.249387	7.32822951	-19.138	0.0001
D1SQR	1	0.483186	0.02884949	16.749	0.0001
D3INV	1	-6058.417758	1304.4264676	-4.645	0.0001
D4INV	1	14218	1248.8883185	11.385	0.0001
D5INV	1	3670.900996	734.97592933	4.995	0.0001
D6INV	1	3613.207782	1152.6229012	3.135	0.0017