ECONOMIC BENEFITS OF SEDIMENT REMEDIATION

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EXECUTIVE SUMMARY

This study aimed to: (1) assess the economic effects of sediment remediation on residential and commercial property values and public revenues in the Buffalo River Area of Concern (AOC) and collect data that will permit future assessment of the effects of remediation on property values for the Sheboygan River AOC; (2) assess the potential to finance municipal bonds based on property value changes at the Buffalo River AOC; and (3) share the results of the study through outreach to public officials in the Buffalo River area, to groups interested in the economic aspects of AOC remediation, and through peer-reviewed publication.

(1) Economic Effects. The study collected data for and applied two distinct empirical methods to assess the economic benefits of AOC remediation. One method analyzes the spatial configuration of property values and infers the effect of proximity to the AOCs. The second uses responses to a choice survey that elicits trade-offs between environmental quality of the river, home characteristics, and home prices. The choices yield estimates of the willingness to pay for river cleanup. For both methods, the data must be reduced using statistical models. All price impacts are measured in 2004 dollars. Within a five-mile radius of the Buffalo River AOC, after controlling for numerous structural, community, and spatial effects, single-family residential property prices are depressed due to their proximity to the AOC. The estimated overall effect ranges from $83 million to $118 million (3.9% to 5.4% of market value), depending on the statistical model used. The impacts are greater for properties closer to the river, and they are concentrated in the vicinity of and to the south of the Buffalo River – there is little indication of price impacts north of I-190 and the major railroad corridor nearby. Additional impacts worth $57 million to $80 million (10% to 14%) in market value losses are evident for multi-family residential properties both north and south of the river. The survey-based estimates of willingness to pay for full cleanup of the AOC are $566 million (14% of the total market value) using the median single-family home value and to $790 million (16% of total market value) using the mean value. North - south differences were not apparent. Data were not available for multi-family homes. Using equivalent methods, the estimated overall effect of the Sheboygan River AOC on single-family residential prices is in the range of $80 million to $120 million (4% to 6% of market value). The effects are concentrated around the lower and upper sections of the river and are smaller in magnitude near the middle section. The survey responses reveal a willingness to pay for full cleanup of approximately $234 million – equivalent to 9% to 10% of total market value using the median and mean values of homes, respectively. Data were not available for multi-family residences.

(2) Revenue Implications. Using approximate property tax rates and assumptions about bond interest rates and issue charges, eliminating the lower-bound estimate of impact could generate net revenue sufficient to retire a $76 million bond in Erie County and a $19 million bond in Sheboygan County. These findings are illustrative only.

(3) Outreach. The study has been reported in public meetings, involving public officials, in both Sheboygan and Buffalo. It has also been the subject of presentations, manuscripts, and press accounts.

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Economic Benefits of Sediment Remediation

1. Introduction and Background

A. Study Objectives

The proposal to conduct this study identified the following objectives:

(1) Assess the economic effects of sediment remediation on residential and commercial property values and public revenues in the Buffalo River Area of Concern (AOC) and collect data that will permit future assessment of the effects of remediation on property values for the Sheboygan River AOC;

(2) Assess the potential to finance municipal bonds based on property value changes at the Buffalo River AOC; and

(3) Share the results of the study through outreach to public officials in the Buffalo River area, to groups interested in the economic aspects of AOC remediation, and through peer-reviewed publication.

Through the good fortune of complementary funding received from the Illinois-Indiana Sea Grant Program and the Cooperative States Research Education and Extension Service, U.S. Department of Agriculture (administered through the Office of Research, College of ACES, University of Illinois), it has been possible to exceed these original objectives. In addition to a full report on the benefits estimates for the Buffalo River AOC, as originally proposed, this report includes empirical results and community outreach for the Sheboygan River AOC.

B. Great Lakes Areas of Concern

In 1987, 31 sites in the U.S. portion of the Laurentian Great Lakes Basin were designated "Areas of Concern" (AOCs). These sites are described on the website of USEPA/GLNPO (http://www.epa.gov/glnpo/aoc/index.html). While the 31 sites vary in their environmental problems, all contain amounts of toxic chemicals in their sediments that qualify them to be included on the National Priority List for cleanup under the Comprehensive Environmental Response, Compensation, and Liability Act of (1980). Five of the sites cross the international boundary with Canada.

The toxic materials found at the AOCs commonly include polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), and heavy metals. These compounds have been associated with cancers and developmental and reproductive effects in fish and humans. They are highly stable and bioaccumulate in the aquatic food chain of the Lakes. Their presence in the tissue of many Great Lakes fish accounts, in part, for widespread advisories against the consumption of these fish. However, fish consumption is not the only vector of potential human exposure to these compounds. Some of them volatize from shoreline sediments or through the water column and can be inhaled. Dermal exposure is possible for those who come into contact with contaminated sediments.

The AOCs not only affect fisheries, they may also stigmatize land surrounding sites of intensive contamination. Many studies have shown negative effects on real estate prices from localized noxious environmental conditions (Faber 1998; Won, Braden, and Taylor 2006). Out of concern for the potential risks, liabilities, or unpleasantness associated with those sites, many prospective buyers of real estate shy away from them. The result is lower prices. The price differential between similar properties near and far from a noxious site is a partial measure of the economic damage it causes and the potential economic benefit that a community might realize by eliminating the environmental problem.

Remediation of toxic contamination can be costly – tens or hundreds of millions of dollars per AOC. The Great Lakes Regional Collaboration (2005) estimated that remediation of all U.S. AOCs could cost up to $4.5 billion. The costs typically are shared between responsible parties, local and state government, and the federal government. All seek assurance that the investment in remediation is worthwhile. Sound estimates of the economic benefits of cleanup can inform the decision process.

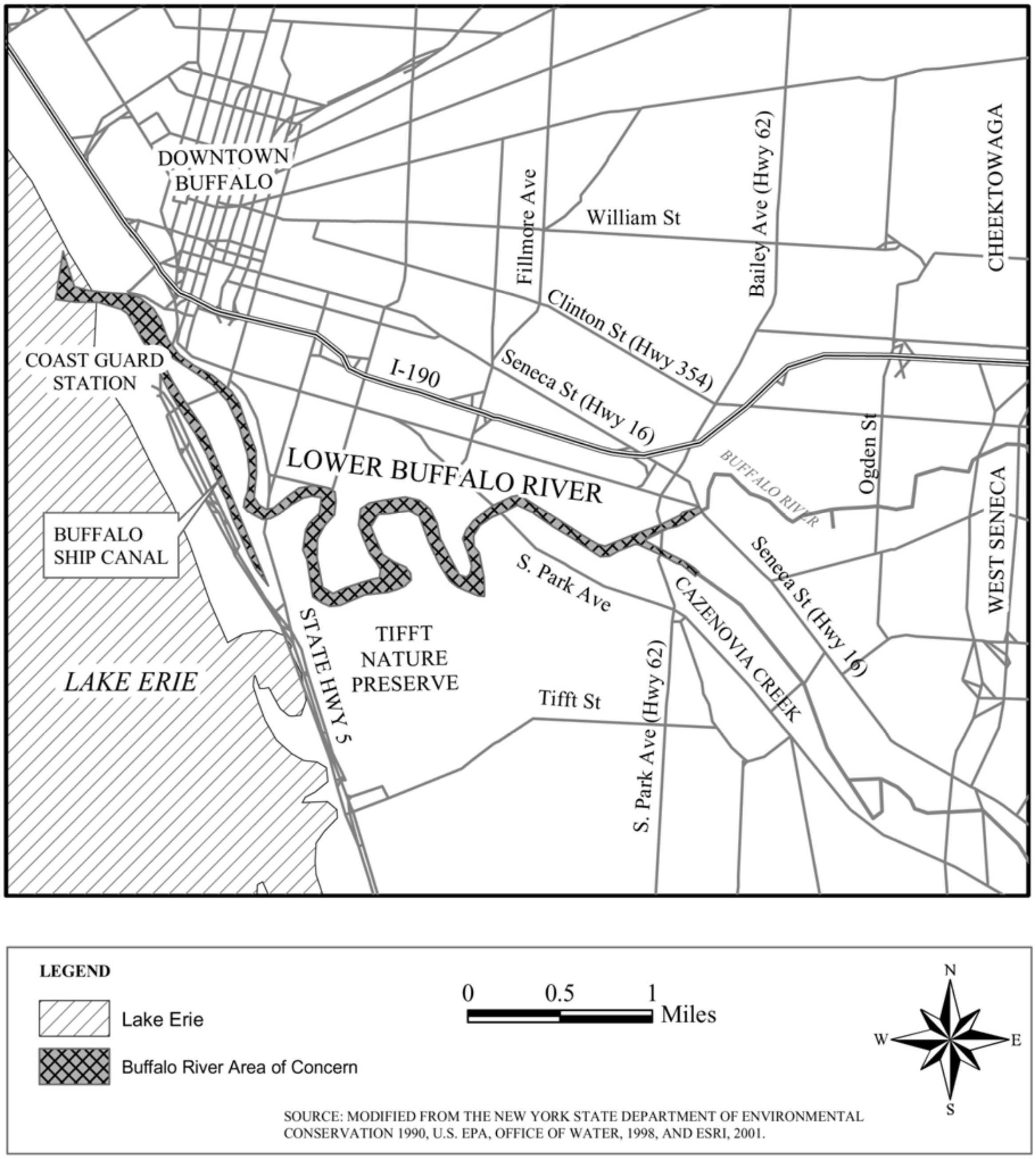
This study focuses on two of the U.S. AOCs: Buffalo River, NY and Sheboygan River, WI.

C. Buffalo River, NY AOC

The Buffalo River, NY AOC is depicted in Figure 1.1. The following description of the AOC comes from the USEPA, Great Lakes National Program website (http://www.epa.gov/glnpo/aoc/buffalo.html, June 21, 2006):

> *The AOC extends from the mouth of the Buffalo River to the farthest point upstream at which the backwater condition exists during Lake Erie's highest monthly average lake level (approximately 10 km). The AOC is regarded as the "impact area" and is characterized by historically heavy industrial development in the midst of a large municipality. Today, industrial development continues to be an important use of the river although some river bank areas can be seen in various stages of abandonment. The sources of contamination for the AOC comes from the sediments and the Buffalo River Watershed. There are three major streams in the watershed that feed the Buffalo River: Cayuga Creek, Buffalo Creek and Casenovia Creek. These stream areas consist of residential communities, farmland, wooded areas and parks.*
>
> *Remedial activity efforts are focused in six major areas: stream water quality monitoring, river bottom sediments, inactive hazardous waste sites, municipal and industrial wastewater treatment facilities, combined sewer overflows, and fish and wildlife habitat. RAP strategies and remedial*

Figure 1.1. Buffalo River, NY Area of Concern and Environs



activities are updated in the most current Buffalo River RAP Status Report dated June 1999. Ongoing assessment activities include the evaluation of remedial options through the modeling of scour and deposition characteristics. Needs include further sampling, treatment assessment, and sediment criteria guidance development to assist the decision making process in addressing contaminated sediments. Three habitat improvement projects have been constructed to address habitat impairments with funding provided through USEPA. Habitat project plans were developed by Erie County in cooperation with the City of Buffalo, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, and NYSDEC. These projects have been completed. The Buffalo Sewer Authority has received Bond Act funding to address sewer overflows.

A local nonprofit organization, Buffalo Niagara RIVERKEEPER, has been designated to oversee the remedial action plan (RAP) for the Buffalo River AOC.

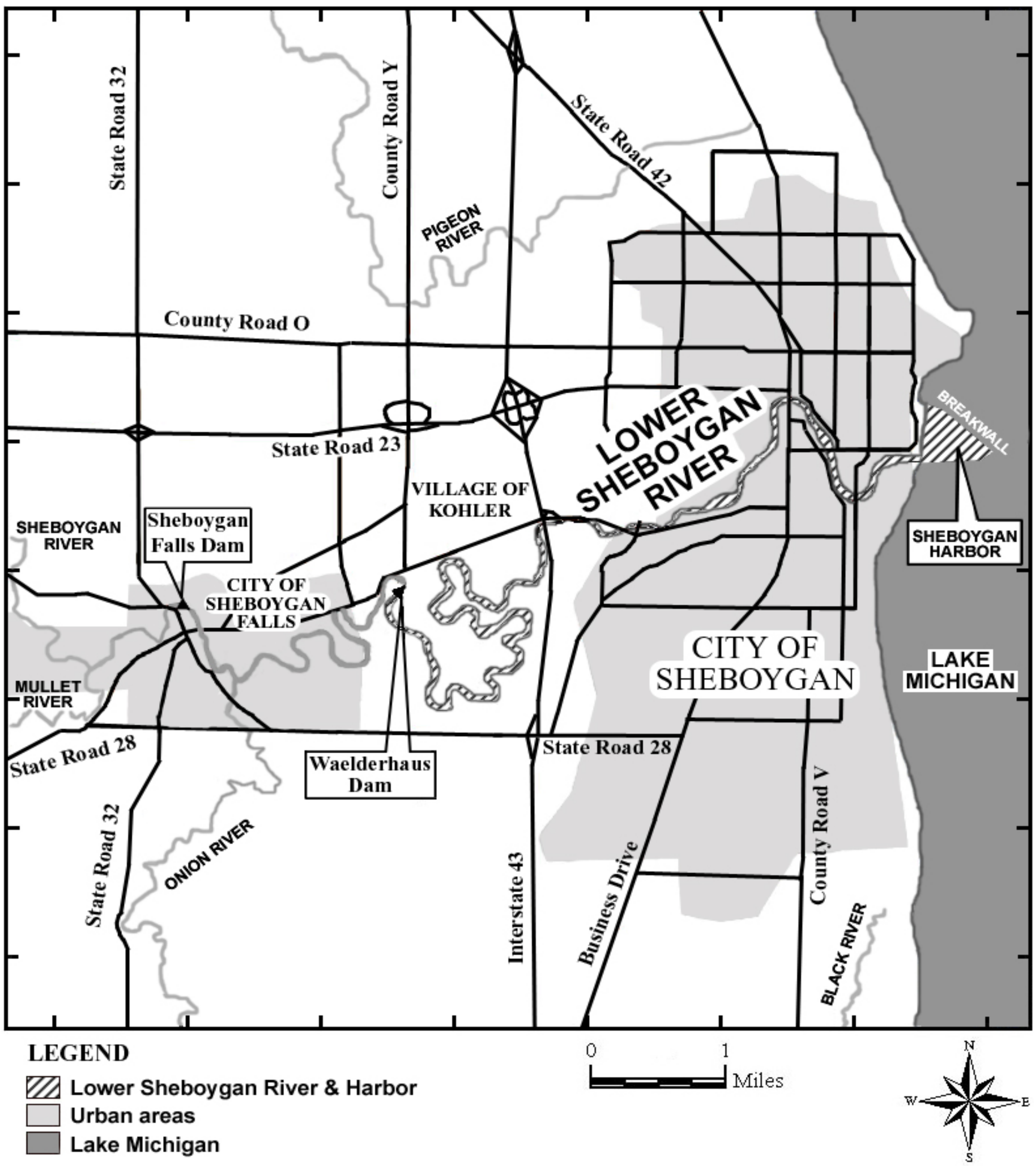
While largely confined to the City of Buffalo, six other New York municipalities lie close to the Lower Buffalo River and might experience its effects in their real estate markets. These jurisdictions are Blasdell, Cheektowaga, Hamburg, Lackawanna, Sloan, and West Seneca. Over 500,000 people live in the area.

D. Sheboygan River, WI Area of Concern

The Sheboygan River AOC is highlighted in Figure 1.2. The following description of the AOC comes from the USEPA, Great Lakes National Program website (http://www.epa.gov/glnpo/aoc/sheboygan.html, June 21, 2006):

The Sheboygan River Area of Concern (AOC) encompasses the lower Sheboygan River downstream from the Sheboygan Falls Dam, including the entire harbor and nearshore waters of Lake Michigan. The AOC serves as a sink for pollutants carried from three watersheds: the Sheboygan River, Mullet River and Onion River. Pollutants of concern, both conventional and toxic, have been identified as: suspended solids, fecal coliform bacteria, phosphorus, nitrogen, PCBs, PAHs and heavy metals. Today, industrial, agricultural and residential areas line the rivers of the Sheboygan River Basin. Agriculture is the dominant land use in the area, totaling 67%. A number of past and present pollution sources and practices have contributed to the use impairments identified in the impairment graphic below.

Figure 1.2. Sheboygan River, WI AOC and Environs



The Sheboygan River AOC, approximately 14 miles long, impinges on seven different local jurisdictions: the cities of Sheboygan and Sheboygan Falls, the Village of Kohler, and the townships of Lima, Sheboygan, Sheboygan Falls, and Wilson. The AOC can be considered in three different segments: (1) the Lower River – from the harbor to the Kohler Landfill; (2) the Middle River – from the Kohler Landfill to the Waelderhaus Dam; and (3) the Upper River – from the Waelderhaus Dam to the Sheboygan Falls Dam. The major sources of contamination are in the upper and middle segments. In 2005, a remediation project began in the Upper River. The estimated cost for this segment is $28 million.[1] USEPA continues to work on plans for the other segments. As of early 2005, the cost estimate for monitoring the Middle River and dredging contaminated sediments out of the Lower River was $12 million. The nonprofit group, Sheboygan River Basin Partnership, advocates for cleanup and other river improvements but does not have formal responsibility for the remedial action plan.

[1] Personal communication from Marc Tuchman, USEPA/GLNPO, January 4, 2005.

2. METHODS OF ANALYSIS

A. Valuation of Nonmarket Goods

Markets do not directly attach prices to environmental quality and many natural resources. Pricing is difficult because these goods are often "consumed" by many people at once and that consumption is not easily limited. As a result, in order to develop some sense of the economic value of environmental quality and natural resources, economists have developed a set of specialized analytical methods. One class of methods, called revealed preference techniques, manipulates data from markets in order to distill out signals about the value of the environment. The second class of methods, called stated preference techniques, supplement the market by adding new information derived from surveys or experiments. In this study, we use both types of methods to estimate the economic impact of AOC remediation. The parallel use of multiple distinct methods helps determine whether the estimates are robust.

B. Revealed Preferences – The Hedonic Method[2]

The hedonic method is commonly applied to housing markets to determine the value of attributes which comprise the composite good "housing". The variation in housing quality and location gives rise to variations in price which is exploited in statistical models to determine the contribution of each housing characteristic to overall price. Intuitively, the hedonic method is easily understood by considering the following hypothetical scenario. Suppose there are two identical lakes, each with 100 homes surrounding them. All homes are lakefront and all the characteristics of the homes themselves are identical across properties. If the current price of a home on either lake was $200,000 per house, all 200 homes on either lake should be equally preferred. Now imagine that the contamination is present in one lake, say Lake B, while there is no contamination present at the other lake, Lake A. If homes on Lake B were still offered for $200,000 they would be uniformly less preferred to homes offered on Lake A for the same price. In other words, at the current price, there would be excess demand for homes on Lake A and excess supply of homes on Lake B. In this situation, market forces would result in the prices of houses on Lake A rising relative to those on Lake B. The price differential that results from the change in the environmental quality at Lake B is thought of as the implicit price consumers are willing to pay to avoid being located on the lake with less desirable environmental quality. This willingness to pay for better environmental quality (or conversely, to avoid environmentally degraded areas), is revealed through the market prices of homes. For instance, if the new equilibrium prices of homes are $205,000 for on Lake A and $195,000 on Lake B, then the "implicit price" associated with avoiding contamination is $10,000.

Of course, housing markets are not as simple as the preceding example. Housing choice depends on many factors including the structure of the house, amenities of the land, the quality of the neighborhood, and location. Yet, the fundamental intuition behind the hedonic method extends easily to these complicated markets. By observing the choices consumers make over a variety of

[2] Discussion in this section is largely drawn from Taylor (2003) and Ihlanfeldt and Taylor (2004). For coverage directly related to the Great Lakes, see Cangelosi (2001).

houses in a variety of locations with a variety of prices, we can use regression methods to estimate the implicit price of any one of the component characteristics. These implicit prices allow the recovery of household willingness to pay to avoid an environmental disamenity.

More formally, the hedonic price function we estimate has the following general form:

$$P_i = f\,(HC_i, LC_i, AOC\_D_i), \qquad (2.1)$$

where P_i represents the sales price of home *i*, HC represents the housing characteristics associated with home *i* such as the acreage of the property, number of bedrooms, number of bathrooms, and whether or not a fireplace is present in the home, LC represents the characteristics associated with the spatial location of home *i* such as the school district in which the home is located, proximity of the home to a highway interchange, proximity of the home to the shoreline, and proximity of the home to the airport and, AOC_D represents the proximity of home *i* to the AOC.

The variables used in this study to describe housing characteristics, HC, and property location characteristics, LC, are discussed in section 2.D. Here, we focus on the relationship between sales prices and proximity to the AOC. We expect housing prices to increase at a non-constant rate as one moves further away from an environmental disamenity such as an AOC. In other words, we would expect property values to increase relatively quickly with distance from the AOC initially – within the first mile or so. But, for properties located 3 or 4 miles from the AOC, we would expect the change in property value due to increased distance from the AOC to be relatively minor. These expectations help guide our decision on the functional forms to use in our statistical analysis. We focus on two commonly used functional forms for the hedonic price function which are consistent with our expectations regarding the general relationship between price and distance to the AOC:

$$saleprice = \alpha + \beta_1 * \ln(AOC\_D) + XB + e, \qquad \text{and } \beta>0 \qquad (2.2)$$

$$saleprice = \alpha + \beta_1 * 1/(AOC\_D)^n + XB + e, \qquad \text{and } \beta<0. \qquad (2.3)$$

In equations (2.2) and (2.3), the dependent variable is the sale price of a home. The variable representing distance to the area of concern (AOC_D) is entered into the regressions either as the natural log of distance to the AOC (equations 2.2) or as the inverse of the distance to the AOC (equation 2.3). All other housing attributes and location characteristics are subsumed in the vector X. The variables α, β_1, and B are parameters to be estimated. The error term in each equation is represented by e. Given the restrictions on the parameter estimates, each specification of the price/distance relationship allows price to increase at a decreasing rate as distance to the AOC is increased.[3]

[3] A third, commonly used functional form modifies equation (2.2) by taking the natural log of the dependent variable (sales price). We estimated models with ln(sale price) as the dependent variable and the results are consistent with what is reported for models (2.2) and (2.3). We do not report the results here because our primary concern is to estimate the capital loss associated with proximity to the AOC, which requires predicting sales price at various distances from the AOC. The logarithmic transformation of the dependent variable prior to estimation

For ease of exposition throughout the report, we will refer to the model in equation (2.2) as the "log-model" (reflecting the log transformation of the AOC distance variable) and the model in equation (2.3) as the "inverse model."

Sections 3A and 4A of this report present the externality impacts of the AOC in three ways. The first is the implicit price associated with a marginal change in distance from the AOC. The implicit price is given by the derivative of the hedonic price function with respect to the distance variable. For two models presented above, the implicit prices are respectively computed as:

$$\partial saleprice/\partial AOC\_D = \beta_1(1/AOC\_D) \quad (2.4)$$

$$\partial saleprice/\partial AOC\_D = -n*\beta_1(1/(AOC\_D)^{n+1}) \quad (2.5)$$

As illustrated in (2.4) and (2.5), the implicit prices depend on only proximity to the AOC. This feature allows us to estimate the impact of proximity to the AOC on the market value of houses in our sample (which sold during our study period) and as well as houses which either sold outside our study time-frame or have not sold at all in recent times.[4]

The second indicator of the property value effects of the AOC is the price gradient associated with AOC proximity. To compute the price gradient, a hypothetical house is constructed (based on the mean value of housing characteristics in the sample) and the proximity of that house to the AOC is varied. The changes in predicted price as the house "moves" further from the AOC are computed, tracing out a price gradient.

The third indicator is the realized capital loss for properties located near the AOC. For the log-model, the reduction in property value for house j, located at a distance of AOC-D_j from the AOC, is given by:

$$\Delta saleprice = saleprice|_{AOC\_Db} - saleprice|_{AOC\_Dj} = \beta_1[\ln(AOC\_D_b) - \ln(AOC\_D_j)] \quad (2.6)$$

where $saleprice|_{AOC\_Dj}$ is the predicted price of house j at its actual distance from the AOC, and $saleprice|_{AOC\_Db}$ is the predicted price of house j at a hypothetical "boundary" distance from the AOC. The boundary distance is a distance just far enough from the AOC so that there is no price effect from the AOC. Depending on the model results, this distance may be our study "outer-edge" of five miles, or it could be less if statistical analysis indicates that the price discount fades out closer to the AOC.

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complicates this prediction (Wooldridge, 2000). We do report comparison results for the ln(sale price) model in footnotes when appropriate.

[4] The maintained hypothesis is that the homes which have sold during our study period are effectively a random sample of homes in the entire study area. This is reasonable if proximity to the AOC does not systematically affect which types of homes are put up for sale.

For the inverse model, the reduction in property value for house j, located at a distance of AOC-D_j from the AOC, is given by:

$$\Delta saleprice = saleprice|_{AOC\_Db} - saleprice|_{AOC\_Dj} = \beta_1[1/AOC\_D_b - 1/AOC\_D_j] \qquad (2.7)$$

where all variables are defined as before.

C. Stated Preferences – Conjoint Choice

Stated preference methods present people with new information and invite them to respond in ways that shed light on the monetary value they associate with environmental quality. One such method, conjoint choice, has been adopted from the marketing field. Individuals are asked to make choices involving hypothetical goods. Those goods incorporate environmental attributes. The choices made by the respondents indicate whether and how they care about the environmental attribute in relation to other characteristics of the good. Careful organization of the attributes is required to ensure that the experimental design of the study does not influence the responses (Louviere *et al.* 2000).

In the present study, for consistency with the real estate-based analysis, the good of interest is housing. Hypothetical homes are described and survey recipients are asked to choose between a hypothetical home and the home we know they recently purchased. The description of the hypothetical homes specifically states that they are identical in all respects to the individual's current home except for four characteristics: the size of the home, the environmental condition of the river, proximity to the river, and price. Each of those characteristics may take on one of four values. A value for each attribute is selected to construct each choice. Our study has the potential of $4^4 = 256$ choices. This is too many to distribute across only 850 respondents. We therefore selected 64 of the choices using fractional factorial design rules that guard against bias in the experimental design (Louviere *et al.* 2000). These choices were randomly assigned to eight different sets of eight choices. Each version of the survey contained one set of choice questions.

The decision of a household to purchase a home is not continuous. Each household either buys a particular house or not. Thus, the discrete choice model is the appropriate analytical framework (Cropper *et al*., 1993). One way to formulate such an analysis is to use the random utility model (RUM). We can define a RUM as follows (Hanemann, 1984, Alpizar *et al*, 2001):

$$\max_{x,z} U(h_i(A_i), z; \tilde{e})$$

Subject to:

$$\begin{aligned} &\text{i.} \quad y = \sum p_i h_i(A_i) + z \\ &\text{ii.} \quad h_i h_j = 0 \quad \forall\, i \neq j \\ &\text{iii.} \quad z \geq 0, h_i(A_i) \geq 0 \text{ for at least one } i \end{aligned} \tag{2.8}$$

where h is a commodity (e.g. House 1 or 2) with a vector A of generic and alternative-specific attributes (e.g. lot size, distance), z is a composite, numeraire bundle of other goods, y is income, and p is the price of the commodity. The last term in the utility function, $\tilde{e}$, is random error that reflects unobservable components of utility.

RUM translates into a conditional logit model for estimating the probability of choosing goods with specific attributes. The underlying theory and assumptions are well-known (e.g., Ben-Akiva and Lerman, 1985; Louviere *et al*., 2000). Suppose the choice experiment that consists of M choice sets, where each choice set C_m offers K_m alternatives so that $C_m = \{A_{1m}, ..., A_{Km}\}$, where A_i is vector of attributes. The probability of alternative j being chosen from choice set C_m is:

$$\begin{aligned} \Pr(j|C_m) &= \Pr\{V_j(A_{jm}, y - p_j h_j) + \tilde{e}_j > V_i(A_{im}, y - p_i h_i) + \tilde{e}_i; \forall i \in C_m\} \\ &= \Pr\{V_j(\cdot) - V_i(\cdot) > \tilde{e}_i - \tilde{e}_j; \forall i \in C_m\} \end{aligned} \tag{2.9}$$

where $V_j(\cdot)$ is the indirect utility function for attribute bundle j and $h_j(\cdot)$ is the unconditional ordinary demand function.

Following McFadden (1973), if the $\tilde{e}$'s are independently and identically distributed with an Extreme Value Type I distribution, the probability (2.6) can be translated into the *multinomial/conditional logit model*:[5, 6]

$$\Pr(j \mid C_m; \beta, \lambda) = \frac{\exp(\lambda V_j)}{\sum_{i \in S_m} \exp(\lambda V_i)} \quad . \tag{2.10}$$

Once the choice decision is characterized, it is possible to derive a monetary measure of the effects on welfare of a change in a housing attribute. Rewriting the unconditional indirect utility function as:

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[5] Without loss of generality, we assume the location parameter is zero (Louviere *et al*, 2000).

[6] The difference between the MNL and the CLM is that in the latter case, the values of the choice characteristics vary across choices, while the parameters are common across the choices. Here, the likelihood of a choice decision is calculated *conditional* on the nature of the choices that defines the choice sets. In the former case, however, the values of the variables are common across choices for the same person, but the parameters vary across choices.

$$\tilde{U} = V(A, p, y, \tilde{e}) = \gamma y + \max[f_1(A_1) - p_1 h_1 + \tilde{e}_1, ..., f_N(A_N) - p_N h_N + \tilde{e}_N] \quad (2.11)$$

and indexing the without-policy and with-policy states as 0 and 1, respectively, then the *compensating variation* (CV) measure of welfare is obtained by solving $V(A^0, p^0, y) + \tilde{e} = V(A^1, p^1, y - CV) + \tilde{e}$ (see also Bockstael *et al.*, 1991 and Alpizar *et al.*, 2001). CV is essentially the amount of money that makes an individual indifferent between the pre-change state and the post-change state, using the former as the baseline. When the estimation errors are extreme-value distributed, as in the conditional logit model, the expected CV for a change in attributes is:

$$E(CV) = \frac{1}{\gamma}[\ln \sum_{i \in S} \exp(V_{i1}) - \ln \sum_{i \in S} \exp(V_{i0})] \quad (2.12)$$

where γ is the marginal utility of income, and V_{i0} and V_{i1} are utilities before or after the change, respectively .

In summary, conjoint choice analysis uses observations on respondents' willingness to make hypothetical trade-offs between house attributes, environmental characteristics, and price. By analyzing their choices, we can directly estimate their willingness to pay for a change in the environmental condition. Here, the environmental condition is the contamination of a river. The choice scenarios vary the environmental condition. We hypothesize that the environmental condition will influence the hypothetical choices. More specifically, we conjecture that cleaning up the contamination will increase the demand and willingness to pay for properties in the vicinity of the AOC while a worsening of the pollution will decrease demand and willingness to pay for those properties. We use the mathematical expressions shown above to estimate the willingness to pay for those changes.

D. Real Estate Data

<u>Buffalo River AOC</u>

All of the basic data used in this study are furnished to the sponsor in a data file accompanying this report. The data fields are described in Appendix F.

All data in our analysis relate to owner-occupied home sales during the period January 1, 2002 and December 31, 2004 that occurred within five linear miles of the AOCs. These particular properties were chosen because they reflect recent conditions of the property markets in the target areas, including the buyers' then-current knowledge about and impressions of the AOCs, and because they presumably represent a random cross-section of housing and owner types. For Buffalo, we were able to collect data for both single-family and multi-family structures. The study area encompasses most of the City of Buffalo, all of Lackawanna, and portions of Cheektowaga, Hamburg, and West Seneca. Two smaller jurisdictions, Blasdell and Sloan, also fall within the study area. Their real estate assessments are handled by neighboring cities –

Cheektowaga and Hamburg, respectively. Since the data for the two small jurisdictions are relatively sparse, we merge them with the data for the assessing jurisdictions. Table 2.1 provides selected census data for households in the vicinity of the Buffalo River AOC.

Several primary databases are combined to characterize homes sales in our study jurisdictions. The first primary database was obtained from local tax assessors (sources are listed in Table 2.2) and it contains data on:

i) Sales prices and dates

ii) Characteristics of the housing, including:

- *a)* lot size
- *b)* square footage of improvements
- *c)* age of primary structure
- *d)* miscellaneous housing characteristics

Table 2.1. Census Statistics for Buffalo River AOC

Selected Census Variables	Jurisdictions Near Buffalo River AOC							
	Buffalo	Cheek-towaga	Sloan	Hamburg	Blasdell	Lacka-wanna	West Seneca	Total
Population (2003)[a]	282,864	91,554	3,576	56,648	2,578	18,394	45,032	500,646
Median Age	33.6	40.9	41.7	38.9	36.5	37.5	41.1	36.4 [b]
Total Housing Units	145,574	41,910	1,789	22,833	1,282	8,951	18,982	241,321
Occupied Housing Units	122,720	40,045	1,680	21,999	1,201	8,192	18,328	214,165
Owner-occupied Housing Units	33,030	24,322	1,223	14,267	667	3,303	12,626	89,438
Median Value, Owner-occupied Units	59,300	81,800	68,600	95,700	76,600	73,600	95,200	77,077 [b]
Average Household Size	2.29	2.32	2.89	2.51	2.26	2.3	2.47	2.36
Median Household Income (1999)	30,614	38,121	29,420	47,888	43,846	29,354	46,278	34,798 [b]

Source: U.S Bureau of the Census (2000), except as noted

[a] American Community Survey, U.S. Bureau of the Census (2003)

[b] Weighted Average of the Median

Table 2.2. Sources of Erie County Real Estate Assessment Data

City of Lackawanna Tax Assessment Data	Frank Krakowski, Lackawanna City Hall, 714 Ridge Road, Lackawanna, NY 14218
Town of Cheektowaga and Village of Sloan Tax Assessment Data	Brian Hess, Cheektowaga Town Hall, Broadway & Union Roads Cheektowaga, New York 14227
City of Buffalo Tax Assessment Data	Kenneth Sprague, 1201 City Hall, Buffalo NY 14202
Town of Lackawanna, Village of Blasdell, and Town of West Seneca Tax Assessment Data	Robert Hutchison, S6100 South Park Avenue Hamburg, New York 14075

The first section of Table 2.3 reports names and definitions for each of the variables contained in the above categories. The first section of Table 2.4 reports summary statistics for these variables. The mean sales price of parcels in our study (in 2004 dollars) is $100,000. Sales prices vary considerably, up to $1,000,000. The number of acres included in each sale varies from approximately 1/5th of an acre to over 4.5 acres. The mean age of at the time of sale was 60 years old, and varied from being brand new to 200 years old. The square feet of living area varied considerably as well, from fewer than 500 square feet to more than 9,000 square feet. Reflecting this variation in house size, the number of bedrooms varied from 1 to 10 bedrooms, with a mean of 3 bedrooms. The mean number of full baths is 1.25 in our sample, and ranged up to seven full baths. If a half-bath was present in a home, there was predominately just one half-bath present (less than 1% of the sample had two or more half-baths present in the home). Thus, the mean number of half baths reported in Table 2.4 reflects the percentage of homes with a half bath present – approximately 35% of homes had a half-bath present.

The tax assessor's office assigns a five-category overall quality grade to each parcel. Ninety percent of homes receive a grade of "C" (or average quality). Seven percent receive a grade of above average (A or B) and three percent received a grade below average (D or E). Tax assessors also record the exterior style of the home (cape-cod, colonial, "old-style", ranch). Cape-cod and "old-style" comprise over 60% of the sample. Eighty-give percent of homes have a full-basement, and approximately 25% of homes have at least one fireplace.

The second primary database developed describes the spatial location of properties that sold during our study period. Spatial features of primary interest are:

i) Proximity of the house to the AOC.

ii) Proximity of the house to other important location-specific amenities or disamenities such as the shoreline of Lake Erie, other rivers, railways, highway intersections, central business districts, airports, and local parks.

iii) Census tract, census block, and school district in which the house is located.

Variable name and descriptions of location-related variables are provided in Table 2.3 and summary statistics for our sample of homes are reported in Table 2.4.

The second section of Table 2.4 reports the distribution of our sample properties across the jurisdictions in the 5-mile area surrounding the AOC. Forty-two percent of the properties are located in the City of Buffalo (of those, 70% are located north of the AOC). Cheektowaga and West Seneca contain another 23% and 25% of the parcels in our sample, respectively. Lackawanna and Hamburg/Blasdell contain a modest number of properties that sold during our study period; 7.5% and 2%, respectively. Overall, 47% of our sample was located north of the Buffalo River (independent of the specific jurisdiction in which the property lies).

Using a GIS map of the Buffalo Area prepared by the Natural Resources Conservation Service, USDA[7], we created a number of variables for each property that reflect the parcel's location relative to features of interest. These variables are described and summarized in the last sections of Tables 2.3 and 2.4, respectively. The mean distance between a parcel and the CBD was 5 miles. If this is limited to just properties north of the AOC, the mean distance falls to 3.8 miles.

[7] Provided by John Whitney of the East Aurora, NY office, NRCS/USDA.

Table 2.3. Variable Description for Buffalo Area Hedonic Data

Housing Characteristics	
saleprice	sales price of parcel in 2004 dollars
acres (acres2)	acreage of parcel (number of acres squared)
age (age2)	age of home (age of home squared)
sfla	square feet of living area
bedrooms	number of bedrooms
fullbaths	number of full-bathrooms
halfbaths	number of half-bathrooms
grade_ab	dummy variable =1 if tax assessor assigns a quality grade of "a" or "b" (on a scale of a, b, c, d, e, with a being the highest quality)
grade_de	dummy variable =1 if tax assessor assigns a quality grade of "d" or "e" (on a scale of a, b, c, d, e, with a being the highest quality)
grade_c	dummy variable =1 if tax assessor assigns a quality grade of "c" (on a scale of a, b, c, d, e, with a being the highest quality) – this category is omitted from the models.
cape	dummy variable =1 if home is described as a cape-cod style
colonial	dummy variable =1 if home is described as a colonial style
oldstyle	dummy variable =1 if home is described as "old-style"
otherstyle	dummy variable =1 if home is described other than the three categories listed above. This category contains mainly ranch-style homes and is omitted from the models.
fullbasement	dummy variable =1 if the home has a full basement
fireplace	dummy variable =1 if the home has at least one fireplace
Location Variables	
Buffalo_N	dummy variable =1 if the parcel is in the City of Buffalo, north of AOC
Buffalo_S	dummy variable =1 if the parcel is in the City of Buffalo, south of AOC
Cheektowaga/Sloan	dummy variable =1 if the parcel is located in Cheektowaga or Sloan
West Seneca	dummy variable =1 if the parcel is located in West Seneca
Lackawanna	dummy variable =1 if the parcel is located in Lackawanna
Hamburg/Blasdell	dummy variable =1 if the parcel is located in Hamburg or Blasdell
north	dummy variable =1 if the parcel is located north of the Buffalo River (regardless of which jurisdiction the parcel is located in)
Census Tract Identifiers	A series of dummy variables indicating the census tract in which each property is located. Parcels in our census tracts lie in 118 different census tracts – these variables are not reported in the models for succinctness.
Proximity Variables (all distances measured in miles)	
cbd	Distance to the central business district
delpark	Distance to Delaware Park
park	Distance to the closest park
rail	Distance to the closest segment of a rail line
stream	Distance to the nearest stream, other than the AOC
airport	Distance to the Buffalo Airport
hws	Distance to the nearest hazardous waste site
hwy	Distance to the nearest point on a major highway
hwyx	Distance to the nearest highway interchange
shore	Distance to the shoreline
AOC	Distance to the AOC

Table 2.4. Summary Statistics for Buffalo Area Hedonic Data

Housing Characteristics				
	Mean	Std. Dev.	Min. Value	Max. Value
saleprice	100,006.4	74,347.3	10,201	1,092,945
acres	0.184	0.241	0.015	4.583
age	60.82	29.11	0	204
sfla	1,543.43	635.08	480	9,717
bedrooms	3.22	0.81	1	10
fullbaths	1.25	0.56	1	7
halfbaths	0.34	0.49	0	5
grade_ab	0.07	0.26	0	1
grade_de	0.03	0.17	0	1
cape	0.21	0.40	0	1
colonial	0.09	0.28	0	1
oldstyle	0.41	0.49	0	1
fullbasement	0.85	0.35	0	1
fireplace	0.23	0.42	0	1
Location Variables				
	N	% of total		
Buffalo_N	1,041	29.97		
Buffalo_S	427	12.29		
Cheektowaga/Sloan	794	22.86		
West Seneca	881	25.36		
Lackawanna	261	7.51		
Hamburg/Blasdell	70	2.01		
North	1,633	47.01		
Proximity Variables (Non-AOC)				
	Mean	Std. Dev.	Min. Value	Max. Value
cbd	5.01	1.71	0.27	8.22
delpark	4.93	2.71	0.02	9.41
park	0.55	0.34	0.00	2.29
rail	0.57	0.40	0.01	1.99
stream	1.57	1.71	0.01	5.68
airport	5.79	1.99	1.32	10.73
hws	0.66	0.31	0.01	1.94
hwy	0.77	0.46	0.02	2.17
hwyx	0.95	0.46	0.04	2.31
shore	3.70	1.74	0.13	7.09
Proximity to AOC				
	Mean	Std. Dev.	Min. Value	Max. Value
all properties:	3.05	1.27	0.08	4.99
north of AOC:	3.15	1.20	0.10	4.99
south of AOC:	2.96	1.32	0.08	4.86

This indicates the relative sparseness of sales that occur in the inner-city of Buffalo. Similarly, the mean distance of homes to Delaware Park, a large park at the northern tip of our study area, is also 5 miles. However, the mean distance between properties and the closest park (no matter which one) is only one-half of a mile. The mean distance between homes and a stream (that is not part of the AOC) is 1.6 miles, and the mean distance to the shoreline for homes is 3.7 miles.

Other features for which we created proximity measures are railways, hazardous waste sites, highways, and the airport. The mean distance between homes and the nearest point on a rail line is approximately one-half mile. This is similar to the mean distance between homes and the nearest hazardous waste site (mean=0.66 miles) or nearest highway corridor (mean=0.77 miles). Related to highway proximity is the distance to the nearest highway interchange. The mean distance to the nearest highway interchange is almost 1 mile. Lastly, because the airport lies outside our study area, the mean nearest distance is large at almost 6 miles.

Of most interest is distance of our sample to the AOC. The mean distance for all properties in the sample is 3.05 miles, reflecting a large number of sales occurring in the outer-edge of our study area (between 3 and 5 miles from the AOC). Table 2.4 also reports the mean distance to the AOC based on only properties south of the AOC and based on only properties north of the AOC. As indicated in Table 2.4, the mean distance is similar for both the north and the south. Although not reported in Table 2.4, 12% of homes north of the AOC are within 1.5 miles of the AOC, and 16% of the homes located to the south of the AOC are within 1.5 miles of the AOC.

Lastly, although no summary statistics are reported in Table 2.4, there were 118 dummy variables included in the analysis each representing the census tract in which a property is located. Census tracts are designed to be relatively homogeneous with respect to population characteristics, economic status, and living conditions.[8] In the Buffalo study area, this results in 118 tract groups for our data (we do not have homes in every census tract in the region). By including census tract identifiers, our analysis indirectly captures infrastructure and demographic factors that influence home choices. These factors are thereby removed from the proximity variables which are free then to reflect preferences for the object of the distance calculation (e.g., highways, parks, or the AOC) rather than conditions at the residential end of these distances.

Sheboygan River AOC

Because of its mixed urban-rural character, extremely elongated AOC, and highly decentralized and variable real estate assessment practices in the area, the Sheboygan River AOC presented distinctive challenges for defining the study area. In the end, we included all or parts of seven taxing units: the cities of Sheboygan and Sheboygan Falls, the towns of Lima, Sheboygan, Sheboygan Falls, and Wilson, and the Village of Kohler. Lima and Wilson presented special challenges for data collection. On-site coding of the data by the research team (Braden and Won) for these two jurisdictions was necessary. Because of the difficulty associated with data collection and because the Sheboygan River is not physically present in either jurisdiction, we collected data for only the 16 sections closest to the AOC in each of those townships. All other jurisdictions were included in their entirety. We collected data for owner-occupied single-family

[8] See http://www.census.gov/main/www/cen2000.html.

residences sold in all of these jurisdictions from 2002 through 2004. Table 2.5 provides selected census data for these jurisdictions.

The Sheboygan County Planning Office supplied lists of the properties sold during this period. For details of the properties, it was necessary to consult real estate tax assessment records. As of late 2004, five different assessors handled real estate tax assessments in these seven jurisdictions. Several of them rely on incomplete paper records. Considerable judgment often was required in determining which properties to include in our study.[9] In contrast to the relatively homogeneous and complete records found in Erie County, NY, only a few descriptive characteristics could be consistently obtained for all properties sold in Sheboygan County: size of the home (ft^2), size of the lot (acres), the numbers of full bathrooms and half bathrooms, and date of construction.

Several primary databases are combined to characterize homes sales in our study jurisdictions. The first primary database was obtained from local tax assessors (sources appear in Table 2.6) and it contains data on:

- *iii)* Sales prices and dates
- *iv)* Characteristics of the housing, including:
    - *a)* lot size
    - *b)* square footage of improvements
    - *c)* age of primary structure
    - *d)* miscellaneous housing characteristics (many of them incomplete)

Table 2.7 reports variable names and definitions for each of the variables. The summary statistics for each of the variables are presented in the first section of Table 2.8. The mean sales price of parcels in the present study (in 2003 dollars) is $124,700. The range of parcel price in the sample is from $24,000 to $724,000. The means acre of parcels is about 0.28 acres. Acres vary considerably, up to 9.12 acres. The ages of parcels varies as well, from new homes to over 150 years old. The square feet of living area in the Sheboygan data varied from 750 square feet to 6,467 square feet. The mean number of full-baths is 1.34. Almost 70% of parcels have more than one full-bath, whereas there is one parcel without a full-bathroom (but which has a half bath) and one parcel with five full-bathrooms. Approximately 64% of parcels do not have a half-bath, and if one is present, usually there is only one half-bath. Unfortunately, there are so many missing observations in the number of bedrooms that we cannot use this variable in our analysis. Compared to Buffalo, only a few variables are complete. As indicated in both tables, there are five housing characteristics in Sheboygan that can be used to describe the properties.

[9] For example, we excluded properties of a size too small to hold a residence or sold at a price so low that it seemed likely to be a non-arms-length transaction. We also excluded properties for which the minimal attribute data noted above were missing.

Table 2.5. Census Statistics for Sheboygan River AOC

SHEBOYGAN COUNTY, WI, JURISDICTIONS NEAR SHEBOYGAN RIVER AOC

	C.She-boygan Falls	C.She-boygan	V.Kohler	T.Wilson	T.She-boygan Falls	T.She-boygan	T. Lima	Total
Population (2003)[a]	6995	49263	1945	3301	1683	7348	2931	73466
Median Age	39.6	35.4	39.8	41.5	40.4	37.7	39.1	36.68 [b]
Total Housing Units	2826	21762	792	1323	675	2245	1029	30652
Occupied Housing Units	2745	20779	737	1235	657	2148	1008	29309
Owner-occupied Housing Units	1579	10727	630	962	326	1776	724	16724
Median Value of Owner-occupied Units	111600	89400	144400	134600	122900	135800	118500	102667 [b]
Average Household Size	2.58	2.55	2.65	2.62	2.61	2.85	2.88	2.6 [b]
Median Household Income (1999)	47205	40066	75000	59241	50489	60846	53023	44623 [b]

Source: U.S Bureau of the Census(2000), except as noted

[a] American Community Survey, U.S. Bureau of the Census (2003)

[b] Weighted Average of the Median

Table 2.6 Sources of Sheboygan County Real Estate Assessment Data

Jurisdiction	Data Source
City of Sheboygan	Marie Ellis, City Assessor, Assessor Department, City of Sheboygan, WI, 53081
Town of Sheboygan[a]	Associated Appraisal Consultants, Inc. 1314 W. College Ave., Appleton, WI 54912
Town of Sheboygan Falls[a]	Associated Appraisal Consultants, Inc. 1314 W. College Ave., Appleton, WI 54912
Village of Kohler[a]	Associated Appraisal Consultants, Inc. 1314 W. College Ave., Appleton, WI 54912
City of Sheboygan Falls[a]	Kenneth Sonntag, Sonntag Appraisal Services, 532 S 8th St., Sheboygan, WI, 53081
Town of Lima[a]	Ken Sonntag, Sonntag Appraisal Services, 532 S 8th St., Sheboygan, WI, 53081
Town of Wilson[a]	Ken Sonntag, Sonntag Appraisal Services, 532 S 8th St., Sheboygan, WI, 53081

[a] Supplemented by on-site collection of information by Braden and Won.

Table 2.7. Variable Description for Sheboygan Area Hedonic Data

Variable Description for Sheboygan Area Hedonic Data	
Housing Characteristics	
saleprice	sales price of parcel in 2003 dollars
acres(acres2)	acreage of parcel (number of acres squared)
age(age2)	age of home (age of home squared)
sfla	square feet of living area
fullbath	number of full-bathrooms
halfbath	number of half-bathrooms
Location Variables	
CSF	dummy variable=1 if the parcel is located in the City of Sheboygan Falls, 0 otherwise
CS	dummy variable=1 if the parcel is located in the City of Sheboygan, 0 otherwise
VK	dummy variable=1 if the parcel is located in the Village of Kohler, 0 otherwise
TW	dummy variable=1 if the parcel is located in the Town of Wilson, 0 otherwise
TSF	dummy variable=1 if the parcel is located in the Town of Sheboygan Falls, 0 otherwise
TS	dummy variable=1 if the parcel is located in the Town of Sheboygan, 0 otherwise
TL	dummy variable=1 if the parcel is located in the Town of Lima, 0 otherwise
A1	effect code=1 if the parcel is located where the closest point to the AOC is between the Harbor and the Kohler Landfill
A2	effect code=1 if the parcel is located where the closest point to the AOC is between Kohler Landfill and Waelderhaus Dam
A3	effect code=-1 if the parcel is located where the closest point to the AOC is between Waelderhaus Dam and Sheboygan Falls Dam
Proximity Variables (all distances measured in miles)	
air	distance to the Sheboygan Airport
orv	distance to the closest stream , other than the AOC
evrgnwood	distance to Evergreen Park
rwaysite	distance to the closest railroad
shore	distance to the shoreline
hwyx	distance to the closest highway interchange
landfill	distance to Kohler Landfill
uwsheb	distance to University of Wisconsin-Sheboygan campus
AOC	distance to the AOC

Table 2.8. Summary Statistics for Sheboygan Area Hedonic Data

Housing Characteristics				
	Mean	Std. Dev.	Min	Max
saleprice	124698.60	68132.65	24000	723566.5
acres	0.28	0.49	0.08	9.12
age	54.4	33.24	0.0	161.0
sfla	1528.89	580.71	750	6467
fullbath	1.34	0.57	0	5
Halfbath	0.34	0.49	0	2

Location Variables		
Township	N	% of total
CSF	175	8.07
CS	1,597	73.66
VK	128	5.9
TW	68	3.14
TSF	22	1.01
TS	159	7.33
TL	19	0.88
Closest AOC segment	N	% of total
A1 (Lake to Kohler Landfill)	1,614	74.45
A2 (Landfill to Waelderhaus)	211	9.73
A3 (Waelderhaus to Falls)	343	15.82

Proximity Variables (Non-AOC)				
	Mean	Std. Dev.	Min	Max
air	6.09	1.46	0.51	9.28
orv	1.22	0.67	0.00	4.17
evrgnwood	2.81	1.62	0.17	9.35
rwaysite	2.36	1.42	0.14	10.52
shore	1.73	1.64	0.03	10.15
hwyx	1.95	0.63	0.13	5.06
landfill	2.66	0.85	0.66	8.66
uwsheb	2.48	0.89	0.32	9.05

Proximity to AOC				
	Mean	Std. Dev.	Min	Max
all properties	1.23	0.82	0.01	4.91
Only homes closest to segment A1	1.25	0.73	0.03	4.09
Only homes closest to segment A2	2.11	0.71	0.08	4.91
Only homes closest to segment A3	0.57	0.75	0.01	4.67

The second primary database developed describes the spatial location of properties that sold during our study period. Spatial features of primary interest are:

iv) Proximity of the house to the AOC.

v) Proximity of the house to other important location-specific amenities or disamenities such as the shoreline of Lake Michigan, other rivers, highway intersections, Kohler landfill, airports, and local parks.

The second section of Table 2.8 indicates the distribution of Sheboygan parcels across the jurisdictions. Over 70% of the parcels are located in the City of Sheboygan. The City of Sheboygan Falls and the Village of Kohler have 8% and 6% of the parcels in our sample, respectively. The towns of Sheboygan Falls and Lima only contain 1.01% and 0.88% parcels in the sample.

In addition, we count the distribution of the sample by closeness to AOC. Since the Sheboygan AOC does not have homogeneous characteristics, we divide the AOC into three sections: from the harbor to Kohler landfill (Lower River), from Kohler landfill to Waelderhaus Dam (Middle River), and from Waelderhaus Dam to Sheboygan Falls Dam (Upper River). Seventy-five percent of homes are located closest to the Lower River, owing to the location of the City of Sheboygan. Nine percent and 15% of the parcels in the sample are located closest to the Middle and Upper segments, respectively.

The last section of Table 2.8 reports the distance from a parcel to important locations as well as distance to the AOC. The mean distance to the Sheboygan airport is six miles. The mean distance between homes and a stream (that is not part of the AOC) is 1.22 miles, and the mean distance to the shoreline of Lake Michigan is 1.73 miles. The mean distance between homes and the Evergreen Park is approximately 2.8 miles. This is similar to the mean distance between homes and the Kohler landfill (mean=2.66). The mean distance to the nearest highway interchange is 1.95 miles.

The distance between homes and the AOC is our principal focus. The mean distance for all properties in the sample is 1.23 miles. Since we limited our samples within five miles from the AOC, the range of the distance is from 0.01 miles to 4.91 miles. The mean distances to the AOC based on the closeness to each of the three segments just discussed are presented. The mean distance to the AOC among homes that are closest to the Lower River is 1.25 miles. The mean distance to the AOC for homes that are closest to the Middle River is 2.11 miles. And finally, the mean distance to the AOC for homes that are closest to Upper River is 0.57 miles. This reflects the fact that parcels south of the AOC, and just west of the City of Sheboygan, tend to be closest to the Middle River. This area is relatively sparsely populated and relatively sales were recorded close to the AOC; most were at a considerable distance. On the other hand, near the Upper River, residential areas cluster close to the AOC. This reflects the fact that the river passes through the center of the City of Sheboygan Falls and very close to the center of the Village of Kohler

E. Survey Data

Based on the home sales data, we randomly chose 850 properties in each study area to be included in our survey. In order to have samples that would be statistically significant at the taxing jurisdiction level, each sample was stratified to over-represent jurisdictions with fewer home sales.

The survey was developed to complement the real estate market data. Three types of data were collected:

i) Information to verify current home characteristics and to assess respondent attitudes toward housing and the AOC;
ii) Conjoint choice responses; and
iii) Demographic information about the household.

The survey instruments were developed with assistance from the University of Illinois Survey Research Laboratory (SRL). Human subjects research waivers were requested from and granted by the Institutional Research Boards of the University of Illinois at Urbana-Champaign, University of Illinois at Chicago, and the University at Buffalo.[10] Early versions were assessed in late 2004 and early 2005 by focus groups held at the Public Library in downtown Sheboygan, WI, at the University of Wisconsin Campus located in western Sheboygan, and in a public library branch in West Seneca, NY. Advanced versions were pretested by mail in Spring 2005. After further modifications, the final instruments were mailed to the 850 property owners in each jurisdiction. Respondents could either mail back a completed questionnaire or complete an equivalent instrument using the Zoomerang.com commercial survey website.

The survey instrument for each AOC is illustrated in the Survey Methodological Report accompanying this report.[11] In each case, there were eight different versions of the instrument. The versions differed only in the attribute combinations used in questions 6 – 13. Tables 2.9A and 2.9B summarize the survey distribution and response rates. Appendices B and D provide further details about the survey responses and tests performed to assess those responses were reasonable and representative.

The choice questions asked respondents to imagine that additional homes had been on the market during their recent home buying experience. Hypothetical homes were then offered to them, one by one, and respondents were asked to indicate whether they would prefer the hypothetical home to the home they had actually bought. In order to focus respondents' attention on variables of interest, the hypothetical homes were described as being identical to their current home except for selected attributes. Those attributes were selected to focus on trade-offs between private

[10] The SRL is based at the University of Illinois at Chicago. The surveys were designed to be mailed by the SRL but collected by the Wisconsin Sea Grant Institute located at the University of Wisconsin-Madison and the Great Lakes Program of the University at Buffalo. The University of Wisconsin-Madison deferred to the IRB waivers granted by the University of Illinois campuses. The following waivers were issued by the other institutions: UIUC (#05090, 10/6/04), UIC (#2004-0699, 12/1/04), and UB (#1768, 1/20/05).

[11] See the accompanying file: Econ Ben Method Report.pdf.

Table 2.9A. Survey Distribution and Response Summary, Erie County, NY

Jurisdiction	Jurisdiction ID	Mailed	Undeli-verable	Not Returned	Mail Response	Internet Response	Final Usable [c]
Buffalo	1	383	38	206	127	8	126
Cheektowaga[a]	2	208	8	121	71	6	67
Hamburg[b]	3	26	2	15	8	1	9
Lackawanna	4	59	4	26	28	1	26
West Seneca	5	174	11	94	60	7	66
Total[d]		850	63	462	294	23	294

[a] Cheektowaga includes Sloan.

[b] Hamburg includes Blasdell.

[c] 20 observations were lost because distance could not be estimated by GIS. In addition, three respondents did not answer any house choice questions.

[d] Total response=317. Total surveys successfully delivered= 787.
Response rate = 317/787= 40.2%

Table 2.9B. Survey Distribution and Response Summary, Sheboygan County, WI

Jurisdiction	Jurisdiction ID	Mailed	Undeli-verable	Not Returned	Mail Response	Internet Response	Final[e] Usable
City of Sheboygan Falls	1	186	4	90	83	7	87
City of Sheboygan	2	187	2	104	71	7	73
Village of Kohler	3	133	2	67	58	4	58
Town of Wilson	4	106	2	56	45	3	45
Town of Sheboygan Falls	5	26	0	15	11	0	9
Town of Sheboygan	6	187	0	77	103	7	107
Town of Lima	7	25	1	14	8	0	7
Total[f]		850	11	423	379	28	386

[e] Nine observations were lost because distances could not be estimated by GIS. In addition, twelve observations did not respond to any house choice questions.

[f] Total resposes = 407. Total surveys successfully delivered= 839.
Response rate= 407/839 =48.5%

features of homes and the conditions of the neighborhood, particularly the AOC. The literature on conjoint choice analysis (e.g. Louviere, Hensher, and Swait, 2000) supports a balance between detail sufficient to make choices realistic and plausible, and simplicity that allows the choices to be readily understood and responded to. Accordingly, as noted previously, we limited the choice questions to four attributes: home size, environmental quality of the river, distance to the river, and home price. All of the attributes were described in relation to the home currently occupied or the neighborhood condition as it currently exists. The represent a mix of private (size and price) and community (environmental condition and proximity) variables.

Table 2.10. Home Attributes and Levels for Survey Choice Questions

Attribute	Home Size	Environmental Condition of River	Proximity to River	Home Price
Levels	+ 25%	Full cleanup	2 miles closer	+30%
	+15%	Partial cleanup	1 mile closer	+15%
	No change	No change	No change	No change
	-15%	Additional Pollution	1 mile further	-10%

The inclusion of the environmental and distance variables provides a basis to examine a key assumption in the hedonic model – that distance serves as a substitute for exposure to an environmental disamenity. For proximity, we asked the respondents to imagine the river being closer to their home without changing other features of the neighborhood. The environmental condition was varied qualitatively, with toxic pollution increasing, decreasing, or being eliminated.

Each of the four choice attributes was allowed to take on four levels. These are summarized in Table 2.10. A choice alternative consisted of one level for each attribute. With four attributes and four levels per attribute, there are $4^4 = 256$ possible combinations. Rather than examining all possible combinations, we elected a fractional factorial design that varies the attributes in a manner that assures orthogonality – that is, that the design itself does not introduce correlation between variables (Montgomery, 2000). Our design ensures orthogonality between the individual attributes (main effects) and two-way interaction terms. Sixty-four choice alternatives resulted from the design. We divided the 64 alternatives into eight groups of eight alternatives using random assignment.

For size, proximity, and price, the levels are proportioned to the comparable value for the home currently owned. This has the advantage of scaling the alternatives to be realistic for each respondent while also transforming discrete "level" variables into continuous variables. The environmental condition attribute is the exception. There is no obvious way to reduce the environmental condition to a univariate index.

3. BENEFIT ESTIMATES: BUFFALO RIVER AOC, NY

A. Hedonic Analysis of Property Values

This section focuses on the hedonic regression results for single family residences that sold between 2002 and 2004 within five miles of the Buffalo River AOC. Because the data were available to us, we also estimate hedonic regressions for multi-family housing that sold between 2002 and 2004 in the same area. The market for multi-family units is distinct from the market for single-family housing, and thus we estimate separate hedonic price functions for this market sector. Of primary interest are our results for the single-family residences, and so we focus on these results in our discussion, incorporating the multi-family results only at key discussion points.

All prices are in 2004 dollars. The house price index for Buffalo-Niagara, NY metropolitan statistical area provided by the US Office of Federal Housing Enterprise Oversight was used to convert all sales prices to 2004 dollars.

As indicated in Section 2.B, we explored two different econometric models of the impacts of the AOC on surrounding property values. We first present results from the linear-log model (equation 2.2) in Table 3.1. The variables that describe the parcel and its improvements are the parcel's acreage, the age of the home, the square feet of living area, the number of bedrooms, full baths and half baths present, the assessor grade of the home's overall quality, the number of stories that comprise the home, the housing style, and whether or not the home has a full basement or a fireplace. We interact the variable describing square feet of living area with a dummy-variable indicating whether a property is in the northern portion of our study area (north of the AOC), or the southern area of the study area. The definitions for these variables and their summary statistics for our sample are given in Table 2.3 and Table 2.4.

As indicated in Table 3.1, the coefficient estimates for the variables describing the housing characteristics are of the expected sign and generally statistically significant at the 5% level or better. More specifically, parcels with larger acreages sell for more, but as size increases, each additional acre contributes smaller amounts to price (i.e., the effect of lot size on sales price is non-linear). Similarly, the relationship between age of a home and sales price is not a simple linear one – price decreases with age up to a point, and then price begins to increase as homes become older (i.e., become "historic"). Each additional square foot of living area adds to price, and homes in the northern portion of our study area sell for approximately double the price, per square foot, than homes in the southern area of our study area, on a quality-adjusted basis. Our models also indicate that a half-bath contributes approximately one-third the amount to sales price as a full-bath. The coefficient estimate for the variable indicating the number of bedrooms present has a negative sign. Strictly interpreted, this indicates that for a given house size (i.e., constant square feet of living area), an additional bedroom in that same footprint would reduce sales price (i.e., there would be more bedrooms, but each one would be smaller in order to keep the overall square footage the same).

The overall quality grade assigned by the assessor is also a significant predictor of sales price. Homes graded "above-average" (*grade_ab*) sell for significantly more than homes graded "average" (grade_c). Similarly, the coefficient estimate for homes graded "below-average" (*grade_de*) suggests that they sell for less than homes graded "average," although this estimate does not differ statistically from zero at the 10% level of significance. Colonial homes sell for more than ranch-style homes, while cape style and "old-style" homes sell for significantly less than ranch-style homes. Lastly, homes with full basements or with at least one fireplace sell for more than homes without a full basement or lacking a fireplace, although the estimate for basements is marginally above the 10% level of significance.

Two types of location-related variables are included in the model. The first type encompasses dummy variables (zero or one) that indicate the jurisdiction, census tract, or other major location group associated with the property (see "Locational Dummy Variables" in Table 3.1). These dummy variables control for neighborhood and municipality characteristics. As there are over 100 census tract dummy variables included in the model, brevity precludes their inclusion in our table of summary results. There are four dummy variables indicating jurisdiction in Table 3.1. These dummy variables capture differences relative to the baseline jurisdiction. That baseline jurisdiction is the City of Buffalo to the north of the AOC, shown as variable "north". The division of the City of Buffalo into two sectors is motivated by potentially important differences between the parts of the study area that lie to the north of the AOC and those to the south. In particular, to the north of the AOC and just south of the central business district of Buffalo are found a substantial railway network, major highway, and much industrial property. Residential density is relatively sparse. The impacts of the AOC on homes in this area and further north may be significantly different from those to the south of the AOC where there are fewer other potentially-confounding non-residential land uses between residential areas and the AOC. In addition, Hamburg is excluded because of collinearity between its dummy variable and other variables included in the model.

As indicated in Table 3.1, after controlling for home features and other location characteristics of the property, homes in the City of Buffalo south of the AOC, as well as homes in West Seneca and Lackawanna, sell for significantly less than homes in the City of Buffalo north of the AOC. The coefficient estimate for Cheektowaga is also negative but not significantly different from zero. The coefficient estimate for the dummy variable (*north*) indicating a home is anywhere north of the Buffalo River is not significantly different from zero.

The second type of location-related variables included in the model captures distances between individual properties and geographic features of potential importance to homeowners. As discussed in Section 2.D, 10 distance characteristics of each home were computed. In our regression models, seven of these characteristics were interacted with a dummy variable indicating whether or not the property was north of the Buffalo River. This allows the impacts of, for example, proximity to the shoreline to vary across the northern and southern sectors of the City of Buffalo.

Table 3.1 Hedonic Results for Linear-Log Model of Buffalo River AOC

Number of obs = 3474, R-squared = 0.8307

saleprice	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HOUSING CHARACTERISTICS						
acres	29357.43	9509.671	3.09	0.002	10712.03	48002.83
acres2	-8492.726	3306.167	-2.57	0.010	-14975.05	-2010.397
age	937.4721	294.0009	3.19	0.001	361.0309	1513.913
age2	-12.10134	3.957649	-3.06	0.002	-19.86102	-4.341665
age3	.0417965	.0164825	2.54	0.011	.0094796	.0741134
sfla	28.48173	3.229564	8.82	0.000	22.14959	34.81386
sfla*north	27.2038	6.11396	4.45	0.000	15.2163	39.19131
bedrooms	-2353.454	1296.63	-1.82	0.070	-4895.728	188.8193
fullbaths	16720.58	3056.083	5.47	0.000	10728.58	22712.57
halfbaths	6009.634	1732.345	3.47	0.001	2613.063	9406.205
grade_ab	64956.37	6738.739	9.64	0.000	51743.87	78168.87
grade_de	-3981.978	2777.186	-1.43	0.152	-9427.146	1463.189
cape	-8780.211	1647.315	-5.33	0.000	-12010.07	-5550.356
colonial	14254.9	3763.844	3.79	0.000	6875.215	21634.59
oldstyle	-21287.2	4056.633	-5.25	0.000	-29240.95	-13333.45
fullbasement	2948.404	1845.724	1.60	0.110	-670.4658	6567.274
fireplace	4608.768	1888.649	2.44	0.015	905.7354	8311.8
LOCATION DUMMY VARIABLES [a]						
Buffalo_S	-270359	157679.2	-1.71	0.087	-579517.2	38799.15
Cheektowaga	-207797.7	147340.2	-1.41	0.159	-496684.5	81088.99
West Seneca	-274996.5	157459.7	-1.75	0.081	-583724.2	33731.23
Lackawanna	-269222.5	157577.5	-1.71	0.088	-578181.3	39736.16
north	-170661.5	266022.8	-0.64	0.521	-692246.5	350923.6
PROXIMITY VARIABLES (NON-AOC)						
lncbd_n	-15161.38	16621.16	-0.91	0.362	-47750.13	17427.36
lndelpark_n	-17458.48	6234.928	-2.80	0.005	-29683.17	-5233.798
lnpark_s	372.2656	893.9202	0.42	0.677	-1380.424	2124.955
lnrail	643.1972	1006.147	0.64	0.523	-1329.532	2615.927
lnrail*north	2891.101	2121.117	1.36	0.173	-1267.727	7049.928
lnstream	-1271.646	1028.865	-1.24	0.217	-3288.92	745.6276
lnstrm*north	1936.142	3786.896	0.51	0.609	-5488.741	9361.025
lnairport	-21680.57	14903.03	-1.45	0.146	-50900.62	7539.471
lnairp*north	-6821.778	20810.12	-0.33	0.743	-47623.72	33980.16
lnhws	2659.93	1405.441	1.89	0.058	-95.68632	5415.547
lnhws*north	5371.015	3920.075	1.37	0.171	-2314.991	13057.02
lnhwy	2609.936	1673.722	1.56	0.119	-671.6943	5891.567
lnwhy*north	1908.022	2846.051	0.67	0.503	-3672.169	7488.213
lnhwyx	-2031.372	2505.358	-0.81	0.418	-6943.574	2880.829
lnhwyx*north	-14112.96	5333.049	-2.65	0.008	-24569.35	-3656.57
lnshore	-3657.788	7642.245	-0.48	0.632	-18641.77	11326.19
lnshore*north	26668.2	14373.24	1.86	0.064	-1513.098	54849.5
PROXIMITY TO THE AOC						
lnaoc	6769.569	2597.696	2.61	0.009	1676.324	11862.81
lnaoc*north	-5585.481	7968.083	-0.70	0.483	-21208.33	10037.37

[a] Note: Coefficient estimates for the 118 dummy variables indicating the census tracts in which houses were located are not reported for succinctness. Also, the dummy variable for Hamburg is category not included in the model.

To see how to interpret the coefficient estimates for the variables that are interacted with the dummy variable *north*, consider the coefficient estimates related to the distance of a home to the nearest rail line. The impact of a rail line on property values are allowed to vary by whether or not a property is located north or south of the Buffalo River. The change in sales price associated with a percentage change in distance from a rail line is given by:

β_{lnrail} for homes located south of the Buffalo River,
$\beta_{lnrail} + \beta_{lnrail*north}$ for homes located north of the Buffalo River, where β represents the coefficient estimate presented in Table 3.1 for the variable that is subscripted.

For properties located to the north of the Buffalo River, an F-tests of the null hypothesis that the sum of the two coefficients are equal to zero (e.g., H_o: $\beta_{lnrail} + \beta_{lnrail*north} = 0$) is conducted to determine whether or not the overall impact of distance from a feature of interest is significantly different than zero.

The impact results for these variables can be also be interpreted as the value of increasing distance from a feature of interest or, if one reverses the signs of the coefficient estimates, the value of increasing proximity to the feature of interest. In other words, for example, if the model indicates that increasing ***distance from*** the shoreline ***decreases*** property values, a plausible interpretation is that increasing ***proximity to*** the shoreline ***increases*** property values. Below, we describe results variously in these two interpretations, depending on the context.

We begin by discussing the location results for properties located north of the Buffalo River. The results in Table 3.1 indicate that increasing distance from the CBD does not impact home values in a statistically significant manner for properties located in the City of Buffalo, north of the AOC. Proximity to an uncontaminated stream also is not estimated to significantly affect property values. However, for homes located in the City of Buffalo north of the AOC, home values fall with distance to Delaware Park, and this result is statistically significant. Home values also increase in a statistically significant way when homes are located: further from a rail line; closer to the airport[12]; further from a hazardous waste site; further from the shoreline; further from a highway; and closer to a highway interchange.[13] These last three results warrant elaboration. Initially, one would expect home value to increase with proximity to the shoreline, all else held equal. However, the majority of the shoreline around the City of Buffalo is characterized by industrial or highway frontage on the shoreline and is not readily accessible. Under these circumstances, the negative impact of proximity to the shoreline is not surprising. A noteworthy exception to this generalization is the residential complex adjacent to the boat basin west of downtown Buffalo. In our analysis, the inclusion of this residential complex contributed to anomalous results. We concluded that it was such a distinctive sub-sector of the market that it could not plausibly be included in our model.

[12] The southwest corner of the land that comprises the airport lies 1.2 miles outside of our 5-mile buffer of the AOC.
[13] Statistical significance refers to the F-statistic for the test that the sum of the two relevant coefficients is equal to zero. Each is statistically significant at the 5% level, except proximity to rail lines and the shoreline which are significant at the 6% level.

The results for highways indicate that proximity to a highway generally decreases property values but, for a given distance to a highway, being nearer to a highway interchange increases property values. In other words, highways have negative external effects (as expected), but once you control for that effect, greater accessibility to a highway as indicated by proximity to an interchange increases property values.

For properties to the south of the Buffalo River, we find somewhat different results. Fewer location characteristics are significant predictors of property values. Proximity to a park, rail lines, uncontaminated streams, the airport, and the shoreline do not significantly impact property values. The spatial location of properties in the south, relative to each of these features, makes these results realistic. For instance, industrial properties line the shoreline, indicating that most of the shoreline in this area is not accessible to the public. Also, to the south of the AOC, there are few rail lines in close proximity to households, in contrast to the north.

Proximity to a hazardous waste site significantly reduces property values in the southern portion of our study area. Similar to the north, proximity to a highway appears to have a negative (albeit marginally insignificant) effect on property values while proximity to a highway interchange increases property values.

The preceding discussion summarizes results for all covariates in our models except proximity to the AOC. Before discussing the results for the AOC variable, we would first like to note the robustness of the results for the variables described above. Recall that we estimate models where distance variables are either the natural log of distance to a feature of interest (shown in Table 3.1) or the inverse of distance to a feature of interest (see equations 2.2 and 2.3 in Section 2.B). The inverse-distance model results appear in Appendix C, Table C.1. A comparison of the two models reveals that the results for all variables are remarkably stable across specifications. (The negative sign on the coefficient for the inverse-distance variable is consistent with a positive sign in the log-distance model.) The coefficient estimates for housing characteristics are nearly identical in magnitude and significance. Results for the location dummy variables vary only marginally (the dummy variables for West Seneca and Lackawanna are only significant at the 11% level in the model using inverse distance), and the results for distance variables are all the same as reported for the log model.

Estimation results for multi-family homes are reported in Appendix C, Tables C.2 and C.3. We followed the functional form for single family homes as closely as possible while focusing on goodness-of-fit for these data. The results are generally in accord with our expectations, and the effects of proximity to the AOC are described in the next section.

Impact of AOC on Property Values

Table 3.2 reports results relating to the proximity of homes to the AOC. The first two coefficient estimates presented repeat the two AOC-related coefficients reported in the Table 3.1 panel labeled "Proximity to the AOC". Also shown in Table 3.2 are the AOC results for the inverse-distance model (equation 2.3), for estimates based on sales prices of multi-family homes (using both the log and inverse models), and for models that explore different impact zone definitions

Table 3.2. Estimated Impacts of Buffalo River AOC on Property Values[a]

	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
Single Family Homes						
Log Model						
lnaoc	6769.569	2597.696	2.61	0.009	1676.324	11862.81
lnaoc*north	-5585.481	7968.083	-0.70	0.483	-21208.33	10037.37
Inverse Model						
invaoc	-56869.98	23644.76	-2.41	0.016	-103229.7	-10510.21
invaoc*north	17560.05	76778.34	0.23	0.819	-132977.6	168097.7
Multi-Family Homes						
Log Model						
lnaoc	9559.84	4536.221	2.11	0.035	662.2502	18457.43
lnaoc*north	-11631.03	12009.95	-0.97	0.333	-35187.99	11925.94
Inverse Model						
invaoc	-79443.27	41666.81	-1.91	0.057	-161170.8	2284.277
invaoc*north	94654.6	118821.2	0.80	0.426	-138407.7	327716.9
Alternative Impact Zone: Single Family Homes						
Log Model						
lnaoc	5878.976	2304.769	2.55	0.011	1360.065	10397.89
lnaoc*north	-15894.01	20675.8	-0.77	0.442	-56432.6	24644.59
Inverse Model						
invaoc	-47378.75	21298.84	-2.22	0.026	-89138.91	-5618.591
invaoc*north	77264.12	210854.2	0.37	0.714	-336153	490681.3
Alternative Impact Zone: Multi-Family Homes						
Log Model						
lnaoc	3997.217	3706.557	1.08	0.281	-3273.025	11267.46
lnaoc*north	-3011.3	16962.83	-0.18	0.859	-36283.12	30260.52
Inverse Model						
invaoc	-41588.47	34482.13	-1.21	0.228	-109223.6	26046.65
invaoc*north	-4340.143	185056.4	-0.02	0.981	-367319.7	358639.4

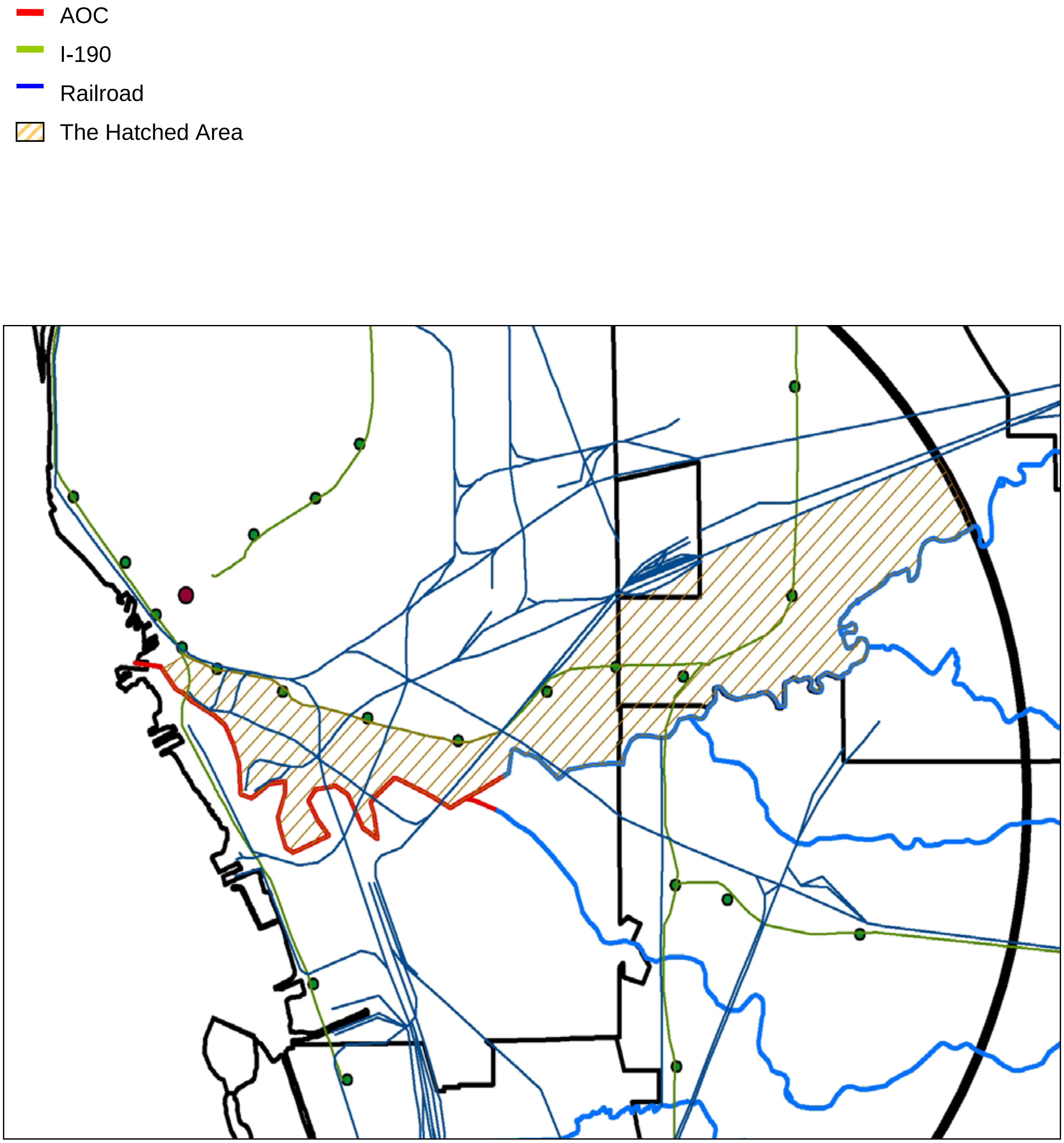
[a] There are 3,474 observations used in the single-family home regressions and 1,741 observations used in the multi-family home regressions. All variables as described for Table 3.1 are also included in the models reported here. The models for multi-family homes do not include four influential observations which significantly affect the coefficient estimate for the AOC variables.

for the AOC. Recall that our basic model captured the differences in spatial features north and south of the AOC by interacting the distance variables with a dummy variable equal to one if a property is located north of the Buffalo River. In particular, to the north of the AOC, crisscrossing rail lines, a heavily-industrial area, and the I-190 corridor lie between the AOC and most of our sample. However, several homes are located within a mile of the AOC to the north, but to the south of I-190 or of the rail corridor that crosses I-190 east of Fillmore Avenue. We re-estimated our models assuming that the homes that lie “close” to the AOC on the north-side may be affected by the AOC like homes to the south of the AOC. Figure 3.1 depicts this new geographic division. In Figure 3.1, the AOC is highlighted as the red segment of the Buffalo River. After the AOC branches between the mainstem of the Buffalo River and Cazenovia Creek, the mainstem continues to the north-east, tracing out the most northerly segment of the AOC. Our original south impact zone encompasses all properties located south, and within five linear miles, of the Buffalo River mainstem extending eastward from the river mouth at Lake Erie to the eastward limit of the AOC. The alternative impact zone includes the original south impact zone plus homes in the area shaded in Figure 3.1 by the simple hatch. The northern boundary of the hatched area is either the I-190 corridor along the northwest of the hatched area or the major rail corridor and rail yard along the northeast edge of the hatched area. Homes are now categorized as being either north of the hatched area, or within and south of the hatched area. For ease of exposition, we will now refer to the alternative north/south division as “I-190/RR” and the resulting “alternative impact zones.” Table 3.2 includes results based on the models re-estimated with this alternative definition of north versus south (see the panel labeled “Alternative Impact Zone”).

As indicated in Table 3.2, proximity to the AOC has a statistically significant, negative impact on single-family homes located south of the Buffalo River regardless of which functional form is used (log-distance model or inverse-distance model) and regardless of the definition of the impact zone. Also, for all models, the impact of proximity to the AOC is not statistically significant for homes located to the north of the dividing line. The active rail lines, interstate highway, and industrial zones located north of the Buffalo River appear to act as a buffer between the residential real estate market and the River. The negative external effects of those land-uses may overwhelm the influence of the AOC in the housing market to the north.

The results for multi-family homes are not as robust as those for single-family homes. We find a significant, negative impact of the AOC on multi-family homes properties located in the south of the AOC when we use the original definition for the impact zone (just properties south of the Buffalo River). But do not find a significant impact for multi-family homes to the north, or in the models with the alternative definition of the impact zone.

Figure 3.1. Highway I-190 & Rail Corridor as North/South Dividers



Marginal Effects of Proximity to the AOC

First, we report the marginal effects associated with proximity to the AOC. The estimated coefficients discussed in Table 3.2 are converted to dollar amounts to show how prices change as houses are located closer to the AOC, holding all else constant at sample mean values (see Section 2.B above for more discussion). Table 3.3 reports the estimated reduction in sales price at various distances from the AOC. All columns report impacts for models assuming the impact zone is limited to the area within five miles south of the AOC. Overall, the estimated marginal impacts are quite consistent across models. The estimated impacts are somewhat larger for multi-family homes than for single-family homes, but the price effects in both segments of the housing market become negligible as distance to the AOC becomes greater than 1.5 miles.

Figure 3.2 graphs the marginal effects reported in Table 3.3. The marginal impacts are converted to percentages of sales prices. We use the mean sales price of properties in our regression samples (in 2004 dollars) within 1.5 miles of the AOC, which is $66,000 and $60,000 for single- and multi-family homes, respectively. The estimated marginal effects for models including only single-family homes are shown in Panel A, and for models including both single and multi-family homes in Panel B. As indicated by these two figures and Table 3.5, the marginal price effects are large very close to the AOC, up to 16% of sales price, but diminish rapidly.[14] As indicated in this figure, the marginal price effects diminish to less than 1% of sales price by one mile for single family homes and 1.5 miles for multi-family homes. In essence, the impacts of the AOC are highly localized.

Total Property Value Losses

The results reported above are for *marginal* effects – the effects on price of a small change in distance from the AOC. However, for purposes of determining the overall impact on property values, we need to compute the *total property value loss* estimated to have occurred as a result of the presence of the AOC. We use equation 2.6 and 2.7 in Section 2.B to compute the total value losses individually for each single and multifamily home south of the AOC within our study boundaries (up to 5 miles away). The computation sums the marginal effects as one moves toward the AOC and away from the five-mile boundary. For comparison purposes, we also report these results for the subset of properties located within 1.5 miles, the area with the largest estimated impacts.

As indicated by Table 3.4, the estimated total capital losses south of the Buffalo River and within five miles of the AOC, based upon the log-model, are substantial: $118 million for single-family homes and $80.3 million for multi-family homes, for a total loss of $198.3 million. If instead we focus on the inverse model results, our estimated losses total for both land-use types is $141.4, approximately 29% lower than the log-model estimates.

[14] Approximately 17% of the single-family housing sample, and 23% of the combined single and multi-family housing sample are within one-and-a-half miles of the AOC.

Table 3.3. Marginal Price Impacts of AOC from Hedonic Models[a]

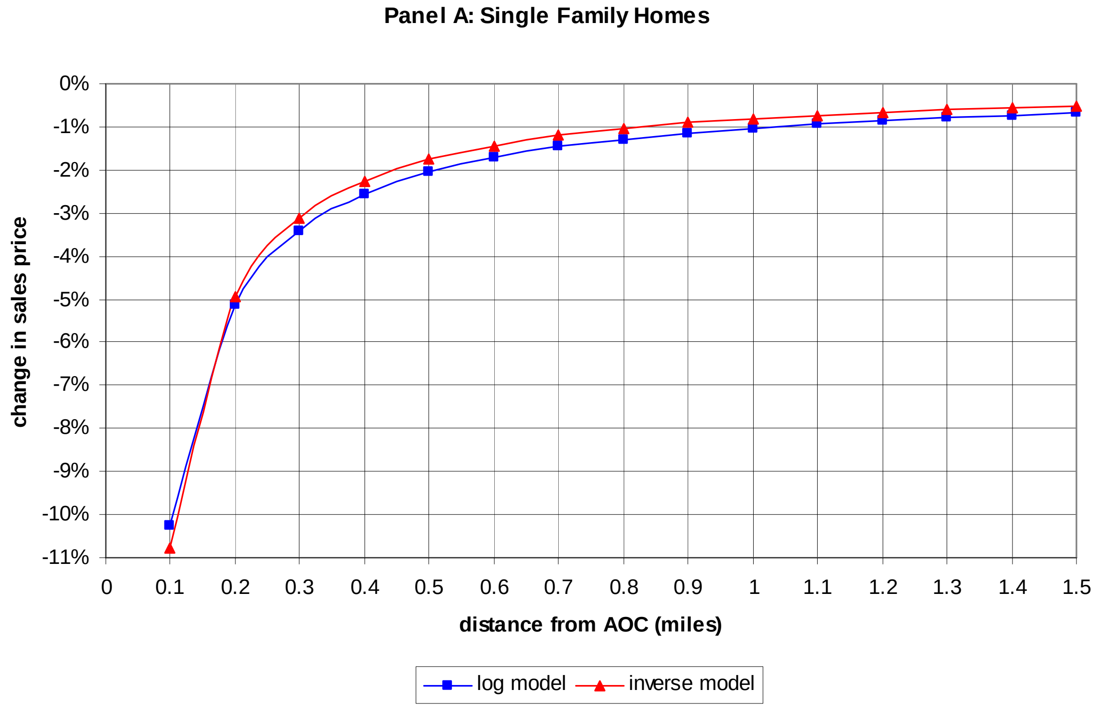
	Single Family Homes		Multi Family Homes	
Distance (mi)	**Log-dist.**	**Inv-dist.**	**Log-dist.**	**Inv-dist.**
0.1	$6,770	$7,109	$9,560	$9,930
0.2	$3,385	$3,259	$4,780	$4,553
0.3	$2,257	$2,066	$3,187	$2,885
0.4	$1,692	$1,494	$2,390	$2,088
0.5	$1,354	$1,163	$1,912	$1,624
1.0	$677	$533	$956	$745
1.5	$451	$338	$637	$472
2.0	$338	$244	$478	$341
2.5	$271	$190	$382	$266
3.0	$226	$155	$319	$216
3.5	$193	$130	$273	$182
4.0	$169	$112	$239	$157
4.5	$150	$98	$212	$137
5.0	$135	$87	$191	$122

[a] Dollar values represent the effect of a 0.10 mile change in location relative to the AOC.

Recall that our estimated impacts fall to less than one percent of property values by 1.5 miles for all samples and models. Estimated losses south of the Buffalo River within 1.5 miles of the AOC account for approximately 50% of the losses computed for up to five miles. Losses for single-family homes are $61.5 and $45.5 million depending on whether the log-model or inverse-model results are considered, respectively. Note, the mean capital loss per home is more than double that when estimating for homes within miles ($13,033 for 1.5 miles versus $5,142 for five miles).

We also compute the total capital losses for single family homes using the alternative definition of our impact zone (homes to the south of the I-190/RR division; see Figure 3.1). To compute total capital losses in this case, we use the coefficient estimates for the models based on this alternative definition of the impact zone (see Table 3.2). These models implied weaker effects of proximity to the AOC on property values, but we are now summing these smaller effects over more properties (approximately 5,000 more properties are within 5-miles of the AOC when we use the alternative definition of the impact zone). Using the alternative definition of the impact zone, total losses increase by $22 million and $11.4 million for the 5-mile and 1.5-mile ring around the AOC, respectively.

Figure 3.2 Marginal Impacts from Hedonic Models as Percent of Sales Price



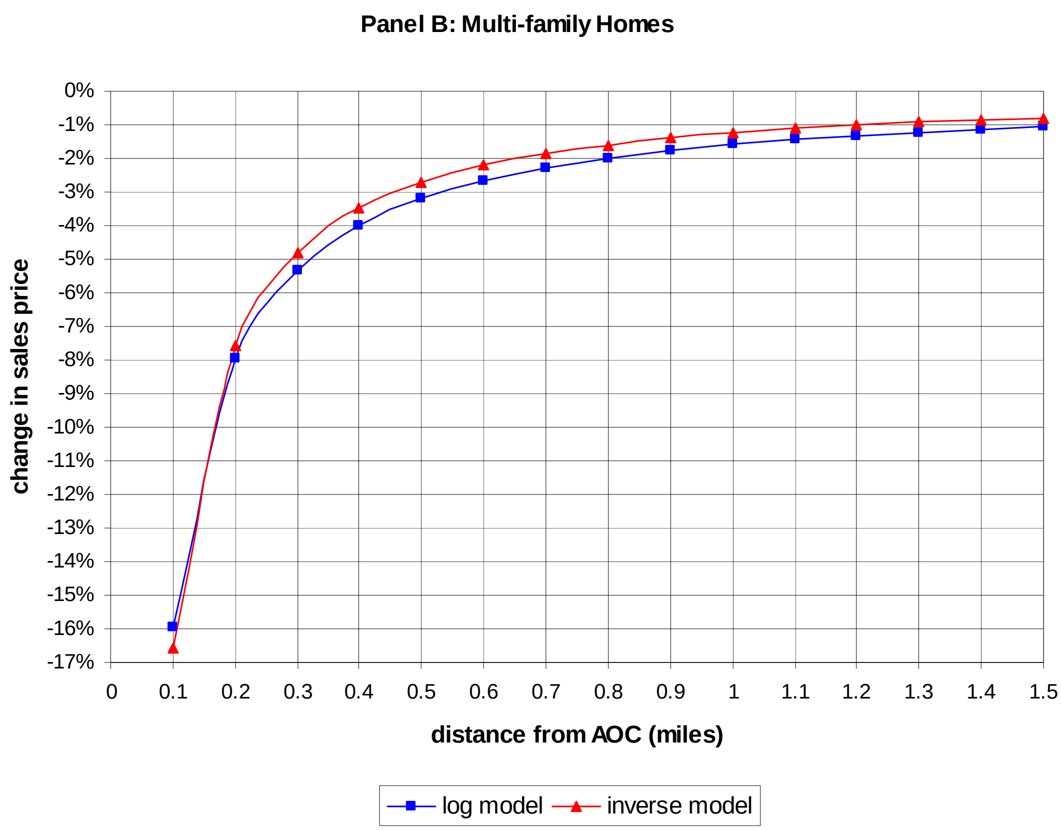


Table 3.4 Total Capital Losses Associated with the AOC from Hedonic Models

Model (Assumed Impact Zone)	No. of Properties	mean loss (std. dev.)	Total Capital Loss (millions)	Total Assessed Value (millions)	Capital Loss / Assessed Value	Total Estimated Value (millions)	Capital Loss / Estimated Value
Single Family Homes							
Log-Model (South of Buffalo River, 5 miles)	23,037	$5,142 (4,938)	$118	$1,390	8.5%	$2,170	5.4%
Inverse-Model (South of Buffalo River, 5 miles)	23,037	$3,639 ($3,787)	$83.8	$1,390	6.0%	$2,170	3.9%
Log-Model (South of Buffalo River, 1.5 miles)	4,721	$13,033 (4,338)	$61.5	$302	20.4%	$379	16.2%
Inverse-Model (South of Buffalo River, 1.5 miles)	4,721	$9,632 ($3,791)	$45.5	$302	15.1%	$379	12.0%
Log-Model (South of Hwy190/RR, 5 miles)	28,269	4,938 (4,461)	$140	$1,650	8.5%	$2,620	5.3%
Inverse-Model (South of Hwy190/RR, 5 miles)	28,269	3,367 (3,302)	$95.2	$1,650	5.8%	$2,620	3.6%
Log-Model (South of Hwy190/RR, 1.5 miles)	6,858	11,379 (3,771)	$78	$410	19.0%	$523	14.9%
Inverse-Model (South of Hwy190/RR, 1.5 miles)	6,858	8,073 (3,156)	$55.4	$410	13.5%	$523	10.6%
Multi-family Homes							
Log-Model (South of Buffalo River, 5 miles)	6,469	$12,418 (7,986)	$80.3	$426	18.8%	$576	13.9%
Inverse-Model (South of Buffalo River, 5 miles)	6,469	$8,903 (6,162)	$57.6	$426	13.5%	$576	10.0%
Log-Model (South of Buffalo River, 1.5 miles)	3,276	$18,979 (5,332)	$62.2	$225	27.6%	$282	22.1%
Inverse-Model (South of Buffalo River, 1.5 miles)	3,276	$13,869 (4,486)	$45.4	$225	20.2%	$282	16.1%

We also report the total capital loss as a percent of total assessed value in Table 3.4. Total assessed value of each parcel for the year 2004 was obtained from the tax assessor office in each jurisdiction (see the column "Total Assessed Value" in Table 3.4). As a percent of total assessed value, the estimated property value losses are substantial – between 6% and 8.5% of total value for properties within five miles of the AOC. Average losses are much larger for properties within 1.5 miles: between 13% and 20% of total value, depending on which model is chosen.

It is important to note that the percentage losses computed relative to total assessed values are likely to be upper bounds on the true loss as the tax assessed value of a property is likely to be lower than sales prices (actual market value). To better determine the magnitude of capital losses as related to property values (rather than tax assessed values), we estimated the extent to which tax assessor values underestimate sales prices. For each jurisdiction, we estimate a simple regression model in which sales price of a home is regressed on total tax assessor value reported for the parcel (with no constant term). The coefficient estimate then tells us the ratio of sale price to tax assessed value, and the goodness of fit tells us the correlation between the two variables. In all jurisdictions, the correlation between the two measures is over 95%, except West Seneca for which it is 91%. The City of Buffalo, Lackawanna, and Hamburg have assessed values that are between approximately 70% and 80% of sale price. Cheektowaga and West Seneca have assessed values that are 57% and 49% of sale price, respectively.

We apply the same regression models as discussed above to multi-family homes, and find that the tax assessed values for multi-family homes are closer to sales prices in every jurisdiction. Tax assessed values are between 85% and 95% of sales price in Buffalo, Lackawanna, and Hamburg, and are approximately 60% of sales price in Cheektowaga and West Seneca.

The estimated relationship between sales price and assessed value for each jurisdiction is used to compute a "Total Estimated Value" for all properties in each jurisdiction, reported in the next to last column in Table 3.4. This alternative measure of property value is then used to compare with the estimated capital losses. The estimated capital losses for single-family homes within 5 miles of the AOC are estimated to be between 3.6% and 5.4% of total estimated value of the properties within five miles (see the last column of Table 3.4). Similarly, there is a reduction of the estimated impacts for multi-family homes, ranging from 10% to 14% of estimated value within five miles of the AOC.

B. Conjoint Choice Analysis

As described in Chapter 2, the analysis of conjoint choice questions is based on the Random Utility Model (RUM) of discrete choice (see model 2.8). First, we estimate a relationship between the attributes included in the choice questions and the utility derived from a home (equation 2.10). Second, based on the utility model, we derive a marginal utility of income and are able to compute an expected value of willingness to pay (the compensating variation measure) for individual attributes. We are chiefly interested in WTP for changes in the environmental condition of the AOC. However, to provide comparison to the hedonic analysis, the survey questions also varied the proximity to the AOC.

RUM models are commonly estimated using conditional logit models (equation 2.12), and we follow this practice. By construction, a respondent maximizes utility as it is affected by the attributes in the choice questions. A small number of attributes – generally six or fewer – eases the cognitive burden placed on respondents. We selected four attributes that capture important characteristics of a home – its size, location, and price – and of its local environment – here the environmental status of the Lower Buffalo River. House size (*HOUSE*) equals the size of the current home times a specified percentage increase or decrease. Four percentage changes were considered: 25% larger, 15% larger, No change, and 15% smaller. A particular percentage change is multiplied times the size of the respondent's current home. This procedure makes home size a continuous variable. Similarly, price (*PRICE*, measured in 2004 dollars) was specified as a percentage change from the price paid for the current home. Four different percentages were considered: 30% higher, 15% higher, No change, and 15% lower. The calculation results in a continuous distribution of hypothetical home prices. Location (PROX, measured in tenths of miles from the closest point on the AOC) was specified as a nominal change in distance between the home and the river. Nominal changes were used out of concern that many respondents would not know their current distance, so percentage changes would not be very meaningful. The distance increments used were 2-miles closer to the river (or adjacent to the river if the current distance was less than two miles), 1-mile closer (or adjacent if currently located within one mile), no change, and one mile further away. Finally, in addition to the current condition of the river, we specified three different variables representing possible environmental conditions of the AOC (*ADD* = Added pollution; *PART* = partial cleanup; and *FULL* = full cleanup). Each of the non-current conditions is represented by a dummy variable. If all of them equal zero, the current condition obtains.

In addition to the choice variables from the survey, the model includes an alternative specific constant (*ASC*). The four attributes are not only factors which determine house choices. The average effects of other home attributes can be estimated by adding *ASC*, a dummy variable indicating whether or not the hypothetical home is preferred (*ASC*=1 if current home, 0 otherwise). A positive value for the *ASC* indicates that the current home is selected. Finally, the conditional logit model allows the introduction of socio-economic characteristics that might influence choice. These variables are interacted with the attributes. They act as shifters on the main effect of the attributes with which they interact. Income is commonly modeled in this way. Income is needed to compute a marginal utility of income for the WTP calculation. We do not have data for actual total household incomes. The survey asked each respondent to indicate an income interval characterizing their household. For modeling purposes, in order to avoid the inclusion of numerous dummy variables for the numerous income intervals, we consolidated the income categories into three groups represented by variables *HIGH* (above $100,000), *MID* (from $60,001 to $100,000); and *LOW* ($60,000 or below). Low is not included in the estimation, since it is the result of a household not being in either of the other categories.

After experimenting with a wide range of specifications, we found that logarithmic transformations of *HOUSE* and *PROX* best fit the data. The reasoning behind this specification is the same as for the hedonic model above – that is, nominal increases in house size and distance to the AOC should eventually diminish in their effects on choice. The logarithmic form implies that a percentage change in each of these attributes, which implies increases in nominal amount as the home grows bigger or farther, has a constant effect on price.

Another issue in arriving at a final specification concerned the potential for correlation due to the fact that each of the 287 usable survey responses provided eight data points for the estimation. Accordingly, we used a panel data estimator. A random effects estimator was chosen because the choice response may not be independent. The responses by one individual are likely to be correlated. Including the potential for correlation improves the estimation of the model (Haaijer et al., 1998).

The conditional logit specification is summarized in Table 3.5. The Wald χ^2-square test indicates that the model is significant at 1% level: the model is specified well. The log likelihood is significantly higher than the general conditional logit: (-1007.89 versus -1086.12). The log likelihood test for correlation within individual is significant at 1% level: The ignorance of the correlation would result in biased estimate. All of the variables have the expected signs. HOUSE and PROX both are positive and highly significant. The positive sign for distance is consistent with perception of the AOC as a disamenity. Concerning the environmental condition of the river, *ADD* affects choice negatively while *FULL* affects it positively, and both are highly significant. *PART* is positive but insignificant, suggesting that it would not induce most respondents to change homes. The negative and significant sign of *PRICE* implies that marginal utility of house price (income) is negative (positive). In addition to the main effects of these variables, several of the interaction terms are significant. *PROX* interacts positively with *ADD*, implying that more pollution would induce movement away from the river. The positive and significant interaction of *HIGH* and *PRICE* implies that high income households require larger price increments to influence their choices. This is consistent with a lesser marginal utility of income. The negative interaction of MID and PRICE, however, means that the middle income households have higher marginal utility of income, compared to other income level households. The positive, significant interaction of *MID* and *HOUSE* implies that middle-income respondents place a premium on housing space. The positive, significant coefficient on ASC implies that, other things equal, respondents were disinclined to select a hypothetical home.

The estimates in Table 3.5 are the basis for calculating WTP. The first step for moving beyond those estimates is to fully enumerate our response sample. That is, the attribute values for the home chosen by each respondent are inserted into the equation, producing a utility value. We calculate the utility differences between the current condition of the AOC and other hypothetical conditions of the AOC. Mean and median of the utility differences values are then selected from the resulting distributions. This process compensates for potential nonlinearities in the relationship of attributes to utility. The second step is to convert the mean and median utility values into WTP measures by change the differences of utility value into 2004 dollar. The third step is to multiply the mean and median values of WTP by the number of households in the population. The mean and median WTP for full cleanup are $15,017 and $10,758, respectively.

Table 3.5. Estimation Results of the Random Effect Conditional Logit for the Buffalo River AOC

Variable	Coefficient	Std. Err.	z	P>z
lnHOUSE	***5.20281	0.57268	9.08	0.00
ADD	***-1.25000	0.16137	-7.75	0.00
PART	0.07943	0.13231	0.60	0.55
FULL	***0.91929	0.13103	7.02	0.00
lnPROX	***0.11653	0.03511	3.32	0.00
lnPROX*ADD	*0.11733	0.06968	1.68	0.09
lnPROX*PART	-0.06793	0.04818	-1.41	0.16
lnPROX*FULL	-0.04399	0.04419	-1.00	0.32
PRICE	***-0.00005	0.00000	-10.26	0.00
HIGH*lnHOUSE	-0.06420	0.89122	-0.07	0.94
HIGH*ADD	-0.18181	0.26429	-0.69	0.49
HIGH*PART	0.01240	0.21610	0.06	0.95
HIGH*FULL	0.18130	0.20756	0.87	0.38
HIGH*PRICE	***0.00003	0.00001	5.65	0.00
MID*lnHOUSE	**1.76383	0.74479	2.37	0.02
MID*ADD	0.04613	0.20951	0.22	0.83
MID*PART	-0.07336	0.17737	-0.41	0.68
MID*FULL	-0.09281	0.16888	-0.55	0.58
MID*PRICE	***-0.00002	0.00001	-2.83	0.01
ASC	***1.16417	0.16633	7.00	0.00
Number of obs	2160			
Number of groups	286			
Obs per group: min	1			
avg	7.6			
max	8			
Wald χ^2 (19)	230.13			
Prob > χ^2	0			
Log likelihood	-1007.894			

*** significant at 1%
** significant at 5%
* significant at 10%

The results of those calculations appear in Table 3.6. The three panels show the calculations for single family homes south of the river (A), south of the I-190/RR corridor (B), and throughout the study area (C). All zones are bounded by the five-mile radius from the AOC. The first two panels support comparisons with the hedonic results. Each panel provides estimates of WTP for additional pollution and partial and full cleanup – in each case, computing values based on the

Table 3.6. Single-family Homeowners Willingness to Pay for Changes in AOC Environmental Quality, by Impact Area within Five Miles (2004 $)

A. All Properties South of the Buffalo River

Total Single Family Homes South of River		23037
Aggregate	With Sample Mean	With Sample Median
WTA for Additional Pollution	-$701,490,575	-$474,088,248
WTP for Partial Cleanup	-$89,185,329	-$33,540,087
WTP for Full Cleanup	$345,942,551	$247,840,564

B. All Properties South of the I-190/RR Corridor

Total Single Family Homes South of I-90 and RR Corridor		28,269
Aggregate	With Sample Mean	With Sample Median
WTA for Additional Pollution	-$860,808,138	-$581,759,808
WTP for Partial Cleanup	-$109,440,468	-$41,157,473
WTP for Full Cleanup	$424,510,569	$304,128,354

C. All Properties within Five Miles of the AOC

Total Single Family Home within Five Miles		52,628
Aggregate	With Sample Mean	With Sample Median
WTA for Additional Pollution	-$1,602,554,412	-$1,083,054,058
WTP for Partial Cleanup	-$203,743,781	-$76,622,290
WTP for Full Cleanup	$790,305,360	$566,191,483

Table 3.7. Total Value Losses per Property Estimated by Random Effect Conditional Logit Model

	Mean WTP(WTA)	Median WTP(WTA)	Mean WTP/ Mean Property Value	Median WTP/ Median Property Value
ADD	-$30,451	-$20,579	-32.9%	-26.5%
PART	-$3,871	-$1,456	-4.2%	-1.9%
FULL	$15,017	$10,758	16.2%	13.8%

mean and median attribute values in the sample. The mean values can be influenced by outliers, so median values are commonly used in real estate studies.

In the first panel, the total WTP for full cleanup in homes south of the river is $247 million based on the median. The estimated WTA for additional pollution is very substantial: $ 474 million.

There are 28,269 single family houses south of the I-190/RR corridor. The absolute value of the aggregated WTP (WTA) is larger because there are more homes south of the I-190/RR corridor than there are south of the river. The larger area produces aggregate estimates of $304 million for full cleanup and -$581 million for additional pollution. The latter estimate is negative because WTA represents payments *to* the residents to compensate them for further degradation of the AOC. The total number of single family homes within five miles of the AOC is 52,628. The estimated WTP for cleanup and WTA for additional pollution are $566 million and -$1,083 million, respectively.

We also report the WTP and WTA as a proportion of the property values in the samples. The mean and median sales prices of the homes in the samples are $92,462 and $77,697 respectively. In Table 3.7, the percentage of WTP for full clean up is approximately 14% to 16%, whereas the percentage of WTA for additional pollution is -27% to -33%.

C. Comparison of Hedonic and Conjoint Choice Estimates

Both the hedonic price model and the conjoint choice model indicate that residential property values are significantly discounted due to the AOC. According to the hedonic models, the estimated total capital losses south of the Buffalo River are substantial – more than $80 million for single family home, irrespective of the model selection. The estimated capital losses for single family homes within five miles of the AOC are between 3.6% and 5.4% of total estimated home values. With the conjoint choice estimation, the total WTP for full cleanup in homes south of the river is between $247 and $304 million based on the median, and that is about 13.8% of total property values in the area.

Even though the hedonic models do not show significant impacts of the AOC on properties north of the Buffalo River, the north/south distinction does not appear in the conjoint choice responses.[15] Together with the fact that the average WTP estimates in the conjoint model are two to three times greater than the hedonic estimates of property value loss, the fact that the conjoint responses apply both north and south of the AOC contributes to an estimated total WTP for full cleanup of $566 million that is four to five times as large as the estimated property value losses.

There are several possible reasons for the discrepancy in the estimates between the two different methods. First, in responding to the survey, homeowners might have considered not only price restoration from the cleanup itself, but also the possibility of ancillary improvements that might reinforce the effects of AOC remediation. Second, those who responded to the survey tended to be above-average in home values and, most likely, in incomes. According to our data, wealthier households generally have a lower marginal utility of income, suggesting that they are willing to spend more for a given change. Third, responses to the hypothetical survey could differ from decisions that would be made in real life. Finally, as is also true in the hedonic approach, the distance measure may be correlated with other environmental factors that we do not observe or include in our model.

[15] We tried to include north interaction variable in the conjoint choice models, but the estimation results were not as good as the final model and the interaction variable was not significant.

D. Revenue Implications

To illustrate the revenue implications of the potential increases in residential property values, we assume that local governments could issue 15-year revenue bonds paying 5% annual coupon interest with a 2% cost of bond issue. An overall property tax rate of 4% of market value seems to be a reasonable approximation for Erie County jurisdictions.

Applying a 4% tax rate to the lower-bound estimate of total (both single-family and multi-family) property value increase, $137 million, produces an aggregate annual revenue stream of $5,480,000. These revenues would suffice to repay principal and interest on a bond worth approximately $76 million.[16]

The preceding calculation is purely illustrative and should not be interpreted as a specific estimate of revenues that Erie County jurisdictions could commit to AOC remediation. This note of caution is warranted for several reasons. First, the actual interest rate on a debt issue would depend on current market conditions, the creditworthiness of the issuing jurisdiction(s), and whether the bond is backed by general revenues of the jurisdiction or only revenues actually realized from the affected properties. Second, issue charges could be less – 2% is a maximum under federal law. Third, in many jurisdictions, assessed property values are significantly less than current market values. Such a situation could a tax base increase less than the change in market values. Fourth, it is unlikely that local jurisdictions would commit the entire property tax increment to remediation costs. Other community services, including infrastructure and schools, would ordinarily claim significant shares of new property tax revenues. In addition to these cautions about the overall amount of potential property tax revenue, it is important to note that the revenues would be distributed among at least seven different primary taxing jurisdictions within Erie County.

[16] Annual coupon interest = 0.05 * $5,480,000 = $274,000. Applying the residual to bond principal annually for 15 years = $5,206,000 * 15 = $78,090,000. Issue fees of 2% would reduce the net bonded amount to $76,528,200.

4. BENEFIT ESTIMATES: SHEBOYGAN RIVER AOC, WI

In this chapter, we present estimates of the property value impacts of the Sheboygan River AOC. The grant from USEPA/GLNPO did not anticipate completion of this study. We have been assisted in developing these estimates by complementary grants received from the Illinois-Indiana Sea Grant Program and from the Cooperative States Research, Education, and Extension Service, U.S. Department of Agriculture.

A. Hedonic Analysis of Property Values

We collected data for single family residences sold in 2002, 2003, and 2004 and located within five miles of the Sheboygan River AOC. These properties are located in seven different jurisdictions. The quality of the assessment data was very uneven between jurisdictions. All sale prices were converted to 2003 dollars using the house price index for the Sheboygan metropolitan area computed by the Office of Federal Housing Enterprise Oversight (OFHEO).

We estimate three different forms of the hedonic price model as discussed in Section 2.B. First, Table 4.1 presents results from the linear-log specification. The variables that describe the parcel and its improvements are acreage, the age of the home, the square feet of living area, and the number of full baths and half-baths. Unfortunately, the assessment data contain a large number of missing observations for other attribute variables, and their inclusion would require many observations to be dropped or extensive use of missing variable techniques. Therefore, we use only these five attribute variables. The jurisdiction dummy variables are included to catch the cumulative effects of township services, tax rates, and other community variables. Distances to the AOC and to other prominent features of the local landscape, including highways, railroads, other rivers, and the central business district, are also included. The definitions for these variables and their summary statistics for our sample were presented in Table 2.7 and Table 2.8.

Table 4.1 presents the estimated coefficients. The model explains the data quite well, as indicated by an R^2 of 0.7445. All parcel characteristic variables are significant at 1% level and reasonable in sign. The positive significant coefficient of *sqftsq* means that the value of house size contributes to house value at increasing rate. Age has a negative but diminishing effect while lot size has a positive but diminishing effect.

The "base" jurisdiction in the model is the Town of Sheboygan Falls (TSF). The jurisdiction dummies included in the model represent changes in property prices relative to TSF as a result of different levels of services, tax rates, and other community features. After controlling for home characteristics and other location characteristics, the jurisdiction dummies are significantly positive for the City of Sheboygan Falls and the Village of Kohler but negative for the City of Sheboygan Falls and the Village of Kohler. The other jurisdiction dummies are not significant at 10% level implying comparability to TSF.

The location-related variables capture the linear distances between each home and geographic features of potential importance to homeowners. Eight features are included: the AOC, major highways, Evergreen Park, the Sheboygan Campus of the University of Wisconsin, the Lake

Michigan shoreline, rivers other than the Sheboygan River, the Sheboygan County Airport, railways, and the Kohler Landfill. Except for distance to the railways, all of the distance coefficients are significant at 5 % level. The significant positive coefficients of the Kohler Landfill and the highway variable means that house values increase with distance. In other words, closeness to those sites depresses house values. The coefficient of distances to Evergreen Park, the airport, the shoreline, UW-Sheboygan, and other rivers are significantly negative. Proximity adds to property values.

Table 4.1. Hedonic Results for Linear-Log Model of Sheboygan River AOC

Number of obs = 2168, R-squared = 0.7442

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HOUSING CHARACTERISTICS						
fullbath	8224.626	2116.056	3.89	0.000	4074.888	12374.36
halfbath	7777.831	1802.419	4.32	0.000	4243.157	11312.51
sqft	15.57118	4.539914	3.43	0.001	6.668077	24.47427
sqftsq	.009483	.0008438	11.24	0.000	.0078282	.0111378
age	-861.2165	97.98266	-8.79	0.000	-1053.368	-669.0654
agesq	2.447601	.7229121	3.39	0.001	1.029918	3.865284
acres	28651.75	4937.244	5.80	0.000	18969.45	38334.04
acressq	-2558.92	650.1631	-3.94	0.000	-3833.937	-1283.904
JURISDICTION DUMMY VARIABLES						
CSF	32011.02	9471.701	3.38	0.001	13436.33	50585.7
CF	-1854.606	13661.37	-0.14	0.892	-28645.54	24936.33
VK	94743.07	13408.31	7.07	0.000	68448.41	121037.7
TW	14112.65	13962.88	1.01	0.312	-13269.56	41494.86
TS	17199.39	11985.19	1.44	0.151	-6304.441	40703.22
TL	8670.388	13201.47	0.66	0.511	-17218.64	34559.42
PROXIMITY VARIABLES (NON-AOC)						
lnkohlerland	59950.08	15538.61	3.86	0.000	29477.74	90422.41
lnevrgnwoods	-4338.146	2095.383	-2.07	0.039	-8447.343	-228.9491
lnairport	-26579.26	7773.831	-3.42	0.001	-41824.3	-11334.21
lnorv	-4531.364	1761.564	-2.57	0.010	-7985.918	-1076.81
lnshoreline	-8632.865	1854.907	-4.65	0.000	-12270.47	-4995.259
lnhighway	14046.14	3928.425	3.58	0.000	6342.219	21750.07
lnuwsheb	-70408.37	13979.97	-5.04	0.000	-97824.1	-42992.63
lnrwaysite	4104.207	4341.914	0.95	0.345	-4410.6	12619.01
PROXIMITY VARIABLES (AOC)						
lnaoc	4032.738	2181.296	1.85	0.065	-244.9402	8310.416
lnaoc*A1	547.8406	1978.064	0.28	0.782	-3331.285	4426.967
lnaoc*A2	-289.9047	2383.686	-0.12	0.903	-4964.485	4384.676

Table 4.2. Hedonic Results for Inverse Distance Model of Sheboygan River AOC

Number of obs = 2168, R-squared = 0.7445

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
fullbath	8211.258	2115.02	3.88	0.000	4063.552	12358.96
halfbath	7790.251	1801.606	4.32	0.000	4257.172	11323.33
sqft	15.39737	4.534281	3.40	0.001	6.505319	24.28942
sqftsq	.0095042	.0008434	11.27	0.000	.0078503	.0111582
age1	-869.676	97.11298	-8.96	0.000	-1060.122	-679.2305
age1sq	2.494759	.7145719	3.49	0.000	1.093432	3.896086
acres	28322.01	4914.068	5.76	0.000	18685.16	37958.85
acressq	-2535.189	648.2417	-3.91	0.000	-3806.437	-1263.94
JURISDICTION DUMMY VARIABLES						
CSF	32013.46	9540.511	3.36	0.001	13303.83	50723.09
CF	6446.57	13661.65	0.47	0.637	-20344.91	33238.05
VK	95624.7	13488.71	7.09	0.000	69172.37	122077
TW	22380.37	13781.34	1.62	0.105	-4645.828	49406.57
TS	24671.32	12112.93	2.04	0.042	916.9889	48425.65
TL	9125.903	13117.12	0.70	0.487	-16597.72	34849.53
PROXIMITY VARIABLES (NON-AOC)						
kohlerlandiv	-514573.5	170268.1	-3.02	0.003	-848481.5	-180665.5
evrgnwoodiv	33699.4	23524.56	1.43	0.152	-12433.97	79832.76
airportiv	259572.1	88301.16	2.94	0.003	86407.19	432737.1
bompiv	40137.34	15053.57	2.67	0.008	10616.21	69658.48
shorelinei	78499.94	16106.43	4.87	0.000	46914.08	110085.8
highwayiv	-132855.4	38429.5	-3.46	0.001	-208218.4	-57492.34
uwshebiv	619142.2	149546.5	4.14	0.000	325870.8	912413.5
rwaysiteiv	-58257.2	39608.18	-1.47	0.141	-135931.7	19417.29
PROXIMITY VARIABLES (AOC)						
aociv	-32026.77	16428.81	-1.95	0.051	-64244.85	191.3126
aociv*A1	1449.847	3589.056	0.40	0.686	-5588.55	8488.243
aociv*A2	-3996.448	2870.525	-1.39	0.164	-9625.754	1632.857

In addition to the linear-log specification, we estimated the inverse-distance model (see again section 2.B of this report). The inverse-distance model is as good as the linear-log model with R^2 of 0.7445. Those results appear in Table 4.2. The inverse-distance function results are qualitatively very similar to those of the log distance model. All coefficients are stable in terms of magnitude and significance. The coefficient estimates for housing characteristics are nearly identical while those for the distance variables change in sign due to the inverse form in which the distance variables appear. After testing powers from 0.10 to 1.0, the inverse-distance variables are raised to the power of 0.10 – the tenth root—providing the best fit to the data. The smaller the value of the exponent (i.e., the higher the root), the more gradual is the effective of distance.

Impact of AOC on Property Values

The AOC is divided into three sections based on its physical characteristics. The Lower River extends three miles from the Kohler Landfills to the harbor. The Middle River extends seven miles from the Waelderhaus Dam to the Kohler Landfill. The Upper River extends approximately four miles from the Sheboygan Falls Dam to Waelderhaus Dam. The bulk of the officially-recognized contamination originated from a small engine manufacturing plant in the City of Sheboygan Falls. The middle section of the river flows through land owned by the Kohler Company and used for a horse farm, a tree nursery, golf courses, and a private hunting and fishing club and wildlife area. The Lower River passes through parkland before reaching commercial and industrial areas in the City of Sheboygan.

Dummy variables are used to distinguish the different sections of the river, using effects coding (Adamowicz et, al., 1994, 1997). A1 and A2 are effects-coded dummy variables for the Lower River and Middle River, respectively. A1 takes the value of 1 if a home is closest to the Lower River, 0 if it is closest to the Middle River, and -1 if closest to the Upper River. A2 equals 0 if a parcel is closest to the Lower River, 1 if closest to the Middle River and -1 if closest to the Upper River. Thus, (A1,A2) = (1,0) for properties closest to the Lower River, (0,1) for properties closest to the Middle River, and (-1,-1) for properties closest to the Upper River. These variables supplement the measurement of distance to the closest point on the River within the AOC. In the linear-log model, the change in sales price associated with a percentage change in distance from the AOC is given by:

β_{lnaoc} for the average distance effect on all properties
$\beta_{lnaoc} + \beta_{lnaoc*a1}$ for homes closest to the Lower River
$\beta_{lnaoc} + \beta_{lnaoc*a2}$ for homes closest to the Middle River
$\beta_{lnaoc} + \beta_{lnaoc*a1} + \beta_{lnaoc*a2}$ for homes closest to the Upper River

where β represents the coefficient estimate presented in Table 4.1 for the variable that is subscripted.

Considering each segment of the river individually, an F-tests of the null hypothesis that the sum of the coefficients of the main effect and interaction variables are equal to zero (e.g., H_o: $\beta_{lnaoc} + \beta_{lnaoc*a1} = 0$) reveals whether the overall impact of distance is significantly different from zero for homes closest to that segment. According to the linear-log model estimates, proximity to the AOC significantly reduces property values in the study area, since *lnaoc* is significantly positive. However, the interactions between the river segment dummies and AOC distance are not statistically significant. Thus, after controlling for the other variables, the property market does not appear to be segmented by river section. F-tests for the combinations of the coefficients are significant for the Lower River and the Upper River at 10% level. However, we cannot reject the null hypothesis that the sum of β_{lnaoc} and $\beta_{lnaoc*a2}$ is equal to zero at the 10% level of significance.

Table 4.3. Estimated Impacts of Sheboygan River AOC on Property Values

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Log Distance						
lnaoc	4032.738	2181.296	1.85	0.065	-244.9402	8310.416
lnaoc*A1	547.8406	1978.064	0.28	0.782	-3331.285	4426.967
lnaoc*A2	-289.9047	2383.686	-0.12	0.903	-4964.485	4384.676
Inverse Distance						
aociv	-32026.77	16428.81	-1.95	0.051	-64244.85	191.3126
aociv*A1	1449.847	3589.056	0.40	0.686	-5588.55	8488.243
aociv*A2	-3996.448	2870.525	-1.39	0.164	-9625.754	1632.857

Table 4.3 compares the estimates for the inverse distance coefficients alongside those from the linear-log model. The significantly negative coefficients in the inverse model are consistent with the oppositely-signed coefficients in the linear log form, indicating once again that proximity to the river depresses sales prices. This includes the Upper River. Although the prospects for clean-up in the Upper River may have been known to some residents in the 2002-2004 period, house values closest to that segment apparently continued to be discounted. The interaction between the river segment dummies and AOC distance are not statistically significant. However, an F-test for the *combination* of the main interactive distance effects in the inverse model indicates that all sections of the river have negative impacts on property values significantly at the 10% level. The same test applied to the linear-log estimates indicates combined significance at the 10% level for the upper and lower sections, but not for the middle segment; that is, the middle segment is not distinct from the main effect observed for the entire area.

Marginal Effects of Proximity to the AOC

We also report the marginal effects associated with proximity to the AOC ($\partial P / \partial D$). The procedures are outlined in Section 2.B. Table 4.4 shows the estimated reductions in sales prices per tenth-mile at various distances from the AOC by statistical model and by river section. Figure 4.1 presents the same information in visual form for continuous distance. The impacts are restricted to the area within five radial miles of the AOC. The reductions consist of the sum of the incremental changes in value that would accompany moving a home from the five-mile boundary, beyond which the river is assumed to exert no impact on property values, and the noted distance less than five miles from the river. It is apparent that there is no significant difference by the section of the AOC regardless of the model specification.

Table. 4.4 Marginal Price Impacts of AOC from Hedonic Models[a]

	Log Distance Model			Inverse Distance Model		
Distance (mi)	Lower River	Middle River	Upper River	Lower River	Middle River	Upper River
0.1	$3,849	$4,535	$3,711	$4,579	$3,743	$3,774
0.2	$1,795	$2,115	$1,731	$2,289	$1,871	$1,887
0.3	$1,149	$1,354	$1,108	$1,526	$1,247	$1,258
0.4	$837	$987	$807	$1,144	$935	$943
0.5	$655	$772	$631	$915	$748	$754
1.0	$305	$360	$294	$457	$374	$377
1.5	$195	$230	$188	$305	$249	$251
2.0	$142	$168	$137	$229	$187	$188
3.0	$91	$107	$88	$152	$124	$125
4.0	$66	$78	$64	$114	$93	$94
5.0	$52	$61	$50	$91	$74	$75

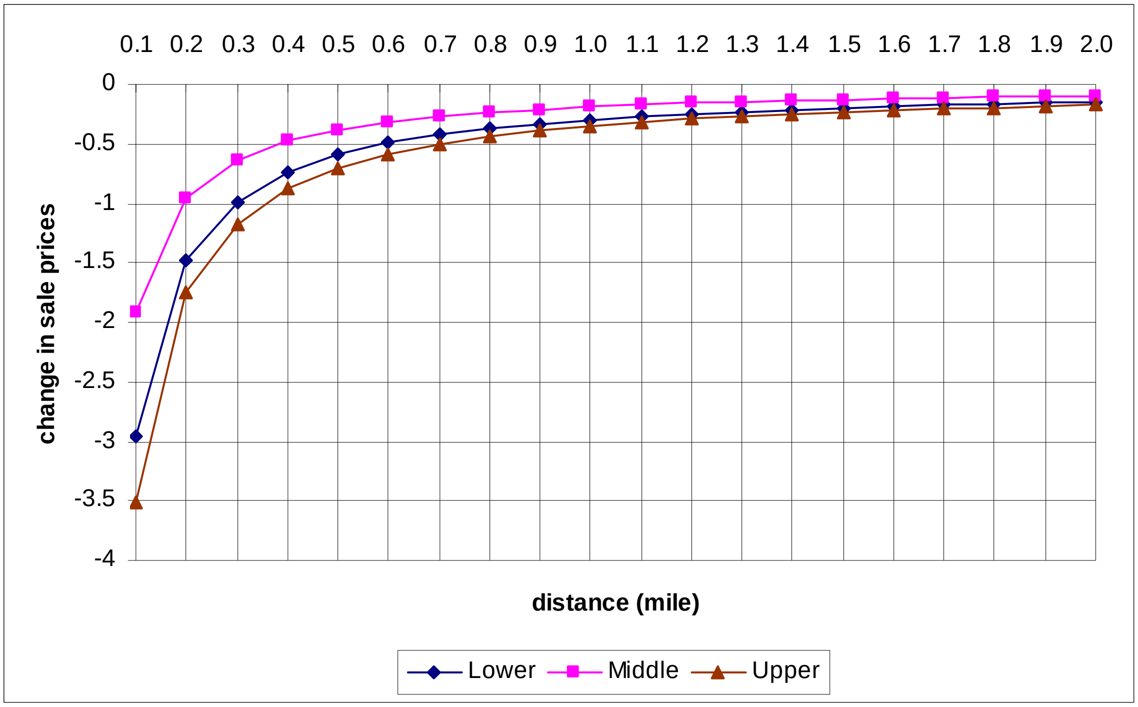
[a] Dollar values represent the effect of a 0.10 mile change in location relative to the AOC.

It is the nature of the log and inverse forms for the distance variables that the marginal impacts diminish rapidly as distance increases. For homes 1.5 miles from the AOC, the estimated marginal effect of the river is in the range of $229 to $137 for a 0.1 mi. change in distance – less than 0.5% of the average home value in the sample, $124,698. However, for homes adjacent to the river (0.1 miles), the marginal distance effect escalates to approximately $4,000 – around 3 percent of the average home value. Beyond two miles, the marginal impacts are very small and gradually diminish in both models.

Figure 4.2 shows the cumulative impacts of the AOC on individual home values. The cumulative impacts are determined by summing the marginal impacts on the mean property beginning at the five-mile boundary and ending at a particular distance from the river. Clearly, the cumulative impact increases for homes closer to the river. At a two mile distance, the overall impact is in the 2% to 3% range. Adjacent to the river, however, home prices are discounted by 8% to 14% depending on the model used and river segment considered.

Figure 4.1. Marginal Impacts as Percent of Average Sales Price for Properties within Two Miles of the Lower Sheboygan River

Panel A: Log Distance Model



Panel B: Inverse Distance Model

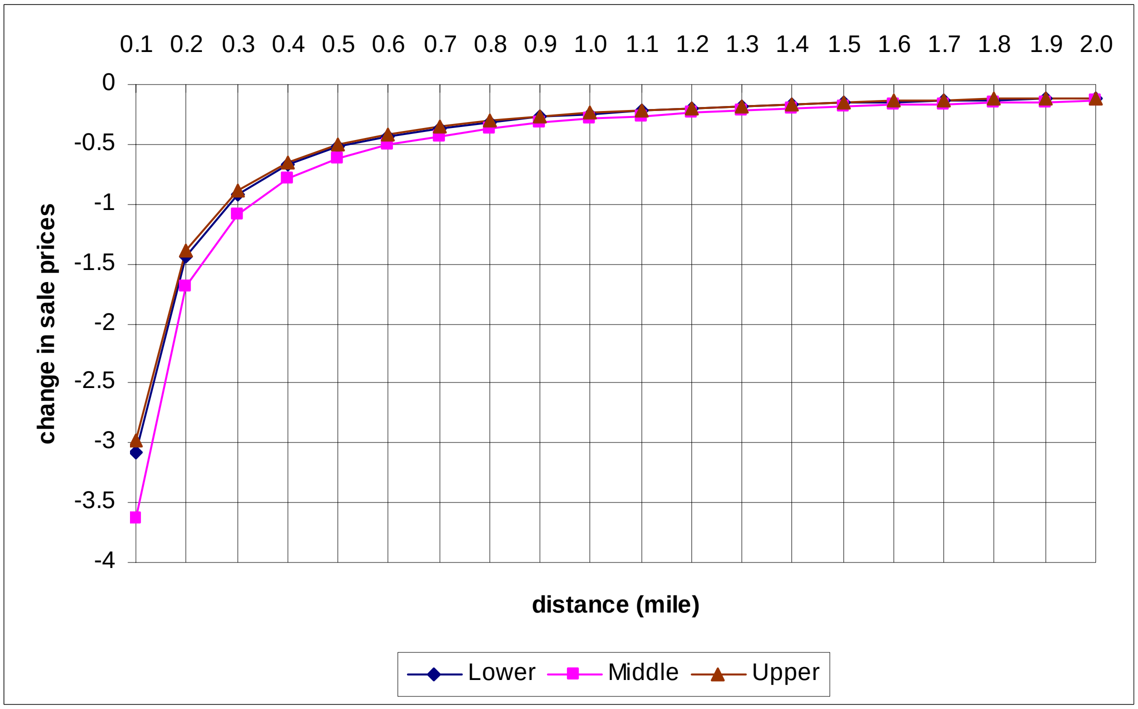
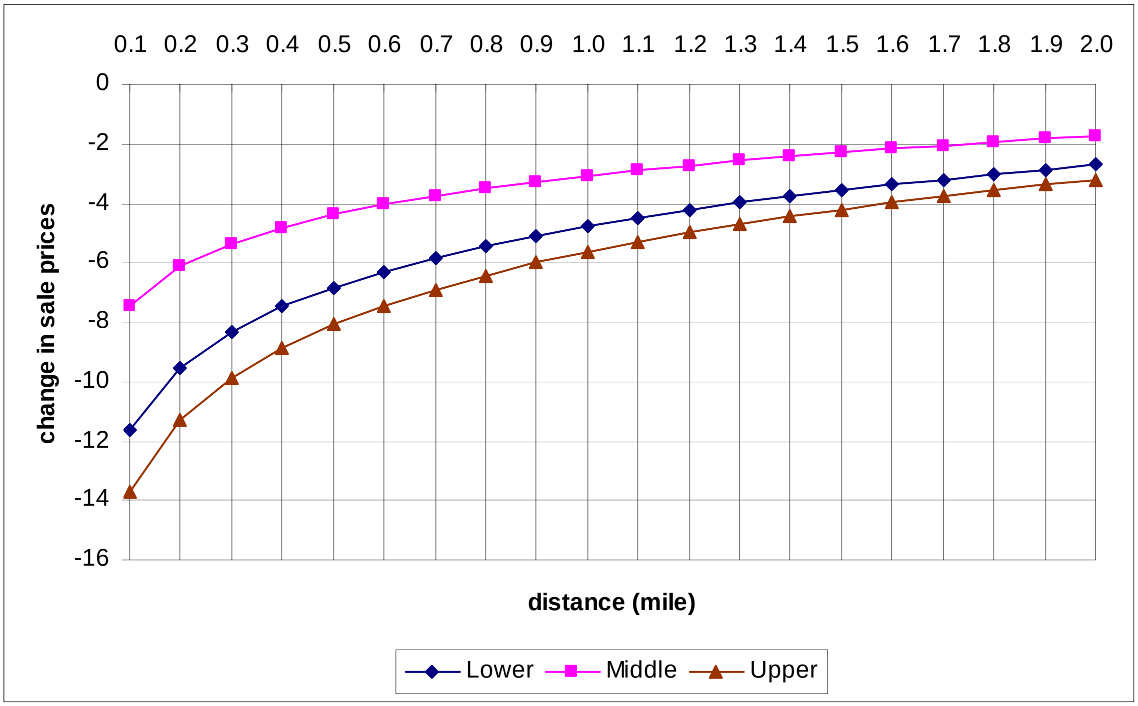
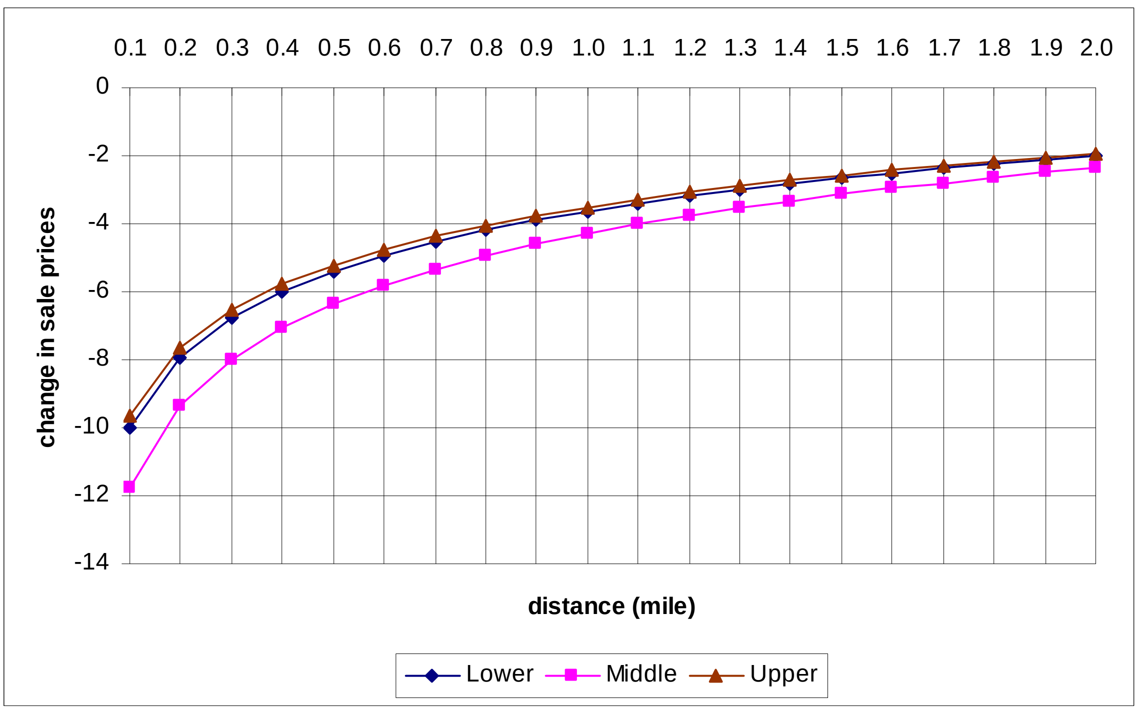


Figure 4.2. Cumulative Impacts as Percent of Average Sales Price for Properties within Two Miles of the Lower Sheboygan River

Panel A: Log Distance Model



Panel B: Inverse Distance Model



Total Property Value Losses

In order to estimate total impacts of the AOC on property values, we use equations 2.6 and 2.7 from Section 2.B to compute the total value losses individually for each home within our study boundaries. We estimate the value that each home would have if located at the five-mile boundary while holding other factors constant, then subtract the actual sales price at the current location.

Table 4.5 presents the mean and median capital loss within five miles of the AOC based on the log model and the inverse model. The mean and median total losses estimated with the inverse distance model are $4,916 and $4,276, respectively. The percentages of loss with respect to mean and median asset values are about 4%. With the linear log model, the mean and median losses are little higher: $7,317 and $6,885, respectively. In percentage terms, the losses are approximately 6%. Disaggregating by river section, the properties located closest to the Upper River are relatively closer to the AOC, in general, than properties closest to the Middle or Lower River. As a result, the mean and median property value losses are higher for the Upper River than for the other sections. The percentage property value losses in the Upper River are from 6% to 7% whereas the percentage property value losses in the Middle River are around 3%. The Lower River appears to have average impacts between those of the upper and lower sections.

Table 4.6 reports the aggregate property value losses for the entire impact area. Using the mean and median losses, we estimated total property value loss within five miles from the AOC. There are 16,724 households in the area: 2,650 nearest the Upper River, 1,641 nearest the Middle River, and 12,433 households closest to the Lower River. We multiplied each section's mean or median loss by the number of nearest households—for example, 2,650 times $4,917 for Upper River households using the inverse distance model, producing a total loss of $21,284,450 associated with that segment. Due to the large number of households closest to the Lower River, the total property value loss is the largest there—in excess of $55 million using the inverse distance model or $88 million with the linear log model. There are relatively few households nearest the Middle River so the total property value loss is least—in the range of $5 million to $6 million. Considering all segments, the estimated total property value losses are approximately $82 million or $122 million, depending on the model used.

For purposes of comparison to the survey results, on the assumption that current remediation efforts will reduce or eliminate the effects for homes closest to the Upper River, it is useful to compute the total losses for the middle and lower sections alone. There are 14,074 households closest to the middle and lower sections. Their combined total capital losses are approximately $56 million or $90 million, depending on the model.

Table 4.5. Mean and Median Capital Losses Associated with the Sheboygan River AOC, Overall and by River Section

River Section	Obs.	Mean	Std. Dev.	Min	Max	Median	Capital loss /Asset value with Mean	Capital loss /Asset value with Median
				Inverse Distance Model				
Upper	343	$8,032	$3,379	$174	$20,535	$7,987	0.06	0.07
Middle	211	$3,303	$2,661	$58	$15,745	$2,872	0.03	0.03
Lower	1614	$4,466	$2,017	$530	$17,600	$4,203	0.04	0.04
Overall	2168	$4,917	$2,731	$58	$20,535	$4,277	0.04	0.04
				Linear Log Model				
Upper	343	$10,284	$3,866	$261	$22,568	$10,430	0.08	0.10
Middle	211	$3,730	$2,610	$71	$15,508	$3,351	0.03	0.03
Lower	1614	$7,156	$2,936	$923	$23,657	$6,855	0.06	0.06
Overall	2168	$7,318	$3,478	$71	$23,657	$6,886	0.06	0.06

Table 4.6. Total Property Losses by Section of the Sheboygan River AOC

	No. Household	Total Value Loss with mean	Total Value Loss with median
		Inverse Distance Model	
Upper	2,650	$21,284,450	$21,165,474
Middle	1,641	$ 5,419,022	$ 4,712,518
Lower	12,433	$55,521,098	$52,251,408
Total	16,724	$82,224,569	$78,129,400
		Linear Log Model	
Upper	2,650	$ 27,253,400	$ 27,638,306
Middle	1,641	$ 6,120,622	$ 5,497,735
Lower	12,433	$ 88,975,169	$ 85,234,931
Total	16,724	$122,349,191	$ 118,370,973

B. Conjoint Choice Analysis

This section focuses on the conjoint choice analysis results from the survey conducted in Sheboygan County. Following the procedures described in Chapter 2 and used in Chapter 3, we first estimate the indirect utility function using the Random Utility Model (RUM). Then, based on the utility function, we compute the maximum willingness to pay for a change in the environmental condition of the river. The primary focus is on how much more homeowners are willing to pay for homes if the AOC is fully cleaned up.

Apart from the descriptions of the respective AOCs, we applied to the Sheboygan AOC the same survey methods used for the Buffalo AOC. The respondents were asked to choose either their current house or a hypothetical house identical to their current home except for four factors: House size (HOUSE), Price of house (PRICE), Proximity to AOC (PROX), and environmental conditions of AOC (ADD=Added pollution; PART=partly cleanup; and FULL=full cleanup) (see Buffalo Conjoint Choice Model for detailed explanation). The size, price, and proximity variables were all defined relative to the respondents' current homes, creating continuous variables even though the changes were confined to a few discrete percentages.

In the Sheboygan survey, we defined the AOC as beginning at Waelderhaus Dam and extending to the mouth of the harbor. The reason for doing so was to address potential confusion about the status of the Upper River. At the time of the survey's administration, the Upper River was about to undergo remediation. There had been a good deal of publicity about the impeding cleanup. We believed it best not to invite confusion about the environmental condition of that section of the river. Since the Upper River was excluded from the AOC in the questionnaire, distances to the truncated AOC are accordingly greater for homes closest to the river section above Waelderhaus Dam.

Also like the Buffalo analysis, we assumed that the attributes do not have constant marginal utility. The logarithmic transformation of HOUSE and PROX yield diminishing marginal utility of the attributes. Because each individual was asked to respond eight repeated choice questions, we use a random effects conditional logit model to allow for possible correlation between an individual's responses.

The conjoint choice model estimates appear in Table 4.7. The Wald χ^2-test indicates that the model is significant at the 1% level. The log likelihood for the random effects panel model is significantly higher than for the general conditional logit model (-1324.72 vs. -1378.91). The log likelihood test for the existence of correlation within individuals shows that we can reject the null hypothesis at the 1% significance level. Thus, the responses from an individual are significant related each other and the failure to correct for the correlation would result in biased coefficient estimates. HOUSE is significantly positive at the 1% level. The end points of the possible environmental conditions of the AOC – ADD and FULL – also affect utility significantly while partial cleanup is insignificant. PROX and interactions between PROX and the environmental condition are not significant with the exception of PROX*FULL. PROX interacts negatively with FULL, implying that full cleanup of the AOC induces movement closer to the river. The negative and significant interaction of HIGH and HOUSE implies that high-income respondents place less value on house size than middle- and low-income respondents – probably because their homes are already larger. The positive interaction of MID and HOUSE means that middle-income respondents place above-average value on added housing space. The positive and significant interaction of *HIGH* and *PRICE* implies that high income households require larger than average price increments to influence their choices.

WTP estimates based on the random effects model are computed following the procedures outlined in Chapter 2. Holding all variables constant at current levels, we first calculate the utility difference between the current condition of the AOC and other hypothetical conditions of

Table 4.7. Estimation Results of the Random Effect Conditional Logit for the Sheboygan River AOC

Variable	Coefficient	Std. Err.	z	P>z
lnHOUSE	***5.07897	0.42919	11.83	0.00
ADD	***-1.40679	0.13879	-10.14	0.00
PART	0.14428	0.10677	1.35	0.18
FULL	***0.87625	0.10343	8.47	0.00
lnPROX	-0.00682	0.02031	-0.34	0.74
lnPROX*ADD	-0.02773	0.03508	-0.79	0.43
lnPROX*PART	0.01643	0.03212	0.51	0.61
lnPROX*FULL	**-0.05388	0.02705	-1.99	0.05
PRICE	***-0.00003	0.00000	-12.64	0.00
HIGH*lnHOUSE	**-1.42694	0.62163	-2.30	0.02
HIGH*ADD	-0.32794	0.21364	-1.54	0.13
HIGH*PART	0.05814	0.15758	0.37	0.71
HIGH*FULL	0.16076	0.14881	1.08	0.28
HIGH*PRICE	***0.00001	0.00000	3.85	0.00
MID*lnHOUSE	***1.55785	0.52379	2.97	0.00
MID*ADD	0.08699	0.15829	0.55	0.58
MID*PART	-0.00060	0.12787	0.00	1.00
MID*FULL	0.01756	0.11880	0.15	0.88
MID*PRICE	0.00000	0.00000	-1.12	0.26
ASC	***1.09100	0.13746	7.94	0.00
Number of obs	2856			
Number of groups	370			
Obs per group: min	1			
avg	7.7			
max	8			
Wald $\chi^2(19)$	360.22			
Prob > χ^2	0			
Log likelihood	-1324.729			

*** significant at 1%
** significant at 5%

the AOC for each observation in the response sample. The mean and median utility differences are then selected from the resulting distributions. This process compensates for potential nonlinearities in the relationship of attributes to utility. The second step converts the mean and median utility values into WTP measures by expressing the differences of utility value in terms of the prices (in 2003 dollars) that would have to be paid for a home in Sheboygan County to attain the indicated increment to utility. The mean and median WTP for full cleanup are $14,096 and $13,849, respectively. The third step multiplies the mean and median values of WTP by the number of households in the population.

Table 4.8. Homeowners' Willingness to Pay for Changes in AOC Environmental Condition, by River Section within Five Miles (2003 $)

A. All Properties within Five Miles

Total Single Family Homes		16,724
Aggregate	with Sample Mean	with Sample Median
WTA for Additional Pollution	-$962,248,788	-$768,754,449
WTP for Partial Cleanup	-$136,388,033	-$125,505,041
WTP for Full Cleanup	$235,733,142	$231,606,328

B. All Properties closest to the Middle or the Lower River and within Five Miles

Total Single Family Homes		14,074
Aggregate	with Sample Mean	with Sample Median
WTA for Additional Pollution	-$809,755,738	-$646,941,152
WTP for Partial Cleanup	-$114,776,679	-$105,618,150
WTP for Full Cleanup	$198,380,067	$194,907,167

Table 4.9. Estimated WTP (WTA) per Home for a Change in Environmental Condition

	Mean WTP (WTA)	Median WTP (WTA)	Mean WTP/ Mean Property Value	Median WTP/ Median Property Value
ADD	($57,537)	($45,967)	(37.6%)	(34.0%)
PART	($8,155)	($7,504)	(5.3%)	(5.6%)
FULL	$14,096	$13,849	9.2%	10.3%

The results of the WTP calculations appear in Table 4.8. Panel A shows the results for all homes in the seven jurisdictions, and panel B show the results for the subset of homes closest to the Middle River or the Lower River. Splitting out the middle and lower sections provides a closer comparison to the hedonic results, since the upper section was excluded from the AOC in the survey. In the hedonic sample, 84% (14,074) of the homes are located closest to the middle or lower segments of the river. In general, the properties located closest to the Upper River are above average in value (the mean price of properties in the Upper Rivers is $162,809 whereas the mean price of the properties in the middle and lower segments is $117,535).

In Panel A, the aggregate median WTP for homes in the presence of full cleanup is about $231 million. In the panel B, the aggregate median WTP for homes closest to the Middle and Lower River, with full cleanup, is about $194 million – approximately 84% of the total value for the full hedonic sample attributable to full cleanup.

Table 4.9 shows the WTP as a percentage of property value. The mean and median prices of the properties in the sample of the conjoint choice model are $153,027 and $135,058, respectively[17].

[17] Since some respondents refuse to reveal their income level, those responses are omitted in the regressions. Therefore, the mean price in the sample is little bit different from the mean price in all responded sample.

The percentages of WTP for full cleanup are 9.2% and 10.3%, respectively, while the percentages of WTA for additional pollution are 34% and 37.6%.

C. Comparison of Hedonic and Conjoint Choice Estimates

Both the hedonic price model and the conjoint choice model indicate that residential property values around the AOC are depressed. Compared to properties greater than five miles from the river, the median value impact in the hedonic model is in the range of $4,277 to $6,886 (4% to 6%) while the median WTP for full cleanup is around $13,849 (approximately 10%) based on the conjoint model.

To account for the fact that the Upper River is being cleaned up, restricting the analysis to the middle and lower sections of the river alone produces total estimated capital losses based on the median home in the range of $56 million to $90 million using the hedonic models. The comparable estimate from the conjoint choice model is a total WTP of $194 million based on the median home.

There are several possible reasons for the discrepancy in the estimates between the two different methods. First, in responding to the survey, homeowners might consider not only price restoration from the cleanup itself, but also the possibility of ancillary improvements to the river and harbor area that might reinforce changes in the housing market. The hedonic models capture only the price decrement due to the river. Second, those who responded to the survey tended to be above-average in home values and, most likely, in incomes. Our results indicate that wealthier households have lower marginal utility of income, indicated willingness to spend more for a given change. Third, it is possible that responses to the survey are different than decisions that would be made in real life. Finally, as is also true in the hedonic approach, the distance measure may be correlated with other environmental factors that we do not consider in the model.

Both models indicate that the Sheboygan River AOC negatively affects nearby residential property values. It is plausible to expect cleanup to reverse these impacts to some degree.

D. Revenue Implications

To illustrate the revenue implications of the potential increases in residential property values, we assume that local governments could issue 15-year revenue bonds paying 5% annual coupon interest with a 2% cost of bond issue. An overall property tax rate of 2.5% of market value seems to be a reasonable approximation for Sheboygan County jurisdictions.

A 2.5% tax rate applied to the lower-bound estimate of the total property value increase, $56 million, implies an aggregate annual revenue collection of $1,400,000. These revenues would suffice to repay principal and interest on a bond worth in excess of $19 million. [18]

[18] Annual coupon interest = 0.05 * $1,400,000 = $70,000. Applying the residual income to bond principal annually for 15 years = $1,330,000 * 15 = $19,950,000. Issue fees of 2% would reduce the net bonded amount to $19,551,000.

The preceding calculation is purely illustrative and should not be interpreted as a specific estimate of revenues that Sheboygan County jurisdictions could commit to AOC remediation. There are several reasons for this note of caution. The reasoning behind this caution mirrors that described in Section 3.D for the Buffalo River and is not reproduced here.

5. COMMUNITY OUTREACH

The project team undertook numerous outreach activities to help local residents in Buffalo and Sheboygan digest the two economic studies and understand their significance. Outreach activities were also aimed at garnering community, state, and federal support for sediment remediation and clean up of Great Lakes AOCs in general. The vehicles used to communicate entire or partial aspects of the project throughout its stages are categorized and described below.

A. Website

The Northeast-Midwest Institute included information about the two economic studies on its Great Lakes webpage (Appendix Exhibits E.1 and E.2). The Institute updated information on the website as the studies progressed including the posting of project summaries, event information, and news releases. A copy of this final report will also available for download from the site.

The website has proved a popular medium for communicating information about the project. It is hoped that interest in the website will continue even though the project is now complete.

B. Presentations

The project team presented information on many phases of the project at numerous events and conferences. Along with informal presentations to local partnership organizations, members of the Great Lakes community, and attendees of the 2005 and 2006 Great Lakes Environmental Summit, official project presentations included:

John B. Braden. “Economic Benefits of Sediment Remediation: Review of the Evidence,” Great Conference Program, Lakes Ecosystem Forecasting: Improving Understanding and Prediction – 48th Annual Conference on Great Lakes Research. International Association for Great Lakes Research, Ann Arbor, MI May 23-27, 2005.

John B. Braden. “Economic Benefits of Sediment Remediation.” Michigan Statewide [AOC] Advisory Committee, Ann Arbor, MI, May 25, 2005.

DooHwan Won. “The Economic Value of Cleaning Contaminated and Noxious Sites: A Meta Analysis.” Accepted for presentation at the Heartland Environmental Economics Conference, Ames IA, September 18-19, 2005.

John B. Braden. “The Economic Value of Cleaning up the Great Lakes.” Department of Civil and Environmental Engineering, Northwestern University, Evanston, IL, October 5, 2005.

John B. Braden. “Buried Treasure: The Economy of Brownfields.” Department of Agricultural, Development, and Environmental Economics, Ohio State University, November 21, 2005; Department of Agricultural and Consumer Economics, University of Illinois at Urbana-Champaign, February 3, 2006; Department of Agricultural and Applied Economics, University of Wisconsin-Madison, February 10, 2006; Department of Agricultural Economics, Michigan State University, March 7, 2006.

John B. Braden. “The ‘Great’ Lakes.” Dial Club at the University of Illinois, Urbana, February 6, 2006.

John B. Braden. “Economic Benefits of AOC Remediation.” Presentation at a public forum sponsored by the Sheboygan River Partnership, Maywood Environmental Park, Sheboygan, WI, February 9, 2006.

John B. Braden, DooHwan Won, Laura O. Taylor, Nicole Mays, and Allegra Cangelosi. “Economic Benefits of AOC Remediation: New Evidence from Buffalo and Sheboygan.” International Association of Great Lakes Research Annual Meeting, Windsor, ONT, May 22-26, 2006.

John B. Braden. “Sunken Treasure? New Evidence about the Economic Value of Contaminated Site Remediation.” Great Lakes Science Advisory Board, International Joint Commission, Windsor, ONT, October 5, 2006.

John B. Braden. “Sunken Treasure? New Evidence about the Economic Value of Contaminated Site Remediation.” University of Michigan/Great Lakes Environmental Research Laboratory Workshop on Great Lakes Health, Ann Arbor, October 5, 2006.

C. Outreach to Local Partners and Stakeholders

The project team provided regular updates on project developments to local, state and federal stakeholders, community groups and concerned citizens in person, via email, phone and postal mail. Particular attention was paid to maintaining contact throughout the project’s duration with local organizations in the two cities: Buffalo Niagara RIVERKEEPER, New York Sea Grant/University of Buffalo, the Sheboygan River Partnership, University of Wisconsin Extension, and Wisconsin Sea Grant. Project representatives visited Buffalo in October 2004, January 2005, and September 2006, and Sheboygan in November 2004, January 2005, February 2006, and September 2006.

D. News Releases

Toward the project’s closing stages, two news releases detailing important findings as well as information about the upcoming public forums were distributed (Exhibits E.3 and E.4). Efforts were made to ensure that local, state and federal stakeholders, community groups, concerned citizens, and local newspapers in both Buffalo and Sheboygan received the releases. The releases were also sent to various regional media outlets and list serves (including the Great Lakes Information Network and NEMW list serve).

E. Press and Publicity

Several articles were published in local newspapers throughout the project's duration. The economic study in Sheboygan was announced in the first article listed below (Exhibit E.5) and summarized in the second (Exhibit E.6). The third and fourth articles describe results of the study as detailed at the public forum on September 21, 200 (Exhibits E.7 and E.12).

> Bob Petrie. "Public forum to focus on river property study." *Sheboygan Press*, week of February 6, 2005.
>
> Emmitt B. Feldner. "Clean river could raise property values." *Plymouth Review Beacon* and *Sheboygan Falls News*, February 21, 2006.
>
> Eric Litke. "River cleanup to help home values." *Sheboygan Press*, September 23, 2006.
>
> Joelle Steffen. "Clean river boosts values." *Plymouth Review Beacon*, September 26, 2006.

For Buffalo we are working with Gerry Rising, a professor from the University at Buffalo who writes a weekly column on natural resources issues for the *Buffalo News*. Gerry recently approached us about including details of the Buffalo economic study in one of his upcoming articles.

A local news/talk back radio show in Buffalo has also shown interest in our study. The station recorded speeches and presentations given at the public forum. On Monday October 2, 2006, one of our local partners from the Buffalo Niagara Riverkeeper, Ms. Jill Jedlicka was invited on the radio station to discuss the Buffalo River, including aspects of the economic study and public forum.

Finally, the work of this team was the focus of an Environmental Almanac story, "Economic Benefits of Environmental Clean-up in Great Lakes Areas of Concern," written and narrated by Dr. Rob Kanter and broadcast on WILL-AM radio of the University of Illinois at Urbana-Champaign on October 12, 2006. The transcript can be viewed and the audio version obtained at: www.environmentalalmanac.blogspot.com/2006/10/economic-benefits-of-environmental.html.

F. Public Forums

Following completion of the economic benefits analyses, the project team convened two public forums, one in Buffalo and one in Sheboygan. For Buffalo, the public forum was held at the Adam's Mark Hotel, 120 Church St., Buffalo, from 2:00 pm to 3:30 pm on Friday, September 15, 2006 (see Exhibit E.8 for the flyer). It featured a presentation by Dr. John Braden from the University of Illinois concerning the results of the two-year study on how local homeowners may realize gains in house prices as a result of cleanup activities in the Buffalo River.

Other speakers at the forum included Buffalo Mayor Byron Brown; State Senator Mark Schroeder; Mary Beth Giancarlo Ross of EPA's Great Lakes National Program Office; Abby Snyder of New York State's Department of Environmental Conservation; Jill Spisiak Jedlicka with Buffalo Niagara RIVERKEEPER; and Helen Domske with New York Sea Grant and University at Buffalo. The forum was a great success with more than 60 people in attendance. In addition there was a boat tour of the Buffalo River, onboard the historic firetug Edward M. Cotter which approximately 30 people attended. The boat tour was organized by the project team in conjunction with the Buffalo Niagara RIVERKEEPER.

For Sheboygan, the forum was held at the Blue Harbor Resort & Conference Center (725 Blue Harbor Drive, Sheboygan, WI) from 2:00 pm to 3:30 pm on Thursday, September 20 (see Exhibit E.9 for the flyer). It featured a presentation by Dr. John Braden concerning the results of the two-year study on the economic value of cleaning up the Sheboygan River Area of Concern (AOC). Other speakers included Sheboygan Mayor Juan Perez, Wisconsin State Senator Joe Leibham, Marc Tuchman with EPA's Great Lakes National Program Office, James McNelly with the Wisconsin Department of Natural Resources, Jon Gumtow with the Sheboygan River Basin Partnership, and Nicole Mays with the Northeast-Midwest Institute. David Ullrich, Executive Director of the Great Lakes and St. Lawrence Cities Initiative, moderated the event. As with Buffalo, the Sheboygan forum was a great success with more than 45 people in attendance.

Both forums provided the local communities of Buffalo and Sheboygan with much-needed evidence of the economic benefits of cleaning up their respective rivers.

G. Summary Documents

The project team produced several project summaries detailing basic information, points of contact, website addresses, and study results (Exhibits E.10 and E.11). Copies of the documents were widely distributed to stakeholders and interested parties by email, at the public forums, and via the project website.

H. Manuscripts

The methods used by the project team to conduct the economic study will significantly advance the field of economic benefits research. To highlight the innovative study, as well as document the project's findings, the project team has prepared several manuscripts aimed for publication in peer journals. These are listed below. Several of these papers were requested by researchers from the Brookings Institution who are conducting a broad study of the economic benefits of Great Lakes restoration. Additional papers are in the planning stage.

> Braden, J.B., D. Won, L.O. Taylor, N. Mays, and A. Cangelosi. "Economic Benefits of Sediment Remediation: Review of the Evidence" Working paper, University of Illinois at Urbana-Champaign, June 2005.

Braden, J.B., L.O. Taylor, and D. Won. "How Well Does Distance Capture Environmental Exposure? Evidence from the Hedonic Property Value Model and a Conjoint Choice Experiment." Paper accepted for presentation to the Association for Environmental and Resource Economists, Chicago, January 2007.

Patunru, A.A., J.B. Braden, and S. Chattopadhyay. "Who Cares about Environmental Stigmas and Does It Matter? A Latent Segmentation Analysis of Real Estate." Paper presented at the 3rd World Congress of Environmental and Resource Economists, Kyoto, July 2006. Also, accepted for publication in the *American Journal of Agricultural Economics*.

Ren, X., A.A. Patunru, and J.B. Braden. "Language-Related Differences in Environmental Benefits Estimation: Evidence from a Mail Survey." Paper presented at the 3rd World Congress of Environmental and Resource Economists, Kyoto, July 2006. Also, in first review for *Contemporary Economic Policy*.

Won, D., J. Braden, and L. Taylor. "The Economic Value of Cleaning Contaminated and Noxious Sites: A Meta Analysis." Paper presented at the 3rd World Congress of Environmental and Resource Economists, Kyoto, July 2006.

6. Discussion and Conclusions

This study aimed to: (1) assess the economic effects of sediment remediation on residential and commercial property values and public revenues in the Buffalo River Area of Concern (AOC) and collect data that will permit future assessment of the effects of remediation on property values for the Sheboygan River AOC; (2) assess the potential to finance municipal bonds based on property value changes at the Buffalo River AOC; and (3) share the results of the study through outreach to public officials in the Buffalo River area, to groups interested in the economic aspects of AOC remediation, and through peer-reviewed publication. In brief, the major findings are as follows:

(1) Economic Effects. The study collected data for and applied two distinct empirical methods to assess the economic benefits of AOC remediation. One method analyzes the spatial configuration of property values and infers the effect of proximity to the AOCs. The second uses responses to a choice survey that elicits trade-offs between environmental quality of the river, home characteristics, and home prices. The choices yield estimates of the willingness to pay for river cleanup. For both methods, the data must be reduced using statistical models. All price impacts are measured in 2004 dollars. Within a five-mile radius of the Buffalo River AOC, after controlling for numerous structural, community, and spatial effects, single-family residential property prices are depressed due to their proximity to the AOC. The estimated overall effect ranges from $83 million to $118 million (3.9% to 5.4% of market value), depending on the statistical model used. The impacts are greater for properties closer to the river, and they are concentrated in the vicinity of and to the south of the Buffalo River – there is little indication of price impacts north of I-190 and the major railroad corridor nearby. Additional impacts worth $57 million to $80 million (10% to 14%) in market value losses are evident for multi-family residential properties both north and south of the river. The survey-based estimates of willingness to pay for full cleanup of the AOC are $566 million (14% of the total market value) using the median single-family home value and to $790 million (16% of total market value) using the mean value. North - south differences were not apparent. Survey data were not available for multi-family homes. Using equivalent methods, the estimated overall effect of the Sheboygan River AOC on single-family residential prices is in the range of $80 million to $120 million (4% to 6% of market value). The effects are concentrated around the lower and upper sections of the river and are smaller in magnitude near the middle section. The survey responses reveal a willingness to pay for full cleanup of approximately $234 million – equivalent to 9% to 10% of total market value using the median and mean values of homes, respectively. Data were not available for multi-family residences.

(2) Revenue Implications. Using approximate property tax rates and assumptions about bond interest rates and issue charges, eliminating the lower-bound estimate of impact could generate net revenue sufficient to retire a $76 million bond in Erie County and a $19 million bond in Sheboygan County. These findings are illustrative only.

(3) Outreach. The study has been reported in public meetings, involving public officials, in both Sheboygan and Buffalo. It has also been the subject of presentations, manuscripts, and press accounts.

It is useful to consider these findings in the context of other studies of AOC economic impacts and, more broadly, of the economic impacts of contaminated sites. With respect to AOCs, four sites were previously studied. Zegaric and Muir (1998) found that the partial remediation of the Hamilton Harbour, ONT AOC undertaking in the 1990s, along with shoreline improvements, had increased property values within a mile of the Harbour on the order of 12%. Lichtkoppler and Blaine (1999) conducted a mail survey of household willingness to approve a referendum imposing fees directed toward the cleanup of the Ashtabula River AOC. Based on a county-wide sample, the response indicated a mean willingness to pay of less than 1% of mean property value, but sufficient to repay a bond worth approximately $14 million. McMillan (2003) conducted a study of the effects of the Grand Calumet Harbor AOC on property values within six blocks of the waterfront. The average impact was approximately 17%. Finally, Braden et al. (2004), Chattopadhyay, Braden, and Patunru (2005), and Patunru, Braden, and Chattopadhyay (forthcoming) studied the Waukegan Harbor AOC using both hedonic and survey methods comparable to those reported here. Both methods resulted in economic effects of 15% or more for households in the City of Waukegan, resulting in economic impacts of $400 million or more.

The results reported here are in the mid-range of those produced by the earlier studies. They are most directly comparable to the Waukegan results in both methodology and geographic coverage. Using percentage impacts for comparison, in order to circumvent differences due to time and absolute levels of property prices, our estimates for Buffalo and Sheboygan are less than those for Waukegan. The hedonic results for Buffalo and Sheboygan are quite comparable to one another and about one-third of the estimates for Waukegan. The survey results for Buffalo are slightly greater in percentage terms than for Sheboygan, but both are substantially less the estimates produced for Waukegan.

Won et al. (2006) collected more than 30 hedonic studies of the impact of “noxious sites” on residential property values. The noxious sites included in the analyses include nonhazardous landfills, toxic waste sites – both terrestrial and aquatic, and nuclear facilities. After controlling for the analytical methods used in the studies and other factors, the analysis found an average impact of approximately 4% within a mean geographic area of approximately six radial miles around the site. Of the site types, aquatic sites stood out – producing average impacts approaching 10%. Won et. al.’s analysis included the other AOC studies noted above, but it did not include the Buffalo River or Sheboygan River analyses.

Our hedonic findings for Buffalo River AOC and Sheboygan River AOC appear to be highly consistent in order of magnitude with received knowledge about the impacts of contaminated sites on real estate markets. Relative to the sub-literature on AOCs, the hedonic estimates for Buffalo and Sheboygan seem highly plausible. We have fewer points of comparison for the survey estimates. The Waukegan and Ashtabula studies are the only ones to have used stated preference methods, and the Ashtabula study was quite different in method and geographic scope.

Nevertheless, using percentage WTP for comparison, the estimates for Buffalo and Sheboygan fall between those for Ashtabula and Waukegan.

Overall, our findings suggest that the Buffalo River and Sheboygan River AOCs have depressed nearby residential real estate values. Furthermore, if the AOCs are cleaned up, according to our survey results, residents of both communities would be willing to pay considerably more for properties in the affected areas.

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Appendix A.

Great Lakes Areas of Concern
Homeowner Survey:
Final Methodological Report

By

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November 2006

A complete version of the methodological report prepared by the University of Illinois Survey Research Laboratory accompanies this final report in an electronic file entitled. Econ Ben Method Report.pdf. That report includes examples of the survey instruments.

Appendix B. Buffalo Data Summary

Table B.1. Survey Sample Distribution by Questionnaire Version, Erie County, NY

Survey Version	Mailed	Returned	Percent
1	107	33	11.22
2	107	35	11.9
3	106	34	11.56
4	106	38	12.93
5	106	40	13.61
6	106	34	11.56
7	106	38	12.93
8	106	42	14.29
Total	850	294	100

χ^2-test for distribution of responses by survey version:

H_0: Response distribution is same as mailed distribution.

χ^2	1
df	7
$P(X \geq \chi^2)$	0.9948

=> Can't reject H_0.

Table B.2. Survey Distribution by Jurisdiction, Erie County, NY

Jurisdiction	Mailed	Returned
Buffalo	383	126
Cheektowaga[a]	208	67
Hamburg[b]	26	9
Lackawanna	59	26
West Seneca	174	66
Total	850	294

[a] Cheektowaga includes Sloan.

[b] Hamburg includes Blasdell.

χ^2-test for distribution of responses by jurisdiction:

H_0: The distribution of responses by jurisdiction is the same as the sample distribution.

χ^2	0.999989
df	4
$P(X \geq \chi^2)$	0.999999

=> Can't reject H_0.

Table B.3. Response Distributions across Response Methods, Erie County, NY

	Mail	Internet	Total
# Observations	273	21	294
Average income	65584	67142	65999
Average age	43.3	41.5	43.2

Testing for respondent similarity across response methods:

H_0: Mean income is the same for the mail response & internet response groups

diff = mean(mail) - mean(web)   t = --0.1640
Ho: diff = 0   degrees of freedom = 284
Pr(|T| > |t|) = 0.8709

=> Can't reject H_0

H_0: Mean age is the same between the mail response & internet response groups

diff = mean(mail) - mean(web)   t = 0.8291
Ho: diff = 0   degrees of freedom = 289
Pr(|T| > |t|) = 0.4152

=> Can't reject H_0

Table B.4. Comparison of Properties in Mail Sample and Response Sample, Erie County, NY

	Mail	Response	t-test	Prob(T<t)
# Questionnaires	779[a]	294		
Average House Size (ft^2)	1493	1489	0.09685[b]	0.52
Average Price (2003 $)	86276	83985	0.58975[c]	0.72
Average Distance to AOC (mi)	2.58	2.52	0.760958[d]	0.77

[a] Includes only properties for which GIS program was able to compute distances to points of interest.

[b] H_0: Average house size is equal between the two sample groups. T-test fails to reject H_0.

[c] H_0: Average house price is equal between the two sample groups. T-test fails to reject H_0.

[d] H_0: Average Distance to AOC is equal between the two sample groups. T-test fails to reject H_0.

Table B.5. Rationality Check: Are "Inferior" and "Superior" Homes Selected Differentially?

Ranking of hypothetical home[a]	Selected	Not Selected	Sum	% Selected
Inferior hypothetical home	8	95	103	7.8
Neither inferior nor superior	488	1484	1972	24.7
Superior hypothetical home	78	70	148	52.7

[a] A home is assumed "superior" if it is larger, farther from the river, cheaper and the environmental condition is improved relative to the status quo. An inferior home has the opposite relationship to the current home. A mixture of superior and inferior attributes results in the mixed category.

Two-sample test of proportion (Inferior home vs. Neither inferior nor superior)

Inferior hypothetical home (x)			Number of obs =	103
Neither inferior nor superior (y)			Number of obs =	1972
Variable	prop	st.d	[95% Conf. Interval]	
x	0.78	0.264237	.0262104	.1297896
y	0.247	0.0097116	.2279655	.2660345

diff = prop(x) - prop(y)   z = -3.9228

H_o: diff = 0

H_a: diff != 0   Pr(|Z| < |z|) = 0.0001   => Can reject H_0

H_a: diff < 0   Pr(Z < z) = 0.0000   => Can reject H_0

Two-sample test of proportion (Neither inferior nor superior vs. Superior home)

Neither inferior nor superior (x)			Number of obs =	1972
Superior hypothetical home (y)			Number of obs =	148
Variable	prop	st.d	[95% Conf. Interval]	
x	0.247	0.0097116	.2279655	.2660345
y	0.527	0.0410398	.4465635	.6074365

diff = prop(x) - prop(y)   z = -7.4302

H_o: diff = 0

H_a: diff != 0   Pr(|Z| < |z|) = 0.0000   => Can reject H_0

H_a: diff < 0   Pr(Z < z) = 0.0000   => Can reject H_0

==> Choice rates are significantly changed by the ranking of hypothetical home

Table B.6. Frequency of House Choice, Erie County, NY, Sample

Selected House	Frequency	Percent
Hypothetical House	574	25.8
Current House	1,649	74.2
Total	2,223	100

Table B.7. Erie County, NY, Property Assessment Data for Survey Sample

Jurisdiction (# Observations)		Year Built	House Size(ft^2)	House Price (2003$)[a]	Distance to AOC (mi)
All (294)	Mean	1942.09	1489.28	87537.47	2.5294
	S.D	27.62	625.21	57907.51	1.1135
	Min	1850	624	19272	0.2005
	Max	2003	5301	467611	4.3036
Buffalo (126)	Mean	1927.87	1682.74	95051.32	1.7935
	S.D	29.69	829.94	83365.41	1.0318
	Min	1850	624	19272	0.2205
	Max	1998	5301	467611	4.3036
Cheektowaga (67)[b]	Mean	1952.16	1260.5	76704.16	3.3977
	S.D	16.82	306.37	22390.5	0.7617
	Min	1900	660	43072	1.4338
	Max	2003	2263	178533	4.2896
Hamburg (9)[c]	Mean	1940.33	1222.55	83685.22	4.0647
	S.D	21.54	244.52	12234.36	0.1491
	Min	1989	963	66731	3.8994
	Max	1960	1721	103970	4.2937
Lackawanna (26)	Mean	1948.92	1301.61	66319	2.9759
	S.D	19.84	388.45	14885.73	0.4184
	Min	1900	780	33132	2.2284
	Max	1990	2492	90070	3.8361
West Seneca (66)	Mean	1956.59	1462.5	93074.38	2.6677
	S.D	22.76	354.32	26347.41	0.7936
	Min	1910	864	32859	1.1698
	Max	2001	2594	159851	3.89

[a] Prices normalized to 2003 using Office of Federal Housing Enterprise Oversight (OFHEO) index.
[b] Includes Sloan.
[c] Includes Blasdell.

Table B.8. Descriptive Statistics of Homes Chosen in Survey, Erie County, NY

Jurisdiction		Characteristics of Home Chosen		
(# Observations)		House Size (ft^2)	Miles to AOC	House Price (2003$)
All (2223)	Mean	1535.495	2.442253	88196.15
	S.D	648.1801	1.207524	58009.35
	Min	624	0	18766.8
	Max	6178.75	5.303629	467611
Buffalo (965)	Mean	1731.364	1.741941	95443.34
	S.D	845.5409	1.0989	82984.11
	Min	624	0	18766.8
	Max	6178.75	5.303629	467611
Cheektowaga (493)	Mean	1286.989	3.324353	76840.92
	S.D	330.8543	0.9582392	20677.89
	Min	660	0	38764.8
	Max	2828.75	5.169758	178533
Hamburg (72)	Mean	1245.669	3.925844	85432.07
	S.D	264.7585	0.5790974	12670.45
	Min	936	1.89949	66713
	Max	2151.25	5.293748	135161
Lackawanna (197)	Mean	1336.6	2.853937	67262.14
	S.D	398.3306	0.657628	15353.64
	Min	780	0.5304848	33132
	Max	3115	4.375494	110942
West Seneca (496)	Mean	1522.49	2.54912	94098.56
	S.D	384.0752	0.9651245	26681.13
	Min	864	0	29573.1
	Max	2855	4.890093	182639.5

Table B.9. Descriptive Statistics for Responses to Selected Questions, Erie County, NY, Survey Sample

Question[a]	Number of Responses[b]	Modal Reponse	Modal Count	Modal %	Mean	S.D	Median
2	284	2.1-4	89	31.34	3.15	1.96	3
3a	290	3	167	57.56	3.07	0.77	3
3b	290	1	203	70.00	1.36	0.63	1
3c	263	0	155	58.94	0.43	0.54	0
3d	289	3	108	37.37	3.16	1.19	3
5a	290	5	107	36.90	3.99	0.96	4
5b	290	5	205	70.69	4.63	0.64	5
5c	290	5	125	43.10	3.93	1.16	4
5d	290	3	94	32.41	3.06	1.25	3
5e	290	4	103	35.52	3.95	0.96	4
5f	290	5	209	72.07	4.64	0.63	5
5g	291	5	149	51.20	4.31	0.82	5
21	288	2	95	32.99	2.72	1.28	2
22	286	40000-60000	81	27.55	65699	58455	50000
24	291	35-44	102	35.05	43.2	11.99	40
25	291	26-more	230	79.04	24.14	7.44	27.5

[a] The questions appear in Appendix A.
[b] The numbers vary due to incomplete responses.

Table B.10. Descriptive Statistics for Responses to Attitudinal & Perception Questions, Erie County, NY, Survey Sample

Survey Question [a]	Number of Responses [b]	Percentage of Responses: Strongly agreed	Somewhat agreed	Somewhat disagreed	Strongly disagreed	No opinion
4a	284	3.87	20.07	18.66	23.59	33.8
4b	284	6.34	20.42	20.77	16.9	35.56
4c	283	10.6	29.33	15.19	6.71	38.16
4d	283	0.71	12.01	27.56	27.92	31.8
4e	284	18.31	25.7	15.49	7.75	32.75
14		Bottom only	Bottom & Site	B&S& Upstream	Don't Know	
	290	9.31	28.97	61.38	0.34	
15		Increase greatly	Increase somewhat	No effect	Decrease somewhat	Decrease greatly
	289	19.72	55.71	23.18	0.69	0.69
16		Much more	Somewhat more	More	No more	
	289	10.73	27.68	31.14	30.45	
17		Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely
	289	6.92	10.03	15.92	20.42	46.71
18		Highly improved	Somewhat improved	No effect	Somewhat worse	Much worse
	289	1.04	30.8	66.44	1.04	0.69
19		2004	2003	2002	2001	2000
	290	2.07	14.48	70.69	11.72	1.03
20		Single detached	Townhouse duplex	Condo	Other	
	290	91.03	7.24	1.38	0.34	
23		Increase 20% more	Increase 5%-19%	Very little change	Decrease 5%-19%	Decrease 20% more
	290	5.86	28.62	48.28	11.03	6.21
26		Never	1-3 times	4-6 times	7-11 times	12 or more
	291	13.4	35.4	17.87	7.22	26.12
27		Never	1-5 times	6-10 times	11-25 times	26 or more
	291	17.53	27.49	12.03	13.06	29.9

[a] Questions appear in Appendix A.
[b] Numbers of responses differ due to data incompleteness.

Appendix C. Additional Model Results for Hedonic Analysis of the Buffalo River AOC

Table C.1. Results for Single Family Homes Using Inverse-Distance Measures

Number of obs = 3474, R-squared = 0.8303

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
			HOUSING CHARACTERISTICS			
acres	29536.69	9529.848	3.10	0.002	10851.73	48221.66
acres2	-8573.579	3308.212	-2.59	0.010	-15059.92	-2087.24
age	936.3224	294.5329	3.18	0.001	358.8382	1513.807
age2	-12.11319	3.975442	-3.05	0.002	-19.90775	-4.318625
age3	.0419258	.0165973	2.53	0.012	.0093837	.0744678
sfla	28.43006	3.232511	8.80	0.000	22.09214	34.76797
sfla*north	27.36623	6.121489	4.47	0.000	15.36396	39.36849
bedrooms	-2349.497	1296.904	-1.81	0.070	-4892.309	193.3145
fullbaths	16734.69	3062.709	5.46	0.000	10729.7	22739.68
halfbaths	6025.148	1730.502	3.48	0.001	2632.19	9418.106
grade_ab	64936.4	6743.684	9.63	0.000	51714.2	78158.59
grade_de	-3957.487	2776.111	-1.43	0.154	-9400.546	1485.572
cape	-8824.851	1647.268	-5.36	0.000	-12054.61	-5595.088
colonial	14226.8	3770.907	3.77	0.000	6833.267	21620.33
oldstyle	-21145.98	4069.364	-5.20	0.000	-29124.69	-13167.27
fullbasement	2963.431	1843.602	1.61	0.108	-651.2795	6578.141
fireplace	4708.563	1886.199	2.50	0.013	1010.333	8406.792
			LOCATION DUMMY VARIABLES [a]			
Buffalo_S	199288.9	124350.6	1.60	0.109	-44522.67	443100.5
Cheektowaga	23873.56	115498	0.21	0.836	-202580.8	250327.9
West Seneca	195438.5	123556.3	1.58	0.114	-46815.63	437692.7
Lackawanna	201560.3	123570	1.63	0.103	-40720.82	443841.3
north	51963.92	208901.7	0.25	0.804	-357625.1	461553
			PROXIMITY VARIABLES (NON-AOC)			
invcbd_n	156640.1	184591	0.85	0.396	-205283.5	518563.6
invdelpark_n	136610.8	53307.77	2.56	0.010	32091.42	241130.2
invpark_s	-2599.31	7305.765	-0.36	0.722	-16923.56	11724.94
invrail	-2601.052	8333.683	-0.31	0.755	-18940.72	13738.62
invrail*north	-25480.62	17711.02	-1.44	0.150	-60206.22	9244.985
invstream	10277.81	8608.173	1.19	0.233	-6600.048	27155.66
invstr*north	-14374.51	31521.81	-0.46	0.648	-76178.63	47429.62
invairport	270652.6	188984.1	1.43	0.152	-99884.27	641189.6
invairp*north	54785.7	240505.9	0.23	0.820	-416768.9	526340.3
invhws	-24269.13	12905.35	-1.88	0.060	-49572.37	1034.11
invhws*north	-43864.32	34123.11	-1.29	0.199	-110768.8	23040.12
invhwy	-26302.82	14995.82	-1.75	0.080	-55704.81	3099.162
invhwy*north	-11648.01	24721.61	-0.47	0.638	-60119.13	36823.11
invhwyx	23508.45	25203.67	0.93	0.351	-25907.83	72924.73
invhwyx*north	119738.2	49411.65	2.42	0.015	22857.87	216618.5
invshoreline	-2004.655	84819.2	-0.02	0.981	-168307.8	164298.5
invshor*north	-240033.9	147991.4	-1.62	0.105	-530197.5	50129.65
			PROXIMITY TO THE AOC			
invaoc	-56869.98	23644.76	-2.41	0.016	-103229.7	-10510.21
invaoc*north	17560.05	76778.34	0.23	0.819	-132977.6	168097.7

[a] Note: Coefficient estimates for the 118 dummy variables indicating the census tracts in which houses were located are not reported for succinctness. Also, the dummy variable for Hamburg is the category not included in the model.

Table C.2. Results for Multi Family Homes Using Log-Distance Measures

Number of obs = 1741, R-squared = 0.7049

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
HOUSING CHARACTERISTICS						
acres	27352.88	12754.66	2.14	0.032	2335.189	52370.57
acres2	-4916.253	3193.851	-1.54	0.124	-11180.84	1348.339
age	208.1851	802.3633	0.26	0.795	-1365.614	1781.984
age2	-4.592781	7.689185	-0.60	0.550	-19.67477	10.4892
age3	.0175002	.0242686	0.72	0.471	-.0301015	.065102
sfla	18.79136	2.729722	6.88	0.000	13.43714	24.14559
sfla*north	13.61559	4.439136	3.07	0.002	4.908432	22.32276
bedrooms	-4973.066	920.476	-5.40	0.000	-6778.538	-3167.595
fullbaths	5502.152	3873.286	1.42	0.156	-2095.121	13099.42
halfbaths	13806.43	5584.864	2.47	0.014	2851.976	24760.89
grade_ab	61190.06	25275.2	2.42	0.016	11613.92	110766.2
grade_de	6268.612	3752.665	1.67	0.095	-1092.069	13629.29
cape	-9805.988	6418.865	-1.53	0.127	-22396.3	2784.321
colonial	-18573.53	7116.322	-2.61	0.009	-32531.87	-4615.192
oldstyle	-29978.75	12517.76	-2.39	0.017	-54531.77	-5425.739
fullbasement	2729.02	1936.083	1.41	0.159	-1068.518	6526.558
fireplace	15585.59	3511.003	4.44	0.000	8698.916	22472.26
LOCATION DUMMY VARIABLES [a]						
Buffalo_S	45018.51	139011.4	0.32	0.746	-227646	317683
West Seneca	39885.23	138948.4	0.29	0.774	-232655.8	312426.2
Lackawanna	32533.87	141340.1	0.23	0.818	-244698.2	309765.9
Hamburg	18759.95	142873.2	0.13	0.896	-261479.4	298999.3
north	-1000332	484947.9	-2.06	0.039	-1951535	-49128.77
PROXIMITY VARIABLES (NON-AOC)						
lncbd_n	5981.537	15316.18	0.39	0.696	-24060.45	36023.52
lndelpark_n	-11898.1	5415.748	-2.20	0.028	-22520.84	-1275.357
lnpark_s	-291.8403	1667.371	-0.18	0.861	-3562.313	2978.632
lnrail	4744.102	2067.639	2.29	0.022	688.5222	8799.681
lnrail*north	-2688.238	2646.501	-1.02	0.310	-7879.228	2502.752
lnstream	-2752.905	1662.725	-1.66	0.098	-6014.264	508.4546
lnstr*north	6797.538	6493.226	1.05	0.295	-5938.626	19533.7
lnairport	-105862.3	43123.49	-2.45	0.014	-190447.1	-21277.59
lnairp*north	84904.44	47768.63	1.78	0.076	-8791.541	178600.4
lnhws	6803.432	2598.82	2.62	0.009	1705.964	11900.9
lnhws*north	-4190.161	3587.102	-1.17	0.243	-11226.1	2845.775
lnhwy	-3557.275	3083.363	-1.15	0.249	-9605.151	2490.601
lnhwy*north	2328.729	3815.965	0.61	0.542	-5156.111	9813.57
lnhwyx	2156.053	6503.062	0.33	0.740	-10599.41	14911.51
lnhwyx*north	1835.386	9204.294	0.20	0.842	-16218.41	19889.19
lnshoreline	-13548.08	15638.4	-0.87	0.386	-44222.09	17125.94
lnshor*north	27913.53	16203.14	1.72	0.085	-3868.19	59695.26
PROXIMITY TO THE AOC						
lnaoc	9559.84	4536.221	2.11	0.035	662.2502	18457.43
lnaoc*north	-11631.03	12009.95	-0.97	0.333	-35187.99	11925.94

[a] Coefficient estimates for the 118 dummy variables indicating the census tracts in which houses were located are not reported for succinctness. Also, the dummy variable for Cheektowaga is the category not included in the model.

Table C.3. Results for Multi Family Homes Using Inverse-Distance Measures

Number of obs = 1741, R-squared = 0.7045

	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
acres	27564.05	12655.31	2.18	0.030	2741.245	52386.86
acres2	-4960.108	3172.478	-1.56	0.118	-11182.78	1262.562
age	212.155	800.4894	0.27	0.791	-1357.968	1782.278
age2	-4.622828	7.67345	-0.60	0.547	-19.67395	10.42829
age3	.0175227	.0242371	0.72	0.470	-.0300173	.0650627
sfla	18.74629	2.724534	6.88	0.000	13.40224	24.09034
sfla*north	13.72232	4.403944	3.12	0.002	5.084187	22.36046
bedrooms	-4979.778	920.1439	-5.41	0.000	-6784.598	-3174.958
fullbaths	5513.136	3868.909	1.42	0.154	-2075.553	13101.82
halfbaths	13754.28	5581.035	2.46	0.014	2807.336	24701.22
grade_ab	61162.62	25186.67	2.43	0.015	11760.12	110565.1
grade_de	6262.43	3744.575	1.67	0.095	-1082.383	13607.24
cape	-9789.681	6410.529	-1.53	0.127	-22363.64	2784.278
colonial	-18467.16	7071.981	-2.61	0.009	-32338.53	-4595.792
oldstyle	-29842.63	12463.08	-2.39	0.017	-54288.39	-5396.867
fullbasement	2719.228	1937.554	1.40	0.161	-1081.195	6519.652
fireplace	15598.54	3507.281	4.45	0.000	8719.172	22477.91
LOCATION DUMMY VARIABLES [a]						
Buffalo_S	45077.08	96608.38	0.47	0.641	-144415.8	234570
Cheektowaga	-92804.51	100193.7	-0.93	0.354	-289329.9	103720.9
West Seneca	39787.74	96924.85	0.41	0.681	-150325.9	229901.4
Lackawanna	35634.08	98100.56	0.36	0.716	-156785.7	228053.8
north	739399	420020.2	1.76	0.079	-84451.3	1563249
PROXIMITY VARIABLES (NON-AOC)						
invcbd_n	-73975.71	171475.6	-0.43	0.666	-410317.3	262365.9
invdelpark_n	101618	49438.56	2.06	0.040	4646.502	198589.4
invpark_s	3751.786	13400.43	0.28	0.780	-22532.54	30036.11
invrail	-39394.9	17084.85	-2.31	0.021	-72906.05	-5883.743
invrail*north	25781.33	21246.11	1.21	0.225	-15891.94	67454.6
invstream	18771.31	13061.56	1.44	0.151	-6848.351	44390.97
invstr*north	-53194.49	57716.13	-0.92	0.357	-166402	60013.06
invairport	1328288	555671.1	2.39	0.017	238364.3	2418211
invairp*north	-1035120	607611.5	-1.70	0.089	-2226922	156682
invhws	-63025.04	22810.51	-2.76	0.006	-107766.8	-18283.27
inhws*north	38495.1	31887.43	1.21	0.228	-24050.64	101040.8
invhwy	25649.45	23230.84	1.10	0.270	-19916.78	71215.67
invhwy*north	-14009.94	30090.64	-0.47	0.642	-73031.36	45011.48
invhwyx	-17619.94	63492.38	-0.28	0.781	-142157.3	106917.5
invhwyx*north	-14975.83	88636.66	-0.17	0.866	-188832.6	158880.9
invshoreline	92136.77	177297.4	0.52	0.603	-255623.9	439897.4
invshor*north	-240048.6	180300.7	-1.33	0.183	-593700.1	113603
PROXIMITY TO THE AOC						
invaoc	-79443.27	41666.81	-1.91	0.057	-161170.8	2284.277
invaoc*north	94654.6	118821.2	0.80	0.426	-138407.7	327716.9

[a] Coefficient estimates for the 118 dummy variables indicating the census tracts in which houses were located are not reported for succinctness. Also, the dummy variable for Hamburg is the category not included in the model.

Appendix D. Sheboygan Data Summary

Table D.1. Survey Sample Distribution by Questionnaire Version, Sheboygan County, WI

Survey Version	Number	Percent
1	51	13.21
2	46	11.92
3	43	11.14
4	50	12.95
5	42	10.88
6	54	13.99
7	51	13.21
8	49	12.69
Total	386	100

$\chi 2$ - test for distribution of version:

H_0: The distribution of the mailed sample and returned sample are the same.

$\chi 2$	1
df	7
$P(X \geq \chi 2)$	0.994828537

Can't reject H_0

Table D.2. Survey Sample Distribution by Jurisdiction, Sheboygan County, WI

Data by Jurisdiction	Mailed	Unable to Locate	Never Returned	Responded by Mail	Responded by Web	Unusable[a] Responses[b]	Final* Usable
City of Sheboygan Falls	186	4	90	83	7	3	87
City of Sheboygan	187	2	104	71	7	5	73
Village of Kohler	133	2	67	58	4	4	58
Town of Wilson	106	2	56	45	3	3	45
Town of Sheboygan Falls	26	0	15	11	0	2	9
Town of Sheboygan	187	0	77	103	7	3	107
Town of Lima	25	1	14	8	0	1	7
Total	850	11	423	379	28	21	386

[a] Eight observations were lost because distances could not be estimated by GIS. Twelve failed to respond to the choice questions

[b] Total responses = 407. Total surveys successfully delivered= 839. Response rate= 407/839 =48.5%

$\chi 2$ - test for distribution of jurisdiction:

H_0: The distribution of the mailed sample and returned sample are same

$\chi 2$	0.999999501
df	7
$P(X \geq \chi 2)$	0.985612341

Can't reject H_0

Table D.3. Response Distribution by Response Method, Sheboygan County, WI

	Mail	Internet	Total
Number of Observations	359	27	386
Average income	77115	91200	78067
Average age	44	39	43

Table D.4. Comparison of Properties in Mail Sample and Response Sample, Sheboygan County, WI

	Mail Sample	Response Sample	T - statistic	Pr(|T|>|t|)
Observations	850	386		
Average House price (2003)	151447	154117	0.4939[a]	0.6215
Average Square Footage	1702	1699	-0.0686[b]	0.9453
Average Year Built	1961	1963	1.0314[c]	0.3025

[a] H_0: The average house price is equal between the two sample groups. T-test fails to reject H_0.

[b] H_0: The average square footage is equal between the two sample groups. T-test fails to reject H_0.

[c] H_0: The average house price is equal between the two sample groups. T-test fails to reject H_0.

Table D.5. Rationality Check, Sheboygan County, WI: Are Inferior & Superior Homes Selected Differentially?

Ranking of hypothetical home	Selected	Unselected	Sum	Select Percentage
Inferior hypothetical home	9	127	136	6.62
Neither inferior nor superior	649	2011	2660	24.4
Superior hypothetical home	115	73	188	61.17

Two-sample test of proportion (Inferior home vs. Neither inferior nor superior)

Inferior hypothetical home (x) Number of obs = 136
Neither inferior nor superior (y) Number of obs = 2660

Variable	prop	st.d	[95% Conf. Interval]	
x	0.0662	0.2132	.0244136	.1079864
y	0.244	0.0083275	.2276784	.2603216

diff = prop(x) - prop(y) z = -4.4674
H_o: diff = 0
H_a: diff != 0 Pr(|Z| < |z|) = 0.0000 => Can reject H_0
H_a: diff < 0 Pr(Z < z) = 0.0000 => Can reject H_0

Two-sample test of proportion (Neither inferior nor superior vs. Superior home)

Neither inferior nor superior (x) Number of obs = 2660
Superior hypothetical home (y) Number of obs = 188

Variable	prop	st.d	[95% Conf. Interval]	
x	0.244	0.0083275	.2276784	.2603216
y	0.6117	0.0355446	.5420338	.6813662

diff = prop(x) - prop(y) z = -10.9972
H_o: diff = 0
H_a: diff != 0 Pr(|Z| < |z|) = 0.0000 => Can reject H_0
H_a: diff < 0 Pr(Z < z) = 0.0000 => Can reject H_0

==> Choice rates are significantly changed by the ranking of hypothetical homes

Table D.6. Frequency of House Choice, Sheboygan County, WI

Selected House	Number[a]	Percent
Hypothetical House	773	25.9
Current House	2,211	74.1
Total	2,984	100

[a] Excludes 104 choice questions that respondents did not complete.

Table D.7. Sheboygan County, WI, Property Assessment Data for Survey Sample

Jurisdiction (No. responses)	Stat.	Year Built	House Size (ft^2)	House Price (2003)[a]	Distance to AOC123[b] (mi)	Distance to AOC12[c] (mi)
All (386)	Mean	1963.40	1699.42	154117.10	1.44	1.93
	S.D	35.23	708.32	85610.50	1.20	1.23
	Min	1870.00	528.00	15068.00	0.02	0.03
	Max	2004.00	6467.00	732335.00	4.73	8.06
C. Sheboygan Falls (87)	Mean	1963.41	1581.43	129770.50	0.30	1.92
	S.D	34.66	511.22	53344.08	0.23	0.71
	Min	1890.00	660.00	28700.00	0.04	0.93
	Max	2004.00	3596.00	273223.00	0.95	3.82
C.Sheboygan (73)	Mean	1943.14	1503.69	108214.50	1.16	1.16
	S.D	35.74	487.56	40063.53	0.64	0.64
	Min	1870.00	696.00	15068.00	0.03	0.03
	Max	2003.00	3228.00	229325.00	2.94	2.94
V. Kohler (58)	Mean	1949.93	2010.28	208520.30	0.45	0.56
	S.D	32.45	1012.65	134046.90	0.39	0.38
	Min	1910.00	1103.00	80509.00	0.07	0.08
	Max	2002.00	6336.00	640425.00	1.78	1.79
T. Wilson (45)	Mean	1962.69	1777.20	170489.40	2.92	2.93
	S.D	32.23	701.18	69705.00	0.63	0.61
	Min	1900.00	768.00	62854.00	0.65	0.87
	Max	2004.00	5184.00	398787.00	4.10	4.10
T. Sheboygan Falls (9)	Mean	1935.11	1553.56	117593.60	1.05	5.05
	S.D	34.60	353.46	42894.25	1.15	2.36
	Min	1870.00	1152.00	46867.00	0.02	2.08
	Max	1970.00	2105.00	181385.00	3.14	8.06
T. Sheboygan (107)	Mean	1985.92	1777.41	171952.10	2.39	2.40
	S.D	24.04	744.44	84536.35	0.88	0.88
	Min	1885.00	927.00	78821.00	0.43	0.43
	Max	2003.00	6467.00	732335.00	4.55	4.61
T. Lima (7)	Mean	1983.14	1126.71	153727.10	3.06	3.91
	S.D	13.87	346.83	51726.65	1.44	1.75
	Min	1965.00	528.00	85765.00	1.52	2.03
	Max	2002.00	1647.00	223501.00	4.73	6.50

[a] Prices normalized to 2003 using Office of Federal Housing Enterprise Oversight (OFHEO) index.
[b] Minimum distance to AOC segment 1 or 2 or 3.
[c] Minimum distance to AOC segment 1 or 2.

Table D.8. Descriptive Statistics of Homes Chosen in Survey, Sheboygan County, WI

Jurisdiction (No. responses)	Stat.	House Size (ft^2)	House Price (2003)[a]	Distance to AOC123[b]	Distance to AOC12[c]
All (2984)	Mean	1751.317	155376.9	1.373954	1.938334
	S.D	739.2569	88376.5	1.235714	1.23555
	Min	528	13561.2	0	0.0285757
	Max	7286.4	842185.3	5.665398	8.064069
C. Sheboygan Falls (687)	Mean	1624.844	131001.3	0.3250973	1.927281
	S.D	530.0687	54392.76	0.3484839	0.711716
	Min	660	26010	0	0.9333322
	Max	4495	352562.6	1.954305	3.817364
C. Sheboygan (560)	Mean	1567.14	109800.6	1.09827	1.164041
	S.D	502.1608	41008.83	0.7781956	0.643019
	Min	696	13561.2	0	0.0285757
	Max	3228	235952.6	3.06103	2.936474
V. Kohler (457)	Mean	2066.455	210565.5	0.4499782	0.5598492
	S.D	1042.679	139890.6	0.4586384	0.3766714
	Min	1103	80509	0	0.0793354
	Max	7286.4	832552.5	2.16766	1.790298
T. Wilson (351)	Mean	1807.607	168386.6	2.806678	2.921858
	S.D	732.391	68496.87	0.8419384	0.6106979
	Min	768	56568.6	0	0.8691172
	Max	6480	398787	4.614553	4.102307
T. Sheboygan Falls (72)	Mean	1583.607	117164	1.040874	5.054571
	S.D	357.4067	39726.71	1.0926	2.242882
	Min	1152	42180.3	0	2.0829
	Max	2545	181385	3.13665	8.064069
T. Sheboygan (801)	Mean	1839.154	174247.4	2.289033	2.426498
	S.D	786.1153	87329.82	1.043324	0.8838195
	Min	877.2	70938.9	0	0.4298907
	Max	6467	842185.3	4.951318	4.608032
T. Lima (56)	Mean	1179.307	157468.5	2.897567	3.912625
	S.D	345.0763	49796.8	1.451497	1.632293
	Min	528	77188.5	0	2.027131
	Max	1710	257026.2	5.66539	6.50457

[a] Prices normalized to 2003 using Office of Federal Housing Enterprise Oversight (OFHEO) index.

[b] Minimum distance to AOC segment 1 or 2 or 3.

[c] Minimum distance to AOC segment 1 or 2.

Table D.9. Descriptive Statistics for Responses to Selected Survey Questions, Sheboygan County, WI

Survey Question[a]	Number of Responses[b]	Modal Response	Modal Resp. Count	Modal Resp.(%)	Mean Resp.	S.D	Median Resp.
2	379	2.1-4	115	30.34	2.4	1.78	1.5
3a	385	3	217	56.36	2.96	0.78	3
3b	385	2	197	50.39	1.75	0.7	2
3c	346	0	182	52.60	0.51	0.58	0
3d	381	3	109	28.61	3.51	1.14	3
5a	384	4	133	34.64	3.89	1	4
5b	385	5	259	67.27	4.56	0.73	5
5c	382	5	116	30.37	3.51	1.29	4
5d	381	3	122	32.02	3.01	1.23	3
5e	383	4	124	32.38	3.59	1.07	4
5f	385	5	224	58.18	4.43	0.79	5
5g	386	5	159	41.19	4.08	0.96	4
21	383	2	142	37.08	2.79	1.31	2
22	370	40000-59999	95	25.68	78067	55028	70000
24	383	25-34	119	31.07	43.76	14.12	40
25	384	26 more	165	42.97	16.75	10.88	22.5

[a] The questions appear in the Survey Methodological Report accompanying this report.

[b] Numbers of responses differ due to data incompleteness.

Table D.10. Descriptive Statistics for Responses to Attitude and Perception Questions, Sheboygan County, WI, Survey Sample

		Percentage of Response				
Survey Question[a]	Number of Responses[b]	Strongly agreed	Somewhat agreed	Somewhat disagreed	Strongly disagreed	No opinion
4a	383	15.93	45.95	13.32	3.39	21.41
4b	380	17.9	39.74	11.84	2.89	27.62
4c	377	22.55	37.93	8.49	2.65	28.38
4d	380	3.95	15	29.21	22.11	29.74
4e	377	18.04	36.6	10.08	7.16	28.12
14	Sample #	Bottom only	Bottom & Side	B&S& Upstream		
	379	12.4	30.84	56.46		
15	Sample #	Increase greatly	Increase somewhat	No effect	Decrease somewhat	Decrease greatly
	383	12.01	59.27	27.42	0.78	0
16	Sample #	Much more	Somewhat more	more	No more	
	386	10.79	21.32	28.95	38.95	
17	Sample #	Extremely likely	Very likely	Somewhat likely	Slightly likely	Not at all likely
	384	10.16	18.75	28.13	14.32	28.65
18	Sample #	Much Improved	Somewhat Improved	No effect	Somewhat worse	Much worse
	379	4.75	46.44	46.97	1.06	0.53
19	Sample #	2004	2003	2002	2001	2000
	382	27.75	39.79	28.53	2.88	1.05
20	Sample #	Single detached	Townhouse duplex	Condo	Other	
	383	79.63	7.57	12.79	0	
23	Sample #	Increase 20% more	Increase 5%-19%	Very little change	Decrease 5%-19%	Decrease 20% more
	380	5.79	28.42	56.05	5	4.74
26	Sample #	never	1-3times	4-6times	7-11times	12more
	384	9.38	25.78	20.57	11.98	32.29
27	Sample #	never	1-5 times	6-10 times	11-25 times	26 or more
	385	4.16	12.21	6.49	14.29	62.86

[a] The questions appear in Appendix A.

[b] Numbers of responses differ due to data incompleteness.

Appendix E. Outreach Documents
Exhibit E.1 NEMW Great Lakes webpage featuring Buffalo economic study

Economic benefit of Remediating Contaminated Sediments from the Buffalo River AOC, NY

With economists from the University of Illinois, the Northeast-Midwest Institute is nearing completion of a two-year study to estimate how much the overall value of residential property values in the City of Buffalo and surrounding Erie County community might be influenced by cleanup of contaminated sediments in the Buffalo River Area of Concern (AOC).

The Buffalo River AOC is one of 41 Areas of Concern in the Great Lakes region. The AOC's Remedial Action Plan has made progress on several factors limiting beneficial uses, but the continuing presence of toxic contaminants in the sediments impedes further recovery.

A public forum hosted by the Northeast-Midwest Institute and featuring a presentation by Dr. John Braden (University of Illinois) concerning the results of the economic study was held at the Adam's Mark Hotel, Buffalo on September 15, 2006. The forum also included speeches by community, city, state and federal stakeholders.

It is hoped results of this study will catalyze contaminated sediment remediation in the Buffalo River AOC, as well as provide leverage for the use of economic benefits analysis in AOC decision-making, generally.

- **News release:** Buffalo Area Homeowners to Benefit from River Clean-up (9/13/2006)
- **Public Forum:** One page summary and agenda (9/15/2006)

For more information contact John Braden (217-333-5501) or Nicole Mays (202-544-5200).


Exhibit E.2 NEMW Great Lakes webpage featuring Sheboygan economic study

Economic benefit of Remediating Contaminated Sediments from the Sheboygan River AOC, WI

With economists from the University of Illinois, the Northeast-Midwest Institute is nearing completion of a two-year study to estimate how much the overall value of residential property values in the City of Sheboygan and surrounding Sheboygan County community might be influenced by cleanup of contaminated sediments in the Sheboygan River Area of Concern (AOC).

The Sheboygan River AOC is one of 41 Areas of Concern in the Great Lakes region. The AOC's Remedial Action Plan has made progress on several factors limiting beneficial uses, but the continuing presence of toxic contaminants in the sediments impedes further recovery.

A public forum hosted by the Northeast-Midwest Institute and featuring a presentation by Dr. John Braden (University of Illinois) concerning the results of the economic study was held at the Blue Harbor Resort and Conference Center, Sheboygan on September 21, 2006. The forum also included speeches by community, city, state and federal stakeholders.

It is hoped results of this study will catalyze contaminated sediment remediation in the Sheboygan River AOC, as well as provide leverage for the use of economic benefits analysis in AOC decision-making, generally.

- **News release:** Sheboygan Area Homeowners to Benefit from River Clean-up (9/19/2006)
- **Public Forum:** One page summary and agenda (9/21/2006)

For more information contact John Braden (217-333-5501) or Nicole Mays (202-544-5200).


Exhibit E. 3

NEWS RELEASE – September 13, 2006
Northeast-Midwest Institute, Washington DC

Buffalo Area Homeowners to Benefit from River Clean-up

Contact: Nicole Mays, Northeast-Midwest Institute (202 584 3378)
Dr. John Braden, University of Illinois (217 333 5501)

Buffalo, NY. Residential property values near the Buffalo River could increase by as much as $140 million if contamination in the river is eliminated, according to a study conducted by the University of Illinois and the Northeast-Midwest Institute.

Findings of the study will be officially released September 15, 2006 at a community forum in Buffalo. The forum will be open to the public and feature a presentation by Dr. Braden concerning the results of the two-year study. Other speakers include Buffalo Mayor Byron Brown; State Senator Mark Schroeder; Mary Beth Giancarlo Ross of U.S. EPA's Great Lakes National Program Office; Abby Snyder of New York State's Department of Environmental Conservation; Jill Spisiak Jedlicka with Buffalo Niagara Riverkeeper; Helen Domske with New York Sea Grant and University at Buffalo; and Nicole Mays of the Northeast-Midwest Institute.

Pollution from past industrial and municipal discharges and disposal of waste earned the Lower Buffalo River designation as one of 43 "Great Lakes Areas of Concern (AOC)" by the International Joint Commission, the U.S.-Canadian government organization concerned with water quality. The major sources of pollution are contaminated bottom sediments and non-point source pollution. Contaminants of concern include PCBs, PAHs, heavy metals and industrial organics. PCBs (polychlorinated biphenyls) are known to affect human reproduction, fetal development, and neurological functions, and harm fish and other aquatic species.

Through a two year study, the Northeast-Midwest Institute in Washington, D.C. and economists from the University of Illinois and Georgia State University have gauged the economic value to local homeowners of clean-up of the Buffalo River AOC. The study focuses on the benefits to homeowners specifically in Buffalo, Cheektowaga, Lackawanna, Hamburg, and West Seneca, as well as Blaisdell and Sloan. The results of the study suggest that eliminating the pollution would make the area a more desirable place to live and increase property values.

Researchers collected data from housing sales in Erie County in the years 2002 through 2004, and directly surveyed 850 recent home buyers in Erie County. Results of the study of housing sales data indicate that the polluted state of the river currently is depressing single-family, owner-occupied property values by $80 to $140 million[1], or six to nine percent of the assessed residential property values in the area studied. Clean-up could be expected to raise the property values commensurately. The negative effects of the pollution appear concentrated near the river and to its south. Further to the north in Buffalo and Cheektowaga, property values seem to be affected more by other industrial areas, highways, and rail corridors than by the pollution in the Buffalo River.

These housing sales data findings were further bolstered by homeowner responses to direct surveys on their willingness to pay more for residential properties if the AOC were cleaned up. Based on the responses to the surveys, residents within five miles both north and south of the river would be willing to pay on average approximately 15% more for homes if the contaminated area were cleaned up. Relative to the median property value in the area, this translates into a $543 million addition to the assessed values of current properties.

The estimated benefits of Buffalo River clean-up generated in the study apply only to single-family residential property owners living within five miles of the river. However, preliminary analysis of multi-family properties suggests that current prices are depressed proportionately more than for single-family homes and could benefit from river cleanup. In addition, river improvements might attract new residents and businesses to the area.

The study was funded by the Great Lakes National Program Office, U.S. Environmental Protection Agency and the College of ACES, University of Illinois at Urbana-Champaign.

[1] All dollar values are expressed in year 2004 (4th quarter) purchasing power. Subsequent inflation in housing prices would increase the current dollar values.

Disclaimer: Until the methods and results described here have been reviewed by qualified scientific peers and published in the peer-reviewed literature, they must be considered preliminary. The opinions, findings, and conclusions of this study are solely those of the authors and do not necessarily reflect the views of the sponsors.

Exhibit E.4

NEWS RELEASE – September 19, 2006
Northeast-Midwest Institute, Washington DC

Sheboygan Area Homeowners to Benefit from River Clean-up

Contact: Nicole Mays, Northeast-Midwest Institute (202 584 3378)
Dr. John Braden, University of Illinois (217 333 5501)

Sheboygan, WI. Residential property values near the Sheboygan River could increase by as much as $108 million if contamination in the river and neighboring land areas were eliminated, according to a study conducted by the University of Illinois and the Northeast-Midwest Institute.

Findings of the study will be officially released September 21, 2006 at a community forum in Sheboygan. The forum will be open to the public and feature a presentation by Dr. Braden concerning the results of the two-year study. Other speakers include Sheboygan Mayor Juan Perez; State Senator Joe Leibham; Marc Tuchman of U.S. EPA's Great Lakes National Program Office; James McNelly of Wisconsin's Department of Natural Resources; Jon Gumtow with the Sheboygan River Basin Partnership; and Nicole Mays of the Northeast-Midwest Institute. .

Pollution from past industrial discharges and disposal of waste earned the Sheboygan River designation as one of 43 "Great Lakes Areas of Concern (AOC)" by the International Joint Commission, the U.S.-Canadian government organization concerned with water quality. The major sources of pollution are contaminated bottom sediments and non-point source pollution. Contaminants of concern include PCBs, PAHs, and heavy metals. PCBs (polychlorinated biphenyls) are known to affect human reproduction, fetal development, and neurological functions, and harm fish and other aquatic species.

Through a two year study, the Northeast-Midwest Institute in Washington, D.C. and economists from the University of Illinois and Georgia State University have gauged the economic value to local homeowners of clean-up of the Sheboygan River AOC. The study focuses on the benefits to homeowners specifically in Sheboygan, Sheboygan Falls, Kohler, and the surrounding townships. The early results of the study suggest that eliminating the pollution in the AOC would make neighboring towns a more desirable place to live and increase property values significantly.

Researchers collected data for housing sales in Sheboygan County in the years 2002 through 2004, and directly surveyed 850 recent home buyers in Sheboygan County. Results of the study of housing sales data indicate that the polluted state of the river currently is depressing single-family, owner-occupied property values by $8 to $108 million[1], or one to seven percent of the assessed residential property values in the area studied. Clean-up could be expected to raise the property values commensurately. The negative effects of the pollution appear greatest close to the river and diminish with distance from the river, with properties east of the Waelderhaus Dam suffering the highest reduction in values.

These housing sales data findings were further bolstered by homeowner responses to direct surveys on their willingness to pay more for residential properties if the AOC were cleaned up. Based on the responses to the surveys, residents within five miles both north and south of the river would be willing to pay on average approximately 10% more for homes if the contaminated area if the area were cleaned up.

The estimated benefits of Sheboygan River AOC clean-up generated in the study apply only to single-family residential property owners living within five miles of the river, though cleanup of the AOC east of the Waelderhaus Dam would likely have a positive effect on other property types as well. Property value increases are however, only one of the ways that benefits from remediation of the Sheboygan River AOC would be realized by local residents. Clean-up might also attract new residents and businesses to the area.

The study was funded by the Great Lakes National Program Office, U.S. Environmental Protection Agency and the College of ACES, University of Illinois at Urbana-Champaign. The results are preliminary and will be refined through further analysis.

[1] All dollar values are expressed in year 2004 (4th quarter) purchasing power. Subsequent inflation in housing prices would increase the current dollar values.

Disclaimer: Until the methods and results described here have been reviewed by qualified scientific peers and published in the peer-reviewed literature, they must be considered preliminary. The opinions, findings, and conclusions of this study are solely those of the authors and do not necessarily reflect the views of the sponsors.

Exhibit E. 5

Public forum to focus on river property study

By Bob Petrie
Sheboygan Press staff

Postcard by postcard, John Braden is putting together a study on whether cleaning up the heavily polluted Sheboygan River will make the land alongside its meandering path more valuable to the communities it flows through.

"I think it's a beautiful place and it's a shame that people aren't able to make full use of it, because of the chemicals that are in there," said Braden, a professor of environmental economics at the University of Illinois.

The river, a federal Superfund site, is laced with polychlorinated biphenyls and other contaminants from Sheboygan Falls to the City of Sheboygan harbor. A $41 million cleanup project, overseen by the Environmental Protection Agency, is under way, but will take years to complete.

On Thursday, Braden will speak about his study in progress at a forum sponsored by the Sheboygan River Basin Partnership. The talk, free and open to the public, will begin at 7 p.m. at Maywood Environmental Park, 3615 Mueller Road.

In the study, Braden has been canvassing property owners along the Sheboygan River to get their thoughts on whether cleaning up the river would help improve property values.

Postcards were mailed to 850 people in the vicinity of the river last spring, and about 410 were returned by the August 2005 deadline. Braden, who has also visited the river several times, is also looking at property records for river frontage parcels, using a hypothesis that cleaning up the Sheboygan River might encourage more development along its banks.

"Typically, you don't sell condos if you have to tell people the river out there has got PCBs in it," Braden said in a telephone interview. "It's a little easier to sell those things if you say you can go canoeing in that river, catch fish."

The PCBs were traced to a former Tecumseh Products Co. plant in Sheboygan Falls, and the contamination dates to the late 1950s. Initial cleanup was started around the plant in late 2004, and largely complete by the end of 2005, said Rick Nagle, assistant regional counsel for the EPA in Chicago.

The next step is cleanup of the upper river, above Kohler Dam, which will continue this year and wrap up by November, Nagle said.

"It's slow and steady," Nagle said of the work to date.

Nagle said the cleanup of the river to the Eighth Street Bridge in Sheboygan could be complete by about 2011.

Tom Gierke, a member of the Sheboygan River Basin Partnership, said Thursday's public forum is one of several the group will hold on area environmental issues.

"We're starting out with trying to show to people the actual economic benefits of cleaning up the (Sheboygan) river, how it can definitely help the area," Gierke said.

Dave Kuckuk, Maywood director, said he hopes many city and county officials will turn out for Braden's report on the river.

"It has great impact on the decision-making that they'll be doing regarding some of the development, the economics, and the cleanup efforts that are going to be going on this summer," Kuckuk said.

Braden said he thinks the river is worth saving, and that economic development such as the Blue Harbor Resort and Conference Center and other shops in the harbor area are testament that the future is encouraging, if the cleanup is completed.

"You've got a fair amount of vacant land along the river where more can happen," he said. "I think the scene is set there for some more good things to happen."

Reach Bob Petrie at bpetrie@sheboygan-press.com and 453-5129.

Exhibit E.6

Clean river could raise property values

by Emmitt B. Feldner
Review Correspondent

SHEBOYGAN — Is the contamination at the bottom of the Sheboygan River and harbor bringing down property values nearby?

University of Illinois professor of environmental economics Dr. John Braden is in the middle of a study of that question, but he thinks he knows what the answer will be, based on similar studies elsewhere.

"Contaminated sites have an effect on property values," Braden told an audience of about 20 people Thursday at Maywood Environmental Park.

The decline in property values in close proximity to other cleanup sites has been anywhere from 9 to 27 percent, Braden said.

Braden's study is being sponsored in part by the Sheboygan River Basin Partnership, which hosted Thursday's meeting.

The economist said that, if Sheboygan follows patterns from other contaminated waterway cleanups, the value of existing properties near the Sheboygan River could increase from $12 million to $36 million once the cleanup of poly-chlorinated biphenyl contaminated river bottom soil is completed. That's based on property value increases of 4 to 12 percent, Braden said.

That includes properties in the cities of Sheboygan Falls and Sheboygan, the village of Kohler and the towns of Sheboygan Falls and Sheboygan, as well as parts of the towns of Lima and Wilson.

Braden said he based his estimates on 31 other studies of contaminated sites, including several he conducted himself.

His study in Waukegan, Ill., found property values within five miles of the contaminated Waukegan harbor were 9 to 19 percent lower than similar properties beyond that area.

"There was over $400 million increase in property value after the cleanup [in Waukegan], which is more than 15 percent of the total residential property value," Braden said.

"That was existing home stock," Braden added, explaining that his study did not look at existing or potential commercial or industrial values in the Illinois city of nearly 90,000 people located on Lake Michigan north of Chicago.

"There's value to communities who can get the process to move forward and clean up contamination," Braden said.

Braden's Sheboygan study is similar to the one he conducted in Waukegan. It began with collecting sales and assessment data a year ago, followed by a postcard survey of residents living near the river. His study group is now collecting, assessing and mapping the data.

"We hope to bring the results back to the public in late summer or early fall," Braden said.

Braden said he got a 48 percent response to the 850 postcards he sent out, which he termed a remarkable response.

His study will not address commercial or industrial property values, or the potential for increased value in those areas. It also will not make any projections of new growth or development in the residential, commercial or industrial areas in the river basin.

New growth in those areas would be quite likely if existing property values increase, he said. "That would be gravy on top of the meat."

The stigma of being located on or near a cleanup site is the main driving force behind property value declines, according to Braden. Other benefits of the cleanup he listed included a healthier fishery and ecosystem, and reduced human health threats.

"Our study is looking only at the [property value] benefits," Braden told the audience. "If that is significant, the rest of the stuff is frosting on the cake. The cake is enough to justify the cleanup."

The Sheboygan River, from Sheboygan Falls east to the Sheboygan harbor, has been designated a federal Superfund site. It is in the middle of a $41 million cleanup effort, supervised by the federal Environmental Protection Agency.

Exhibit E.7

River cleanup to help home values

Homes within 1 mile of the river could be affected

By Eric Litke
Sheboygan Press staff. Posted September 23, 2006

Property value of homes within a mile of a PCB-contaminated stretch of the Sheboygan River should increase 15 to 20 percent once the river cleanup is done, according to a preliminary study by a University of Illinois economist.

John Braden, who presented his study at a public forum Thursday at the Blue Harbor Resort and Conference Center, said an analysis of single-family home sales from 2002 to 2004 also found home values within five miles of the river are 1 to 7 percent lower than they would be with an uncontaminated river. A survey of 400 residents in that area showed they would be willing to pay 10 percent more to live near a clean river, he said.

"For homeowners, it helps them to understand that many of them have a real stake in the cleanup of the river, that it affects them," Braden said. "The first two-tenths, three-tenths are where you see the lion's share of the impact. … You move outward and the proportionate impact on each property grow smaller, but there were far more properties, so they have an effect."

A 14-mile stretch of the Sheboygan River from the Sheboygan Falls Dam to the river's mouth in the City of Sheboygan is contaminated with polychlorinated biphenyls, commonly called PCBs. It has been a federally designated Superfund site since 1984, but cleanup did not begin until this summer.

The contamination has caused a total decrease in value of $8 million to $108 million in homes within five miles of the river, Braden said.

Ken Aukerman, project manager at the cleanup site, said Thursday that workers have dredged about 1.3 miles of river — covering some 65,000 square feet of river bottom — since starting work at the Sheboygan Falls Dam in July. He said crews will remain at the site into November and return next April.

Workers had originally hoped to make it to the Waelderhaus Dam in Kohler this year, 3.4 miles downstream, but at this point are hoping to cross the two-mile mark, Aukerman said, adding sediment has been more difficult to remove than anticipated.

Aukerman said it will take three to five years and cost about $40 million to dredge all the way to Lake Michigan.
Braden, who began his study in October 2004, said he hopes to finalize and refine the results of his study within six months. It is funded by several federal and regional organizations, including the U.S. Environmental Protection Agency.

"These results are statistically meaningful, but they're just more different than we are comfortable with," Braden said. "A 5 to 10 (percent) range is what we see commonly in other studies of this kind of site. … I'm really surprised by the number (1 percent) on the low end of the range."

Braden was careful to note his study looked at only one of many benefits of the cleanup. Further economic impact will likely come from new development along the river, and a clean river will benefit human health, fisheries, recreation and commerce, he said.

Sheboygan Mayor Juan Perez told the group a PCB-free river would have saved the city millions in construction of the Eighth Street bridge, as contaminated sediment prevented the city from digging to anchor counterweights. The city has also had to turn away inquiring cruise ships because they cannot fit in the harbor, which is as shallow as three feet at points but cannot be dredged due to contamination, Perez said.

Pollution Risk Services, which is doing the cleanup, uses a dredge with a horizontal auger like on a snow blower to suck up the contaminated sediment and pump it back to the staging area, the former Tecumseh Products Co. plant at 415 Cleveland St. The PCB contamination has been traced to the riverfront Tecumseh plant, which under various ownerships used an absorbent containing PCBs from the 1950s to the early 1970s.

A fish advisory against eating any resident fish has been in effect along the Sheboygan River since 1998.

Reach Eric Litke at 453-5119 and elitke@sheboygan-press.com

Exhibit E.8

Public Forum

Adam's Mark Hotel

120 Church St., Buffalo

September 15, 2006

2:00pm – 3:30 pm

For more information and to RSVP please contact Nicole Mays of the Northeast-Midwest Institute at 202 584 3378 or email nmays@nemw.org

How Erie County homeowners can benefit from cleanup of the Buffalo River

FOLLOWING THE FORUM, JOIN US FOR A TOUR OF THE BUFFALO RIVER AREA OF CONCERN ON THE HISTORIC FIREBOAT "Edward M. Cotter"!

Time: 4:00pm—5:30pm

Venue: Michigan Avenue/Ohio Street Dock

Don't forget! Buffalo Niagara Riverkeeper's Autumn Beach Sweep, September 15-16, 2006. Contact (716) 852-RIVER, or email shannon@bnriverkeeper.org

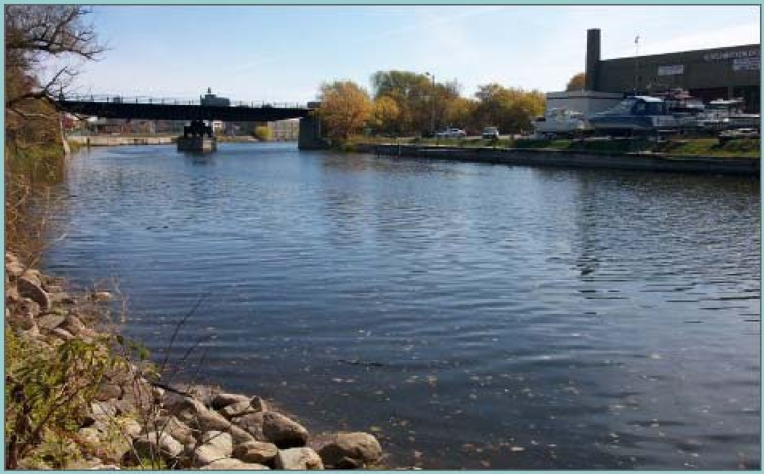
Hear results of a two-year study on the economic advantages improving environmental quality in the Buffalo area can bring to local homeowners.

Speakers include Mayor Byron Brown, City of Buffalo; Hon. Mark Schroeder, 145th District, State of New York; Dr. John Braden, University of Illinois; Ms. Mary Beth Giancarlo Ross, U.S. Environmental Protection Agency, Great Lakes National Program Office; Ms. Abby Snyder, New York State Department of Environmental Conservation; Ms. Jill Spisiak Jedlicka, Buffalo Niagara Riverkeeper; and Ms. Helen Domske, New York Sea Grant and University at Buffalo.

NORTHEAST MIDWEST INSTITUTE

218 D St., SE
Washington DC, 20003
202-544-5200. www.nemw.org

Exhibit E.9



Public Forum

Blue Harbor Resort & Conference Center

725 Blue Harbor Dr. Sheboygan

September 21, 2006

2:00pm – 3:30 pm

How Sheboygan County home-owners can benefit from cleanup of the Sheboygan River

Hear results of a two-year study on the economic advantages improving environmental quality in the Sheboygan area can bring to local homeowners.

Speakers include: Mayor Juan Perez, City of Sheboygan; Senator Joe Leibham, 9th Senate District; Dr. John Braden, University of Illinois; Mr. Marc Tuchman, U.S. Environmental Protection Agency, Great Lakes National Program Office; Mr. James McNelly, Wisconsin Department of Natural Resources; Mr. Jon Gumtow, Sheboygan River Basin Partnership; and Ms. Nicole Mays, Northeast-Midwest Institute. The event will be chaired by Mr. David Ullrich of the Great Lakes and St. Lawrence Cities Initiative.

For more information please contact Nicole Mays of the Northeast-Midwest Institute at 202 584 3378 or email nmays@nemw.org

NORTHEAST MIDWEST INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Exhibit E.10

September 15, 2006

Public Forum: How Buffalo Area Homeowners can Benefit from River Clean-up

Contact: Dr. John Braden
University of Illinois
Phone: 217-333-5501
Email: jbb@uiuc.edu

Contact: Nicole Mays
Northeast-Midwest Institute
Phone: 202-584-3378
Email: nmays@nemw.org

FORUM AGENDA

2:00 – 2:10 pm: Welcome, introduction, and order of events by Mr. Richard Munson, Executive Director, Northeast-Midwest Institute

2:10 – 2:15 pm: Welcome address by Mayor Byron Brown, City of Buffalo

2:15 – 2:25 pm: Opening remarks by Hon. Mark Schroeder, 145th District, State of New York

2:25 – 2:35 pm: Opening remarks by Ms. Mary Beth Giancarlo Ross, Environmental Scientist, U.S. Environmental Protection Agency, Great Lakes National Program Office

2:35 – 2:45 pm: Opening remarks by Ms. Abby Snyder, Regional Director, Region 9, New York State Department of Environmental Conservation

2:45 – 3.00 pm: History, current status, and environmental benefits of Buffalo River cleanup by Ms. Jill Spisiak Jedlicka, Buffalo River Remedial Action Plan Coordinator, Buffalo Niagara Riverkeeper

3:00 – 3:15 pm: Economic benefit of sediment cleanup in the Buffalo River by Dr. John Braden, Economist, University of Illinois at Urbana-Champaign

3.15 – 3:20 pm: Remarks on the Buffalo River Economic Study by Ms. Helen Domske, Sr. Extension Specialist, NY Sea Grant and Associate Director, Great Lakes Program – University at Buffalo

3:20 – 3:25 pm: Helping the communities of Buffalo, Lake Erie, and other Great Lakes Areas of Concern maximize the economic study's findings by Ms. Nicole Mays, Policy Analyst, Northeast-Midwest Institute

3:25 – 3:30 pm: Closing remarks by Mr. Richard Munson, Director, Northeast-Midwest Institute

4:00 – 5:30 pm: Optional boat tour of the Buffalo River onboard the historic firetug "Edward M. Cotter".

Residential property values near the Buffalo River could increase if contamination in the river is eliminated, according to a study by the University of Illinois and the Northeast-Midwest Institute.

The study focuses on the benefits to homeowners specifically in Buffalo, Cheektowaga, Lackawanna, Hamburg, and West Seneca, as well as Blaisdell and Sloan.

Researchers collected data from housing sales in Erie County in the years 2002 through 2004, and directly surveyed 850 recent homebuyers in the county. Results of the study of house sales data indicate that the polluted state of the river currently is depressing single-family, owner-occupied property values by $80 to $140 million, or six to nine percent of the assessed residential property values in the area studied.

These housing sales data findings were further bolstered by homeowner responses to direct surveys on their willingness to pay more for residential properties if the river area were cleaned up. Based on the responses to the surveys, residents within five miles both north and south of the river would be willing to pay on average 15 % more for homes if the contaminated area were cleaned up. Relative to the median property value in the area, this translates into a $543 million addition to the assessed values of current properties.

The study did not look at any of the other benefits that a cleaner river will bring to the local community. Remediated and returned to productive use, the river will undoubtedly generate significant economic, social and environmental benefit to those that live, work, visit and do business in Buffalo.

Exhibit E. 11

September 21, 2006

Public Forum:
How Sheboygan Area Homeowners can Benefit from River Clean-up

Contact: Dr. John Braden
University of Illinois
Phone: 217-333-5501
Email: jbb@uiuc.edu

Contact: Nicole Mays
Northeast-Midwest Institute
Phone: 202-584-3378
Email: nmays@nemw.org

FORUM AGENDA

) – 2:05 pm:
come, introduction, and order of events by Mr. David ch, Director, Great Lakes and St. Lawrence Cities Initia-

5 – 2:10 pm:
come address by Mayor Juan Perez, City of Sheboygan

0 – 2:20 pm:
ning remarks by Opening remarks by Senator Joe Leib-, 9th Senate District

0 – 2:30 pm:
ning remarks by Mr. Marc Tuchman, Great Lakes Leg- Act Program Manager, U.S. Environmental Protection ncy, Great Lakes National Program Office

0 – 2:45 pm:
ory and current status of the Sheboygan River Area of cern by Mr. James McNelly, Regional Water Leader, consin Department of Natural Resources

5 – 2.50 pm:
munity involvement in Sheboygan River cleanup by Jon Gumtow, Sheboygan River Basin Partnership

0 – 3:10 pm:
nomic benefit of Sheboygan River cleanup by Dr. John den, Economist, University of Illinois at Urbana- mpaign

0 – 3:20 pm:
ping the communities of Sheboygan, Sheboygan nty, and other Great Lakes Areas of Concern maximize economic study's findings by Ms. Nicole Mays, Policy lyst, Northeast-Midwest Institute

0 – 3:30 pm:
sing remarks by Mr. David Ullrich, Director, Great Lakes St. Lawrence Cities Initiative

Residential property values near the Sheboygan River could increas contamination in the river is eliminated, according to a study by the versity of Illinois and the Northeast-Midwest Institute.

The study focuses on the benefits to homeowners specifically in She gan, Sheboygan Falls, Kohler, and the surrounding townships.

Researchers collected data for housing sales in Sheboygan County in years 2002 through 2004, and directly surveyed 850 recent homebu in the county. Results of the study of house sales data indicate that polluted state of the river currently is depressing single-family, ow occupied property values by $8 to $108 million, or one to seven per of the assessed residential property values in the area studied.

These housing sales data findings were further bolstered by homeov responses to direct surveys on their willingness to pay more for resi tial properties if the river area were cleaned up. Based on the respor to the surveys, residents within five miles both north and south of river would be willing to pay on average 10 % more for homes if the taminated area were cleaned up.

The findings of the study are preliminary and will be refined with fur analysis. The study did not look at any of the other benefits that a clea river will bring to the local community. Remediated and returned to ductive use, the river will undoubtedly generate significant econo social, and environmental benefit to those that live, work, visit, and business in Sheboygan.

http://www.nemw.org/greatlakes.htm#sheboygan

Exhibit E.12

Clean river boosts values

by Joelle Steffen
of The Review staff

SHEBOYGAN – Although there are many benefits to cleaning up the Sheboygan River, such as reduced human health impacts, a healthier fishery and more recreation, the impact on real estate values has caught the eye of Sheboygan's government.

A study done by economist Dr. John Braden of the University of Illinois at Urbana-Champaign shows that home buyers would be willing to pay 1 to 7 percent more for homes within a five mile radius of the river if it were cleaned of contaminants.

He said that within a mile of the Sheboygan River, that percentage jumps as high as 15 to 20 percent.

This data comes from a survey of 850 homebuyers in the Sheboygan, Sheboygan Falls, Kohler and surrounding townships, randomly selected.

He said that the study is preliminary, and that it is continuing. Within the next six months, more firm numbers will surface.

The study's first task was to create controls for home and lot size, the number of bathrooms and other factors, such as proximity to parks, highways, lakeshore, other rivers and the airport.

Braden and his researchers also collected data for housing sales in Sheboygan County from 2002 through 2004.

Out of the 850 recent buyers, surveys were delivered to 839 and 407 of those buyers responded.

The 48 percent of buyers who responded showed a significant interest in real estate close to the river and would pay 10 percent more than what they paid for their current homes (an increase of $13,800) if contamination were cleaned.

Braden said that even if home buyers were only willing to pay, on average, less than 1 percent more, that could mean an $8 million dollar increase or combined real estate prices for al the homes in the five-mile study area.

If the values jumped 7 percent that would translate to a $10 million dollar increase i combined real estate values.

Braden said that he did no have enough information abou just the properties within a one mile radius of the river t determine the real estate valu increase of a 15 to 20 perce jump in the market.

However, what he did conclu is that the clean up of t Sheboygan River will continue reap economic rewards for t area. He used the South P District, which was recen

See RIVER

River cleanup boosts values

RIVER from 3

announced as the winner of an environmental award, as an example.

"To think, the community has accomplished all this with the worst of [the contamination] still out there," said Braden. "Just think of what you can still accomplish."

John Gumtow, the chairman of the Sheboygan River Basin Partnership – the group that held the homeowner benefits forum – also thought that the South Pier District provided hope.

"This is a prime example that things can change in the watershed," said Gumtow. "It was a blighted area, there was vandalism, no one wanted to be here, and now …"

However, he said that there is a lot of work left to do in getting the Sheboygan River off the Environmental Protection Agency's Area of Concern (AOC) list.

"To get the Sheboygan River delisted, we need the citizens' involvement," he said.

In order to get more involvement, SRBP and Maywood Environmental Center in Sheboygan have partnered to provide a five-part series on the clean up of poly-chlorinated biphenyl (PCB)-contaminated sediment in the river.

The next public involvement forum is Oct. 12, from 6 to 8 p.m., at the Blue Harbor Conference Center in Sheboygan.

Before that, though, the public is invited to the SRBP's next board of director's meeting at Maywood. The first hour of the meeting will focus on the partnership's business, but the second hour will include a presentation of the status of Sheboygan's storm water program and improvements to the water quality in the area.

Appendix F. Guidance to Data Files

Data sets used in this study are compiled in two accompanying folders, Buffalo.zip and Sheboygan.zip. Each folder contains two files prepared in .doc format containing descriptive information for the data fiels, and two files prepared in .dta format. The .dta files contain, respectively, the market-based data for use in the hedonic analysis and the survey data for use in the conjoint choice analysis. The .dta format is compatible with the statistical package, Stata. This appendix provides a brief guide to the data files. The hedonic data include house characteristics and distances to key features around each AOC, in addition to house sale information. All arm-length transactions around each AOC from 2002 to 2004 are covered in the hedonic data sets. The survey data contain the responses to the questions in the survey (see Appendix A) and characteristics of the respondent's home.

Table F. 1. Explanatory Notes for Variables in the Buffalo Data

Buffalo		
Variable		**Description**
csid	the unique household ID	
q1	Closest Stream	1. Lake Erie 2. Niagara River/Back Rock Canal 3. Hoyt Lake (Delaware Park) 4. Buffalo River 5. Buffalo Creek 6. Cayuga Creek 7.Cazenovia Creek 8. Smoke Creek 9. Rush Creek 10. Other 98. Don't Know 99. Refused or Missing
q2	Straight-line distance to the Lower Buffalo River	1. Less than 1/2 mile 2.1/2 - 1 mile 3. 1.1 - 2 miles 4. 2.1- 4 miles 5. 4.1 - 6 miles 6. more than 6 miles 9. Refused or Missing
q3a	Bedrooms	1. One
q3b	Full bathrooms	2. Two
q3c	Half bathrooms	3. Three
q3d	Other rooms	4. Four 5. Five 6. Six of more 9. Refused or Missing
q4a	The River is attractive	1. Strongly agreed
q4b	The River enhances the quality of life	2. Somewhat agreed

q4c	The River is important to the local economy	3. Somewhat disagreed
q4d	The River is environmentally safe	4. Strongly disagreed
q4e	The River is a likely area for new development	5. No opinion 9. Refused or Missing
q5a	Importance of size of house	1. Not at all important
q5b	Importance of neighborhood	2.
q5c	Importance of proximity to polluted sites	3.
q5d	Importance of proximity to water resources	4.
q5e	Importance of proximity to employment & shopping	5. Very important
q5f	Importance of price of home	9. Refused or Missing
q5g	Importance of property taxes	
version	The questionnaire version from 1 to 8	
q6v1-q13v8	The house choice question by version	1. Modified home 2. Current home 9. Refused or Missing
q14	Partial cleanup would occur	1. At the river bottom only 2. At the river bottom and industrial sites nearby 3. At the river and industrial sites and polluted upstream areas 8. Don't know 9. Refused or Missing
q15	Impact of reducing pollution on value of homes	1. Increase the value a great deal 2. Increase the value somewhat 3. No effect 4. Decrease the value somewhat 5. Decrease the value a great deal 9. Refused or Missing
q16	How much affordable for better features	1. 15% or greater 2. 5% - 14% 3. Up to 5% 4. No more 9. Refused or Missing
q17	How likely to look closer to the Buffalo River	1. extremely likely 2. very likely 3. somewhat likely 4. slightly likely 5. not at all likely 9. Refused or Missing
q18	How survey affect on future environmental condition	1. Highly likely to improve conditions 2. Somewhat likely to improve conditions 3. Likely to have no effect

4. Somewhat likely to worsen

		conditions 5. Highly likely to worsen conditions 9. Refused or Missing
q19	Year purchased current home	1. 2004 2. 2003 3. 2002 4. 2001 5. 2000 or earlier 9. Refused or Missing
q20	Type of home	1. Single family, detached 2. Townhouse, duplex or other 3. Codominium 4. Other 9. Refused or Missing
q21	Number of people in household	1. 1 2. 2 3. 3 4. 4 5. 5 6. 6 or more 9. Refused or Missing
q22	Total household income for 2004	1. $0 - $19,999 2. $20,000 - $39,999 3. $40,000 - $59,999 4. $60,000 - $79,999 5. $80,000 - $99,999 6. $100,000 - $119,999 7. $120,000 - $149,999 8. $150,000 - $179,999 9. $180,000 - $219,999 10. $220,000 - $259,999 11. $260,000 - $299,999 12. $300,000 or more 98. Don’t Know 99. Refused or Missing
q23	Income change since purchase of home	1. Incresed 20% or more 2. Increased 5% - 19% 3. Very little change 4. Decrease 5% - 19% 5. Decrease 20% or more 9. Refused or Missing
q24	Respondent age	1. 24 years old or younger 2. 25 - 34 3. 35 - 44 4. 45 - 54 5. 55 - 64 6. 65 or older

		9. Refused or Missing
q25	Number of years lived in Erie county	1. 5 years or less 2. 6 -10 years 3. 11 - 15 years 4. 16 - 20 years 5. 21 - 25 years 6. 26 years or more 9. Refused or Missing
q26	Frequency of visiting lake stream or river	1. never 2. 1 - 3 3. 4 - 6 4. 7- 11 5. 12 or more 9. Refused or Missing
q27	Frequency of seeing the Buffalo River	1. never 2. 1 - 5 3. 6 - 10 4. 11 - 25 5. 26 or more 9. Refused or Missing
q28	Comment	1. Comment
city_web	Dummy for response means	1. By internet 2. By mail
rbsmnt_typ	Basement Type	1. Slab/ pier 2. Crawl 3. Partial 4. Full
nbr_full_baths	number of full bathrooms	
nbr_bedrooms	number of bedrooms	
nbr_fireplaces	number of fireplaces	
grade	house grade	
sfla	house size (square footage)	
yr_built	year built	
bldg_style	building type	1. Ranch 2. Raised Ranch 3. Split Level 4. Cape cod 5. Colonial 6. Contemporary 7. Mansion 8. Old style 9. Cottage 10. Row 11. Log home 12. Duplex 13. Bungalow 14. Other style

		15. Townhouse
nbr_half_baths	number of the half bathroom	
datasource	assessment office	
acres	Lot size (acreage)	
citytown	township	
d_airport	distance to the airport (meter)	
d_aoc	distance to the lower Buffalo River (meter)	
Streamname	The name of the closest stream	
d_stream	distance to the closest stream (meter)	
d_hwyint	distance to the closest highway interchange (meter)	
parkname	The name of the closest park (meter)	
parkacres	The size of the closest park (meter)	
d_park	distance to the closet park (meter)	
siteid	Identification of the closest hazard waste site	
site_code	The code of the closest hazard waste site (meter)	
d_cerclis	distance to the closest hazard waste site (meter)	
d_rail	distance to the closest railroad (meter)	
d_shoreline	distance to Lake Erie shoreline (meter)	
hwyname	The name of the closest highway	
d_highway	distance to the closet highway (meter)	
blkgroup bg36_d00 bg36_d00_i	Census Block Group	
tract tr36_d000 tract_d000_i	Census tract	
saleyear	sale year	
salemonth	sale month	
sale_price	sale price	
price2003	normalized price (2003)	
juris	jurisdiction code	1. Buffalo 2. Cheektowaga/Sloan 3. Hamburg/Blasdell 4. Lackawanna 5. West Seneca
northaoc	dummy variable indicating the north of the buffalo river	
southaoc	dummy variable indicating the sorth of the buffalo river	
eastaoc	dummy variable indicating the east of the buffalo river	

Table F. 2. Explanatory Notes for Variables in the Sheboygan Data

Sheboygan		
Variable		**Description**
csid	the unique household ID	
q1	Closest Stream	1. Lake Michgan 2. Black River 3. Mullet River 4. Onion River 5. Pigeon River 6. Sheboygan River 8. Other 98. Don't Know 99. Refused or Missing
q2	Straight-line distance to the Lower Sheboygan River	1. Less than 1/2 mile 2.1/2 - 1 mile 3. 1.1 - 2 miles 4. 2.1- 4 miles 5. 4.1 - 6 miles 6. more than 6 miles 9. Refused or Missing
q3a	Bedrooms	1. One
q3b	Full bathrooms	2. Two
q3c	Half bathrooms	3. Three
q3d	Other rooms	4. Four 5. Five 6. Six of more 9. Refused or Missing
q4a	The River is attractive	1. Strongly agreed
q4b	The River enhances the quality of life	2. Somewhat agreed
q4c	The River is important to the local economy	3. Somewhat disagreed
q4d	The River is environmentally safe	4. Strongly disagreed
q4e	The River is a likely area for new development	5. No opinion 9. Refused or Missing
q5a	Importance of size of house	1. Not at all important
q5b	Importance of neighborhood	2.
q5c	Importance of proximity to polluted sites	3.
q5d	Importance of proximity to water resources	4.
q5e	Importance of proximity to employment & shopping	5. Very important
q5f	Importance of price of home	9. Refused or Missing
q5g	Importance of property taxes	
version	The questionnaire version from	

	1 to 8	
q6v1-q13v8	The house choice question by version	1. Modified home 2. Current home 9. Refused or Missing
q14	Partial cleanup would occur	1. At the river bottom only 2. At the river bottm and indutrial sites nearby 3. At the river and industiral sites and polluted upstream areas 8. Don't know 9. Refused or Missing
q15	Impact of reducing pollution on value of homes	1. Increase the value a great deal 2. Increase the value somewhat 3. No effect 4. Decrease the value somewhat 5. Decrease the value a great deal 9. Refused or Missing
q16	How much affordable for better features	1. 15% or greater 2. 5% - 14% 3. Up to 5% 4. No more 9. Refused or Missing
q17	How likely to look closer to the Buffalo River	1. extremely likely 2. very likely 3. somewhat likely 4. slightly likely 5. not at all likely 9. Refused or Missing
q18	How survey affect on future environmental condition	1. Highly likely to improve conditions 2. Somewhat likely to improve conditions 3. Likely to have no effect 4. Somewhat likely to worsen conditions 5. Highly likely to worsen conditions 9. Refused or Missing
q19	Year purchased current home	1. 2004 2. 2003 3. 2002 4. 2001 5. 2000 or earlier 9. Refused or Missing
q20	Type of home	1. Single family, detached 2. Townhouse, duplex or other

		3. Condominium 4. Other 9. Refused or Missing
q21	Number of people in household	1. 1 2. 2 3. 3 4. 4 5. 5 6. 6 or more 9. Refused or Missing
q22	Total household income for 2004	1. $0 - $19,999 2. $20,000 - $39,999 3. $40,000 - $59,999 4. $60,000 - $79,999 5. $80,000 - $99,999 6. $100,000 - $119,999 7. $120,000 - $149,999 8. $150,000 - $179,999 9. $180,000 - $219,999 10. $220,000 - $259,999 11. $260,000 - $299,999 12. $300,000 or more 98. Don't Know 99. Refused or Missing
q23	Income change since purchase of home	1. Incresed 20% or more 2. Increased 5% - 19% 3. Very little change 4. Decrease 5% - 19% 5. Decrease 20% or more 9. Refused or Missing
q24	Respondent age	1. 24 years old or younger 2. 25 - 34 3. 35 - 44 4. 45 - 54 5. 55 - 64 6. 65 or older 9. Refused or Missing
q25	Number of years lived in Erie county	1. 5 years or less 2. 6 -10 years 3. 11 - 15 years 4. 16 - 20 years 5. 21 - 25 years 6. 26 years or more 9. Refused or Missing

q26	Frequency of visiting lake stream or river	1. never 2. 1 - 3 3. 4 - 6 4. 7- 11 5. 12 or more 9. Refused or Missing
q27	Frequency of seeing the Buffalo River	1. never 2. 1 - 5 3. 6 - 10 4. 11 - 25 5. 26 or more 9. Refused or Missing
q28	Comment	1. Comment
city_web	Dummy for response means	1. By internet 2. By mail
grade	house grade	1. poor 2. averge 3. good
sfla	house size (square footage)	
yr_built	year built	
juris	jurisdiction code	1. City of Sheboygan Falls 2. City of Sheboygan 3. Village of Kohler 4. Town of Wilson 5. Town of Sheboygan Falls 6. Town of Sheboygan 7. Town of Lima
acres	lot size (acreage)	acreage
saleyr	sale year	
salemo	sale month	
saleprice	house price	
price2003	adjusted house price by the housing price index	
nbr_bedrooms	number of bedrooms	
nbr_bath	number of bathrooms	
distance_airprot	airport	feet
distance_andreapark	Andrea park	feet
distance_aoc1	from the harbor to to the Kohler Landfill	feet
distance_aoc2	from the Kohler Landfill to the Waelderhaus Dam	feet
distance_aoc3	from the Waelderhaus Dam to the Sheboygan Falls Dam	feet
distance_orv	the closest distance to one of the rivers	feet
rivsysname	the closest river name	
distance_evrgnwater	Evergreen park water body	feet

distance_evegnwood	Evergeenpark Wood	feet
distance_fallscbd	the central business district in the City of Sheboygan Falls	feet
distance_haywood	Haywood park	feet
distance_i23_*	the interstate (I-23) ramps	feet
distance_i43_*	interstate (I-43) ramp	feet
distance_koherco	The Kohler company	feet
distance_kohlerlandfill	The Kohler landfill	feet
distance_rwaysite	Railroad	feet
distance_shebcbd	the Central business district in the City of Sheboygan	feet
distance_shoreline	Lake Michigan	feet
distance_uwsheb	The University of Wisconsin at Sheboygan	feet
parcel_id	the unique parcel ID	
mun	the jurisdiction code	1. City of Sheboygan 2. Village of Kohler 3. City of Sheboygan Falls 4. Town of Sheboygan 5. Town of Sheboygan Falls 6. Town of Lima 7. Town of Wilson