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Property Values, Recreation Values, and Urban Greenways

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EXECUTIVE SUMMARY: Planners propose multi-use urban greenways to enhance urban form, promote conservation of habitat and biodiversity, provide opportunities for fitness, recreation, and transportation, and promote economic development. This paper presents a taxonomy of the values of greenways and illustrates how two particular types of values can be measured using complementary techniques. Impacts of greenways on property values in Indianapolis, Indiana are measured with geographic information systems (GIS) and hedonic price modeling using residential real estate sales data from 1999. Recreation values are measured for a greenway trail in Indianapolis with the travel cost method using data from a 2000 survey of trail users and counts of trail traffic taken in 1996. We show that some but not all greenways have a positive, significant effect on property values and that the recreation benefits of a trail exceed costs. Limitations of the approaches are reviewed, and the importance of values not amenable to quantification is discussed. The paper concludes with discussion of the implications of our findings. Planners can use the findings to illustrate the benefits of greenways, to address concerns about negative impacts of greenway systems, and to inform and design research studies.

KEYWORDS: Greenways, trails, property values, hedonic price, recreation benefits, travel cost method, urban planning

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Introduction

Greenways are linear corridors of open space along rivers, streams, historic rail lines, or other natural or man-made features. Planners propose multi-use urban greenways to enhance urban form, promote conservation of habitat and biodiversity, provide opportunities for fitness, recreation, and transportation, promote economic development, and increase the sustainability of communities (Little 1990, Flink et al. 1993, Smith and Hellmund 1993, Fabos and Ahearn 1996, Moore and Schafer 2001, Lindsey 2003).

Planners and scholars have described some economic aspects of greenways (PFK Consulting 1994, Moore, Gitelson, and Graefe 1994, Siderelis and Moore 1995, Lindsey and Knaap 1999, Betz, Bergstrom, and Bowker 2003), provided guidelines for assessing the economic impacts of greenways and trails (National Park Service 1995), and documented high levels of trail use for recreation, transportation, and fitness (PFK Consulting 1994, Hunter and Huang 1995, Lindsey 1999, Lindsey and Nguyen forthcoming). Studies also consistently indicate that most people believe that greenways either have no effects or positive effects on the value of property, the saleability of property, and quality of life in neighborhoods (Crompton 2001). No studies, however, have reported complementary assessments of the values of particular greenways using different methodological approaches.

This paper demonstrates how values of greenways can be measured using two complementary techniques. We measure impacts of greenways on property values in Indianapolis, Indiana, using residential real estate sales data from 1999, geographic information systems (GIS), and hedonic price modeling. We measure recreation values for a trail in Indianapolis using the travel cost method, data from a 2000 survey of greenway trail users, and counts of trail traffic.

The paper begins with a brief review of the values of greenways and economic analyses of them. Then, following descriptions of the study area, data, and methods, we present estimates of the value of greenways in Indianapolis. We show that some but not all greenways have a positive, significant effect on property values and that the recreation benefits of a trail exceed costs. We then review the limitations of the approaches and the importance of values not amenable to quantification. The paper concludes with discussion of the implications of the findings for planning urban greenways.

Economic Analyses of Urban Greenways

People value greenways because they provide opportunities for recreation, exercise that produces fitness and health benefits, alternate transportation routes, conservation of habitats and biodiversity, economic development, and aesthetic, visual, and psychological amenities (Table 1). People realize or obtain these values in different ways, and researchers have developed different methods for measuring them. For example, people who engage in recreational activities such as nature observation gain value from active use of greenways. These types of use values can be measured using travel cost (Loomis and Walsh 1997; Ecosystem Valuation 2002) or unit day value (USACE 1990) methodologies. In addition, to the extent that people purchase homes because they provide accessibility to trails they use for recreation or commuting, the recreational and transportation values of trails may be reflected in property values.

People undertake some activities such as skating or cycling that may be considered recreational, but these activities also may confer fitness and health benefits because of the intensity of physical activity. These health benefits can be estimated using measures such as avoided medical costs or wages lost due to sickness caused or exacerbated by lack of fitness or obesity. Values of greenways that provide alternatives for utilitarian commuting can be estimated by measuring the value of changes in commuting time or avoided pollution costs.

Table1
A Taxonomy of Values of Greenways and Valuation Methods

Value Category	Value Path	Primary Valuation Methods
Recreation (active)	Users value greenway trail as facility for walking, jogging, cycling, skating, nature observation	• Travel cost • Unit day value
Property	People are willing to pay more for properties with accessibility to trails or for properties with amenities such as views of green space	• Hedonic price method
Health/fitness	User physical activity produces health benefits that generate secondary economic benefits	• Avoided medical costs and/or lost wages
Transportation	Users value greenway trail as alternative commuting route (utility trips)	• Value of commuting time; avoided pollution costs
Ecological biodiversity and services	People in community value existence of species (existence value), potential instrumental value of species (option value), or environmental services such as carbon sequestration or mitigation of runoff	• Contingent valuation • Value of comparable technological services
Amenity visual/aesthetic	Neighbors and passers-by benefit psychologically from views of open space or vegetation	• Hedonic price analysis • Contingent valuation
Economic development	Greenway development may spur tourism and commercial investment and development	• Economic impact analysis (input-output models)

Existence values associated with biodiversity do not necessarily involve active use of greenways and therefore cannot be inferred or imputed from observed behavior or markets. These types of values can be estimated, however, using approaches such as contingent valuation.

Effects on property values reflect people's willingness to pay for presence in a greenway conservation corridor, for accessibility to trails, for amenity values provided by greenways, or, in the case of speculators or risk-adverse investors, for factors believed to be important to large segments of the housing market. Property values can be estimated through hedonic price analysis—statistical analysis of property values—although the availability of data historically has limited use of this approach. Amenity values, which include psychological benefits that result from views of open space or vegetation, also can be measured with the hedonic price approach, although this approach does not capture benefits experienced by passers-by who do not live in proximity to the trail. Hence, estimates of property values may include large proportions, but not all, of amenity values, and, to the extent that people have purchased "accessibility," may overlap somewhat with estimates of recreation values

The value of greenways as strategies for economic development can be assessed through economic impact assessment. Studies of economic impact or activity differ from studies of economic value in that they seek to quantify the effects of particular projects in an economy in terms of changes in economic activity, construction earnings, or jobs, while studies of value typically are undertaken in benefit-cost analyses and are designed to answer the normative question of whether a project ought be undertaken or continued.

Attempts to estimate the total value and impact of particular greenways are complicated because many different categories of benefits may be relevant, alternate methods of measurement have different limitations, and use of multiple methods may involve double-counting. A survey of the literature generally indicates that the impacts and values of greenways are positive, but relatively few quantitative assessments have been reported, and most of these assessments have been limited to applications of single methods.

In one of the first economic assessments, Moore et al. (1994) analyzed the economic impacts of three rail-trails. They reported trail visits ranging from 135,000 to 400,000 per year and expenditures by users ranging from $1.2 to $1.9 million, with 34 percent to 59 percent of the expenditures made in the counties where the trails were located. They concluded that "rail-trails appear to generate at least modest economic impacts for their host communities" (p. 69), but they did not estimate total value of the trails using other approaches. In a related paper, however, Siderelis and Moore (1995) used the travel cost method to estimate the economic value of the same three trails. They used on-site surveys to obtain information from trail users about the place of origin, mode of travel to trail, distance and time to trail, and other related costs of using the trail. Their estimates of benefits were based on the direct costs of travel and the value of travel time and did not include the value of time spent on the trail. Their analyses showed that values for rural rail-trails generally were higher than values for suburban trails.

Przybylski and Lindsey (1998) provided examples of the use of complementary techniques to assess the economic value and economic impact of two proposed urban greenway projects. In evaluations of projects for the U.S. Army Corps of Engineers, they used the unit day value method to complete pre-project benefit-cost analyses and input-output models to complete regional economic impact assessments. They estimated substantial total net annual benefits ($4 million and $3.5 million, respectively) and positive benefit-cost ratios (1.4 and 1.9, respectively). Their economic impact analyses indicated that the construction impacts were in the millions and involved 2,859 and 1,280 jobs, respectively. The limitations of the unit day value method, however, are that it involves transfer of generic recreation values and does not necessarily incorporate site-specific estimates of actual use or observed behavior in local markets.

In an experiment to assess the value of a conservation greenway without a trail, Lindsey and Knaap (1999) compared estimates from a contingent valuation (CV) survey with actual payments made in response to solicitations for funds. They found that CV surveys provide “credible information about the relative strength and covariates of support for public goods” (p. 310) but that they may substantially overestimate actual willingness to pay and do not provide precise estimates of the value of public goods. They concluded that CV provides useful information for economic evaluation “when used in conjunction with other estimates, or as measures of relative value” (p. 311).

More recently, Betz, Bergstrom, and Bowker (2003) provide an interesting approach in which they combine contingent valuation and travel cost methodologies to estimate demand for a proposed trail-trail project in Georgia. They found that per-trip consumer surplus ranged from \$18.4 to \$29.23, that annual visits to the trail would exceed 416,000, and that total consumer surplus would exceed \$7.5 million. Although this approach provides a useful estimate of potential recreation value, it provides only a partial estimate of total value because it does not include or capture amenity values or ecological values, if any.

Because consumption of amenity or ecological values of greenways does not necessarily require active use of them, methods that rely on user surveys or observation of trail use are inappropriate. Measurement of the effects of parks, open space, and greenways on property values can be used to address these values. For example, in a study that focused on greenbelts, Correll et al. (1978, p. 211) demonstrated that “distance from the greenbelt has a statistically significant negative impact on the price of residential property” and that, holding other factors equal, price declined \$4.20 for every foot further from the greenbelt up to 3,200 feet. Greenbelts are large tracts of open space used to shape urban forms and to separate residential from other uses of land. Although greenbelts are related to greenways, serve some of the same functions, and provide some of the same types of benefits, planners distinguish between them, partly because they do not necessarily function as linear parks nor provide publicly accessible trails. Greenways, in comparison, may be narrower and typically are used to integrate or connect diverse uses rather than separate them.

Crompton (2001) concludes that the literature has established that parks have positive effects on property values, notes that the effects of parks typically extend between 500 and 2,000 feet, and hypothesizes that these effects probably also can be attributed to greenways. He identifies nine studies that have assessed the effects of greenways with trails on the value of residential property, but eight relied solely on people’s perceptions of impacts on property values, and only one involved analysis of market data. Across the eight studies, between 20 percent and 40 of those surveyed believed that the presence of a trail enhanced property values, but the predominant sentiment was that “the presence of a trail had a neutral impact on the saleability or value of property” (Crompton 2001, p. 114). Only small proportions of residents believed that the presence of a trail reduced property values. One study found that lots adjacent to a trail in a development sold for higher prices than lots not bordering the trail. Crompton (2001) concludes there is a need to analyze real estate transactions to assess the effects of greenway trails on properties when other potential effects are taken into account, determine the magnitude of effects, and assess the distances over which effects occur.

The advent of computerized real estate databases and GIS has made it feasible for researchers to undertake more detailed analyses of factors that affect property values, and a number of scholars recently have published studies of the effects of open space and other natural amenities on property values. Geoghegan et al. (1997), for example, recently used GIS and satellite imagery to test the effects of land use heterogeneity on property values in the Patuxent watershed in the Metropolitan Washington DC region. They found that the effects of land use fragmentation, land use diversity, and open space on property values varied with distance to the central city and the location in the metropolitan landscape. Mahan (1997) analyzed 14,485 transactions in Multnomah County (Portland), Oregon, to determine the effects of different types of wetlands and other natural features on property values. He reported that the effects of wetlands could be positive or negative, depending on their type; that quality of view (from the assessor’s records) had positive, significant effects; and that the effect of distance to streams was negative and significant. In analyses of 3,000 housing sales in the Netherlands, Luttik (2000) found that pleasant views were correlated with sales price and that values were increased by views of water (8 to 10 percent), open space (6 to 12 percent), and attractive landscaping (5 to 12 percent). Similarly, in analyses of 1006 apartment sales in Finland, Tyrvainen (1997) showed that percentage of green space and proximity to recreational areas had statistically significant positive effects on property values.

Other studies indicate that the effects of open space on property values vary by distance and type. Orford (2002) found that parks exerted a significant, positive effect but that the effect declined with distance and was not significant outside one mile. Ready and Abdalla (2003) showed that, within 400 meters of homes, open space had greater positive effects on property values than any other land use, but that between 400 and 1,600 meters, commercial land uses had greater positive amenity effects. At this latter distance, the only open space that had positive, significant effects was land owned by local, state, or federal government or land that was covered by conservation easements. Acharya and Bennett (2001), however, reported that the percentage of open space within one-quarter mile and one mile both had statistically, positive effects on sales price. In analyses of 5,599 sales in a suburban county in Maryland, Geoghagen (2002) found that permanently protected open space had a positive significant effect on property values, but that developable open space did not. Noting that property value methods only indirectly value the ecological services provided by urban green space, McPherson (1992) demonstrated that these services can be valued by assigning prices for functional benefits such as reduction in energy costs for cooling, interception of particulates, and reduction of stormwater runoff. His analyses indicated an annual net benefit per tree of $15.48, with a benefit cost ratio of 2.6. None of these studies, however, focused specifically on greenways, and none combined the analyses of property values with other methods.

Several observations emerge from this review. Researchers have documented the positive effects of parks and open space on the value of property and that people generally perceive greenways to have either neutral or positive effects on property values. Although one paper has documented the effects of a greenbelt on property values, studies of greenways with trails generally have been limited to measurements of perceptions and have not documented their effects on property values through analyses of real estate transactions. Researchers also have shown that greenways and multi-use trails may have significant recreation benefits.

Study Area, Methods, and Data

Indianapolis/Marion County and the Indianapolis Greenways System

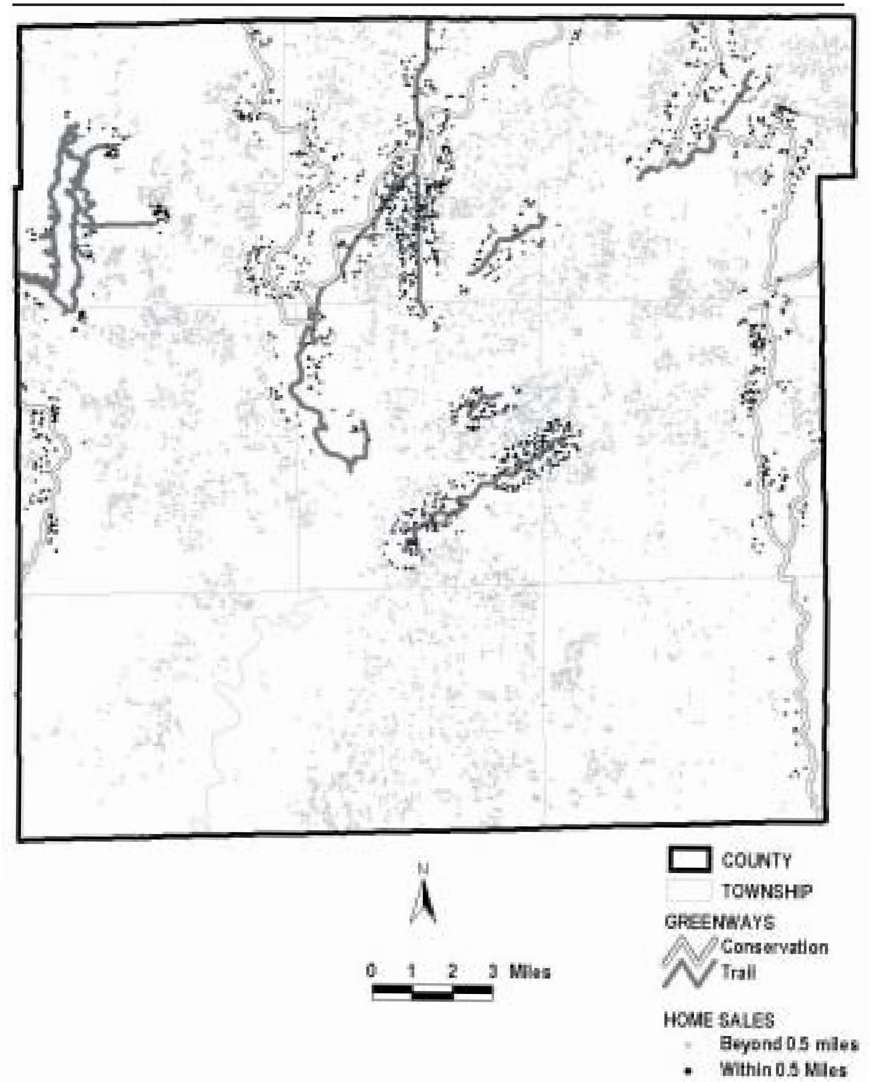
Our study area is Indianapolis / Marion County, Indiana, the 12th largest city by population (860,454) in the United States. With the exception of several small excluded municipalities, the boundaries of Indianapolis are coterminous with Marion County. Marion County occupies 396 square miles, has 352,164 households, and a median household income of $40,421. Within UNIGOV, the city-county governmental consolidation that occurred in 1969, greenways are managed by the Greenways Division of Indianapolis Parks and Recreation in cooperation with the Department of Public Works, other public agencies and organizations, and nonprofit organizations.

Indianapolis adopted its first greenways plan in 1994 and updated it in 2002. The initial plan identified 14 potential corridors, seven of which were to include publicly accessible multi-use trails and seven of which were conservation corridors (Table 2; Figure 1). The conservation corridors are simply place designations, the purpose of which is to encourage better stewardship of the land, forest, and aquatic resources. Most of the land in the conservation corridors is privately owned, they do not contain publicly accessible trails, and they are not regulated more stringently than other areas of the city.

Table 2
Greenway corridors in Indianapolis, Indiana (Indy Parks 1994, 2002)

Corridors with Trails	Monon Trail	Canal Towpath	White River	Pleasant Run	Eagle Creek	Fall Creek	Pogues Run
Active Length (1999, miles)	7.6	5.2	4.8	6.9	0	3.2	2.3
Planned Length (2004, miles)	10.6	5.2	22.8	6.9	22.4	13.2	2.3
Conservation Corridors	B&O Rail	Buck Creek	Crooked Creed	Grassy Creek	Indian Creek	Mud Creek	White Lick
Length	7.1	11.5	11.2	8.8	7.5	4.4	6.8

Figure 1
Greenway and Home Sales in Marion County (1999)



The 14 greenway corridors are located throughout the county (Figure 1), bisect a wide variety of neighborhoods (Lindsey, Maraj, and Kuan 2002), and are heavily used (Lindsey 1999; Lindsey and Nguyen 2002; Lindsey and Nguyen, forthcoming). The flagship of the system is the Monon Trail, a converted rail-trail that, when completed, will extend more than 10 miles from the center of the city north into the neighboring county. The Monon Trail is the most heavily used greenway corridor in the system, although use on individual segments of the trail varies greatly. The Monon Trail passes through the heart of Broad Ripple Village as well as some of the poorest, wealthiest, and most segregated neighborhoods in the city. Broad Ripple Village is evolving from a pedestrian-oriented commercial services center to an up-scale entertainment area with specialty retail shops, galleries, restaurants, and entertainment venues, and it is considered one of the most popular neighborhoods in Indianapolis.

Estimating Impacts on Property Values

We estimate the property value effects of greenways in Indianapolis using the hedonic price approach. This method is based on the theory that the value of public assets or goods like greenways or parks are capitalized in values of nearby properties and that their marginal effects can be isolated and estimated through statistical modeling procedures that control for other factors which affect value and prices. The total effects are estimated by assuming that the average marginal effects apply to all properties proximate to the trail. In our analyses, we use data from 9,348 residential property transactions that occurred in Marion County in 1999. The source of the data is the proprietary Multiple Listing Service (MLS) database maintained by the Metropolitan Indianapolis Board of Realtors (MIBOR). The MLS database includes approximately 85 percent of all residential property transactions in Marion County.

We used GIS to identify sales within one-half mile of publicly accessible trails in the recreational greenway corridors and of rivers and streams in the conservation corridors. The conservation corridors do not have publicly accessible trails and their boundaries have not been delineated by local planning officials. We used a straight line approach or container approach rather then network analysis because accessibility to public facilities is not an objective of the conservation corridors and this approach allowed us to maintain consistency in analyzing the two types of greenways. One-half mile was used as the buffer zone because survey data indicated most users beyond this distance drove to the trails (Lindsey 1999; Eppley Institute 2001a) and because previous studies indicated that the effects of parks and greenbelts on property values either diminish or cannot be convincingly isolated and estimated after 2000-3000 feet (Crompton 2001; Correll et al. 1978).

We present a standard semi-log model in which the natural log of sales price is modeled as a function of twelve property characteristics and twelve different tax and neighborhood characteristics, including proximity to greenways. We use the semi-log formulation because the original distribution of property prices is not normal and transformation helps to meet the distributional assumptions of the linear regression. The semi-log formulation helps control of nonlinearity of housing prices and some explanatory variables, reduces the sum of squared residuals in the regression, reduces problems associated with heteroskedasticity, and allows the independent variables to take on a wider range of values. An additional advantage of this formulation is that the coefficients on the correlates can be interpreted as the approximate percentage change in price associated with changes in the levels of the attributes. Variables included in the model were chosen because they have been shown to be correlated with price in previous studies or because they theoretically are believed to influence price. The mean values for all variables are presented in Table 3. Estimates of neighborhood income and vacancy rates are from the 2000 Census. We construct dummy variables for lot size to reduce the influence of outliers and to explore generally the effects of small and large lots relative to typically-sized parcels.

We measure the effects of greenways using a dummy variable for sales within one-half mile of the Monon Trail, a dummy variable for sales within one-half mile of trails in other recreational corridors, and a dummy variable for sales within one-half mile of the central feature of the conservation corridors. By using a proximity measure to capture effects on property values, we likely are capturing portions of people's marginal willingness to pay for accessibility to trails for either recreation or transportation and for amenity values experienced by owners of properties in conservation corridors or with views of trails and contiguous open space. For particular properties within particular corridors, these different categories of value likely overlap, and they cannot be sorted out with this approach. In addition, with our dummy variables, we do not capture amenity values experienced by passers-by or by other residents outside the half-mile buffer. Our property value measures thus reflect both accessibility and amenity values, but likely do not capture all of them, and must be regarded as only partial measures of benefits.

We also summarize secondary data about people's perceptions of the effects of the Monon Trail on property values that were collected in the Indiana Trail Study (Eppley 2001a; 2001b). In this study, researchers employed a modified Dillman method. They mailed surveys to 636 neighbors of the Monon Trail in 2000 and followed up one week later with a reminder post card and three weeks later with a replacement questionnaire. They eventually received 212 completed responses, for a response rate of 33 percent. Among other items, researchers asked neighbors a series of questions about the effects of the trail on property value, including their perceptions of the magnitude of effects. Approximately 99 percent of the respondents said that their property was their principal residence and that their property was less than 100 feet from the nearest part of the trail. Eighty-three percent of respondents said their properties backed on to the trail.

Table 3
Structural and Neighborhood Characteristices (N=9,348)

Independent Variable	Mean	Units/Notes
Structural Variables		
SQFT100	16.45	Square feet in structure (100)
BATHRMS	2.04	Number of bathrooms in house
COOLNO	0.15	Dummy variable; 1 if no cooling, 0 if air conditioning
AGE	36.20	Years since its construction.
GARAGE	1.63	Number of car bays in garage
BASEYES	0.41	Dummy variable; 1 if basement, 0 otherwise
ROOMS	7.09	Number of rooms in house
BRICK	0.60	Dummy variable; 1 if brick facing, 0 otherwise
PORYES	0.55	Dummy variable; 1 if porch, 0 otherwise
STORIES	1.44	Number in house
ACRE0	0.85	Dummy variable; 1 if lot less than 1/2 acre, 0 otherwise
ACRE1UP	0.03	Dummy variable; 1 if lot greater than 1 acre, 0 otherwise
Tax and Neighborhood Variables		
ETAX	1.17	Effective tax rate: property taxes paid divided by sales price
INCBK	51214.40	Median household income, census block group
CENTER	0.13	Dummy variable; 1 if in Center Township, 0 otherwise
BLACKBK	0.19	Percentage African Americans in census block group
BVILLZ1H	0.05	Dummy variable; 1 if located within 1.5 miles of Broad Ripple commercial zone, 0 otherwise
ACCESS	99076.35	Employment accessibility index: sum of zip code employment weighted by the negative exponential of distance to the zip code
VACBK	0.07	Percentage household vacancy, census block group
ISTEP	57.26	Mean Indiana standardized school test score in school district; indicator of neighborhood school quality
SAT	988.79	Mean Scholastic Aptitude Test score in school district; indicator of school quality and neighborhood socioeconomic class
Greenway Variables		
MONON99	0.04	Dummy variable; 1 if within 1/2 mile of Monon Trail, 0 otherwise
WALKCDUM	0.12	Dummy variable; 1 if within greenway conservation corridor, 0 otherwise
NOTMON99	0.10	Dummy variable; 1 if within 1/2 mile of greenway trail except Monon Trail, 0 otherwise

Estimating Recreational Benefits with the Travel Cost Method

We estimate the recreational benefits of the Monon Trail using the travel cost method (National Park Service 1995, Ecosystem Valuation 2002). The method is based on the theory that the opportunity costs—the costs of time and travel that people incur when using a recreational facility —are equal to the minimum price that they would pay to use the facility. The total value or benefits of the facility are the aggregate of people's "willingness to pay" based on the number of trips they make at different travel costs. Analyses vary with respect to whether an individual or zonal approach is used. The zonal approach, which involves dividing areas surrounding a trail into zones, estimating numbers of visitors from each zone, estimating travel costs associated with each zone, and constructing a demand curve for trail users, is used here.

We adapt results from the Indiana Trail Study and previously published counts of users to construct four travel zones and to estimate the demand curve. The Study included intercept-surveys of 320 users at different locations on the Monon Trail in summer of 2000 (Eppley 2001b). Users were asked about frequency of use, average distance and time to the trail, how they travel to the trail, and a number of questions about their perceptions of the trail (Table 4). The populations in each zone were estimated from 1990 Census using ArcView GIS 3.2.

We estimate annual trail use to be 373,581 by assuming that counts for one segment of Monon Trail in October 1996 were equal to six percent of total annual traffic and then reducing this estimate by 46 percent to account for most users taking loop trips (Lindsey 1999; Eppley 2001b). This estimate of use is conservative because it does not account for use on other sections of the trail. The Greenways Division provided estimates of construction costs ($3.02 million) and annual maintenance costs ($20,000 per year). Consistent with analyses reported in the literature, present values were calculated using a 10-year time horizon and a discount rate of six percent.

Table 4
User Patterns on the Monon Trail

Zone	Population per Zone	Mean Distance to Trail	Mean Time to Trail	Users from Zone	Drivers per Zone	Yearly Visits	Mean Visits / Person
1) 0 – 0.99 miles	55,437	0.31	3.58	30%	4%	110,907	2.00
2) 1 – 4.99 miles	288,203	2.01	9.40	41%	60%	152,935	0.53
3) 5 – 9.99 miles	391,902	6.89	12.20	20%	91%	74,716	0.19
4) 10 – 20 miles	497,772	25.27	25.48	9%	90%	35,023	0..07
Total	1,233,114					373,581	

Values of Greenways in Indianapolis

The Effects of Greenways on Property Values

Our analyses indicate that some greenways, but not all, have positive impacts on property values. The mean value of all homes sold in 1999 was $111,689 (Table 5). Homes near the Monon Trail sold on average for $124,415, slightly more than 11 percent more than the average price. The average price for residential properties in other greenway corridors with multiuse trails was essentially the same as the average price for all sales, while the average price for homes in conservation corridors was substantially higher (almost 26 percent) than the average price.

Table 5
Mean Values of Homes Sold in Marion County and in Greenway Corridors in 1999

CATEGORY	Homes Sold / (% of total)	Mean Value of Homes Sold	Percent Above or Below Mean
ALLSALES99	9,348 (100%)	$111,689	--
NOTMON99 = 1 (within 1/2 mile of greenway trail excluding Monon Trail)	957 (10.2%)	$111,592	-0.1%
WALKCDUM = 1 (in conservation corridor)	1,087 (11.6%)	$140,586	25.9%
MONON99 = 1 (within 1/2 mile of Monon Trial)	334 (3.6%)	$124,415	11.4%

Our hedonic model of sales prices indicates that, after other relevant structural and neighborhood characteristics are taken into account, presence near the Monon Trail (MONON99) or in a greenway conservation corridor (WALCDUM) has a statistically significant, positive impact on sales price, but that proximity to other multiuse greenway trails (NOTMON99) has no significant effect on prices (Table 6). Our model explains nearly 80 percent of the variation in sales price (Adj. $R^2 = 0.794$). The effects of our control variables generally are in the expected direction and significant. For example, more square feet, more rooms, more bathrooms, a garage, a porch, a basement, and larger lot sizes all have positive, significant effects on sales price, while higher tax rates reduce sales prices. The standardized Beta coefficients indicate that total floor space, the number of bathrooms, and the availability of central air conditioning are the most important structural characteristics. With respect to neighborhood variables, higher school quality, higher neighborhood (i.e., census block group) household incomes, and greater accessibility to employment all have positive, significant effects on sales price, while higher vacancy rates and higher proportions of African American residents in neighborhood are correlated with significant, negative effects on prices. The standardized Beta coefficients indicate that, among these variables, the median household income is the most important neighborhood influence on sales price.

Table 6
Hedonic Price Model of Residential Property Sales in Marion County in 1999

	Un-standardized Coefficients		Standardized Beta Coefficient	t statistic
	B	Standard Error		
(Constant)	10.10760	0.0921		109.73
Structural Variables				
SQFT100	0.02224	0.0007	0.2715	32.32
BATHRMS	0.10793	0.0060	0.1524	18.01
COOLNO	-0.29523	0.0095	-0.1675	-31.08
AGE	-0.00348	0.0002	-0.1524	-18.05
GARAGE	0.09490	0.0050	0.1132	19.02
BASEYES	0.10943	0.0075	0.0862	14.61
ROOMS	0.01051	0.0019	0.0351	5.46
BRICK	0.04801	0.0070	0.0377	6.85
PORYES	0.03950	0.0063	0.0315	6.25
STORIES	-0.01912	0.0060	-0.0183	-3.21
ACRE0	-0.04293	0.0093	-0.0247	-4.59
ACRE1UP	0.13416	0.0184	0.0380	7.28
Tax and Neighborhood Variables				
ETAX	-0.02954	0.0013	-0.1083	-23.21
INCBK	0.00000	0.0000	0.1235	16.78
CENTER	-0.22422	0.0120	-0.1223	-18.69
BLACKBK	-0.00297	0.0001	-0.1161	-21.1
BVILLZ1H	0.20629	0.0162	0.0736	12.74
ACCESS	<0.00001	<0.0001	0.0520	5.79
VACBK	-0.00576	0.0007	-0.0541	-8.82
ISTEP	0.00379	0.0008	0.0351	4.81
SAT	0.00030	0.0001	0.0174	3.44
Greenway Variables				
MONON99	0.13995	0.0179	0.0416	7.82
WALKCDUM	0.02067	0.0095	0.0121	2.47
NOTMON99	-0.01074	0.0104	-0.0052	-1.04

Dependent Variable: LSPRICE; Adj. R^2 = .794; F = 1499.596

Location within one-half mile of the Monon Trail (MONON99) has a positive, significant effect on sales price (t-statistic = 7.8) as does presence in a greenway conservation corridor (WALCDUM) (t-statistic = 2.5). Proximity to other greenway multi-use trails (NOTMON99), however, has no significant effects, and the sign on the coefficient is not in the expected direction.

Additional insight into the marginal effects of the Monon Trail can be gained by using the model to estimate its contribution to the mean predicted sales price. Assuming mean values for all variables in the model, the predicted sales price for the "average" property is $93,283, which is lower than actual mean and is an artifact of use of a semi-log model. With the functional form of our model, the coefficients on dummy variables in the estimated equation represent the proportion of the predicted sales price attributable to the variable. For homes within one-half mile of the Monon Trail, the model estimates that 14 percent ($13,056) of the predicted sales price is attributable to the Trail. Assuming this value is correct, the premium for the 334 sales that occurred near the Monon Trail in 1999 would be more than $4.3 million. Analyses of census data using GIS indicates approximately 8,862 households are located near the Monon Trail. If the average Monon premium were assumed to apply to each household, the total increase in property values associated with the presence of the Monon Trail in Marion County would be $115.7 million.

Similar analyses can be completed for the sales in the greenway conservation corridors and the other greenway corridors with multiuse trails. The proportion of the predicted sales price for a residential property in a greenway conservation corridor is approximately 2.4 percent. If this value ($2,239) is multiplied by the 1,087 sales that occurred in conservation corridors in 1999, the total premium is nearly $2.4 million. This difference, if applied to all 23,903 residential properties in the conservation corridors would yield a premium of $53.5 million. In contrast, the model predicts that presence near other greenways with trails has a statistically insignificant (t = - 1.04) but, from a practical perspective, moderate, negative effect on property values. Scholars differ in their interpretation of theoretically important variables that are not statistically significant. Some scholars ignore them, assuming that the effects are random and that even the sign on the coefficient may be incorrect. Other scholars assume that the estimates are appropriate for the data set and estimate overall effects. Given the types of policy debates that occur over the effects of greenways on property values, the latter approach would be, from a practical, policy-oriented perspective, a type of worst case scenario. If the latter approach were followed, the estimated loss in value for the 957 homes sold near other trails in 1999 would be just under $982,000. If these negative effects were summed across the 28,326 households in the trail corridors, the aggregate effect would be a loss of approximately $29.1 million.

These analyses generally corroborate perceptions of neighbors of the Monon Trail that were reported in the Indiana Trail Study. When asked whether the Monon Trail "increased," had "no effect," or "lowered" the resale value of their property, nearly two-thirds (65.9 percent) responded said they believed that the Trail increased value while nearly 29 percent responded "no effect" (Eppley Institute 2001b, p. 61). Approximately 50 percent said that the effect on resale value was less than five percent, while almost 29 percent said the effect was between five and ten percent, and about 20 percent thought the impact on value was greater than 10 percent.

In sum, the impact of the Monon Trail, conservation greenways, and other greenways on property sales in 1999 is estimated to be $5.8 million. If these average premiums (or losses) for 1999 sales were assumed to apply to all residences in the corridors, the total effect would be a premium of $140.2 million. This estimate is a lower bound because it includes losses for greenways where the results were statistically insignificant. If the only the values associated with statistically significant variables are summed, the estimate of benefits is slightly more than $169 million. The results for the Monon Trail provide empirical evidence in support of survey results which indicate that a large majority of trail neighbors believe that the trail has small to moderate positive effects on price. The premium predicted by the equation is larger than the increases in value estimated by a majority of trail neighbors.

The Recreational Value of the Monon Trail

Our analyses indicate that there are substantial recreational benefits associated with use of the Monon Trail (Table 7) and that the benefits of the trail exceed the costs of its construction and maintenance. Using the mean distance, time to the trail, and number of visits presented in Table 4 along with driving costs of $0.19 per mile (Siderelis and Moore 1995) and a value of time of approximately one-half the annual wage rate in Indianapolis ($0.15 per minute; Cesario 1976), we estimate the total consumer surplus associated with use of the Monon Trail to be approximately $3 million. The choice of values for driving costs and wage rates are subject to debate, governed somewhat by precedent and convention, and are to some degree arbitrary. We used the values reported here because they reflect values reported in the literature. We discuss below the implications of choices of different values.

Slightly more than one-third of these benefits are associated with user-visits from Zone 1, where we assume that all users walk and no driving costs are incurred. Although the population in Zone 1 is only four percent of the population of the service area, we estimate it accounts for 30 percent of the visits to the Monon Trail. Approximately 44 percent of the benefits are associated with users from Zone 2, which contains 23 percent of the population in the service area but accounts for 41 percent of all visits. Zones 3 and 4 are proportionately larger and have greater populations, although they account for proportionately fewer trips and benefits. This pattern reflects the increased costs associated with use of the Trail for residents who live farther away.

Using data provided from the Greenways Division for the costs of construction and maintenance of the Monon Trail, we can compare benefits and costs. Using a ten year time horizon and a discount rate of six percent, we estimate the present value of benefits and costs to be $22.6 million and $3.9 million, respectively. These estimates yield a net present value of $18.6 million and a benefit-cost ratio of 5.7. Even with more conservative assumptions about benefits, the benefits remain substantial. For example, if travel time was valued at zero rather than one-half of the wage rate and only the direct costs of driving were used to compute benefits in the analyses, the net present benefits of the Monon Trail would be $7.6 million and the benefit-cost ration would be 2.9.

Table 7
Recreational Benefits of the Monon Trail

Zone	Round Trip Driving Cost / Visit ($0.19/mile)	Round Trip Time Cost / Visit ($0.15/min.)	Mean RT Cost / Visit*	Mean Consumer Surplus per Visit	Annual Consumer Surplus
1	$0.12	$1.08	$1.08	$19.67	$1,090,492
2	$0.76	$2.82	$3.20	$4.66	$1,341,142
3	$2.62	$3.66	$6.28	$1.38	$540,266
4	$7.55	$7.86	$15.41	$0.19	$93,357
Total					$3,065,257

*Assumes no driving cost for Zone 1, 50% drivers from Zone 2, 100% drivers from Zones 3 and 4, and no trips when the cost/visit exceeds $20.74.

Discussion of Results

Our analyses show that one urban greenway with a multi-use trail generates both positive effects on property values and recreation benefits, but that not all recreational greenways have positive effects on property values. Some greenways had no statistically significant effects and the sign on the coefficient in the model was negative, the opposite of the expected direction. This finding is important for it demonstrates that the effects of greenways are not the same and that benefits associated with particular greenways should not be assumed to be similar at other locations. The reasons why the Monon Trail but not other greenways with trails are correlated with higher property values warrant further study. For example, it could be that trails contribute to or boost processes of neighborhood revitalization that are underway but by themselves cannot stem processes of neighborhood decline or deterioration. Factors related to processes of neighborhood change and use of trails need to be studied in greater detail. Hedonic studies that track sales of property over time as trail segments are completed and comparison case studies are two approaches that might prove informative.

The Monon Trail generates substantial benefits, but their actual magnitude is difficult to determine because the property value and recreational benefit categories overlap, because of uncertainties inherent in the methodologies, and because some benefits, including amenity values experienced by passers-by who do not reside in greenway corridors, are not measured. These limitations in turn constrain use of the estimates for some purposes in policy-making. The property value and recreation benefit categories overlap because some property owners likely bought homes near the greenways to have access to the trail for recreation and transportation and not solely because of the amenity values associated with open space. In a survey conducted as part of the Indiana Trail Study, for example, 95 percent of the neighbors of the Monon Trail reported using the trail in the preceding 12 months (Eppley 2001b). Their decisions to acquire property adjacent to the trail reflect personal preferences and their willingness to pay to minimize travel costs to the trail. From the perspective of opportunity costs, therefore, the property values already reflect some measure of the costs of travel. Our decision to assign no direct travel costs for vehicles and only value travel time for users from Zone 1 partially, but not entirely, offsets this concern. Sorting out these overlapping values is difficult because it is unclear that, for example, no recreational benefits from users in Zone 1 should be counted.

Uncertainties inherent in both approaches also raise important issues for estimating total benefits. We use a standard approach to estimation of the hedonic equation (the semi-log function) and explain a large proportion of the variation in sales price. A result of this approach is that our predicted mean sales price is substantially below the actual mean sales price. This difference is an artifact of transforming the data and then taking the anti-logs to estimate price. While our predicted mean sales price is very close to the actual transformed mean price, this result may be difficult to explain to policy makers and the lay public. However, the ease of interpretation of the coefficients helps to offset this difficulty: decision-makers can grasp the idea that changes in price are proportionate to changes in values of particular variables. Focusing discussion on the percent contribution of proximity to trails to the property values may be a useful approach.

Some of the uncertainty associated with our estimates of recreational benefits is associated with our estimates of trail use. Our estimate of annual visits to the Monon Trail, which exceeds 373,000, is purposely conservative and below previously reported estimates because we adjusted it to ensure no double counting of users and did not factor in users on different sections of the Trail. We also assumed no growth in use over time and that no users come from beyond twenty miles. Some decisions, however, offset these factors somewhat. As noted previously, we used a wage rate of one-half the value of the prevailing rate to estimate the value of travel time. Similarly, our mileage rate ($0.19) for travel costs is the same as used by Siderelis and Moore (1995) but higher, for example, than the rate of $0.12 used by Betz, Bergstrom, and Bowker (2003). Although these values are somewhat subjective, sensitivity analyses showed that the trail still would have positive net benefits if travel time were not valued at all. Even with higher travel costs, our estimate of annual consumer surplus is below that estimated for the Antebellum Rail-Trail in Georgia (Betz, Bergstrom, and Bowker 2003). In general, sensitivity analysis is a useful approach for accounting for the uncertainty associated with assumptions about values that are necessary input to analyses.

Even though methodologically-based questions can be raised about the magnitude of the property value effects and recreational benefits, it is clear that some categories of benefits have not been measured. As noted, our estimates do not include all amenity values, and they include no measures of the value of ecological services. Some of these may be captured in our estimates of property value, but since most of these benefits accrue to members of society beyond the greenway corridors, it is likely they are not fully captured. In addition, our estimates of the value of the Monon Trail as a recreational facility do not fully capture the values of ecological services provided by vegetation along the trail. The implication is that the benefits of the greenways system exceed the benefits described here.

Our estimates also do not capture savings in health care costs associated with improvements in fitness. A complication in estimating health benefits would be the problem of estimating the quantity of health improvements attributable to exercise on the Monon Trail. In a survey conducted as part of the Indiana Trail Study, 82 percent of users said they exercise more because of the trail, but 78 percent said that if the trail were not available they would engage in the same activity elsewhere (Eppley Institute 2001b). Hence, the marginal impact of the Monon Trail is unclear.

We also present no estimates of the induced economic effects or economic impact of the greenways. Although these benefits clearly are in a different category and should not be added to estimates of value produced with the travel cost and hedonic methods, user surveys establish that people come from outside the county to use the Monon Trail, thus bringing economic resources to the county. There also is anecdotal evidence that the trail has induced a wide variety of commercial developments such as bicycle shops and coffee shops and restaurants that cater to trail users. A full accounting of the economic aspects of the greenways system in Indianapolis would address these effects.

Implications for Planning Urban Greenways

Our findings have implications for scholars and for planners, managers, and advocates of greenway systems. As Moore and Shafer (2001) suggest, greenways warrant study apart from parks and other forms of open space because they provide unique opportunities for recreation and play distinctive roles in urban landscapes. This study complements an earlier study of the effects of greenbelts on property values (Correll et al. 1978), and it is the first of the effects of greenways with recreational trails that is based on actual sales prices and not perceptions of property owners (Crompton

2001). It is the third that explores the value of recreational benefits (Siderelis and Moore 1995; Betz, Bergstrom, and Bowker 2003).

The results from our property value analyses corroborate the perceptions of residents of greenway corridors in Indianapolis and elsewhere: greenways either enhance or have no statistically significant effects on property values. In contrast with previously reported studies where a majority of trail neighbors believed that the price effects were neutral (Crompton 2001), the Indiana Trail Study results for the Monon Trail indicate that a majority of residents believe the effects are positive. The difference in perception is supported by empirical evidence from analyses of property sales which attribute a significant proportion of price to the presence of the Monon Trail. The results for the other recreational greenways in Indianapolis, however, are more consistent with previous surveys of perception, for they indicate greenways have no statistically significant effects. The negative sign on the coefficient for other recreational greenways raises the issue that the effects of trails could in some cases be negative. Studies that further disaggregate trails variables could inform this issue and provide more information about the range of effects of trails on property values.

Our analyses of recreational benefits confirm previous studies that well-used trails generate substantial benefits. It is clear that greenways offer values beyond those quantified here; it is less clear how to aggregate them across categories. Additional research is needed to refine estimates of the effects of greenways on property values and to distinguish the characteristics of particular greenways that affect value. In addition, scholarly studies of approaches to aggregating benefits of greenways across categories would be helpful.

The hedonic analyses raise other issues that warrant careful study. Like many previous studies, these analyses indicate that, holding other factors equal, sales prices in lower income neighborhoods, neighborhoods with higher proportions of African Americans, and neighborhoods with higher vacancy rates generally are lower. Although it is not clear that development of recreational greenways would improve property values in these neighborhoods, the results indicate that they would not harm them. Detailed case studies of the effects of trails in disadvantaged neighborhoods would be useful and address an important need.

Proposals to develop greenway trails often are met with skepticism or hostility from potential trail neighbors. Planners, managers, and advocates of greenway systems can use these results to inform debates over proposals for particular greenways. These results buttress opinion-based findings which indicate that greenways generally have positive or neutral effects on property values with quantitative measures based on a large sample of real estate transactions. Although the magnitude of these amenity benefits may be an issue, from a pragmatic policy perspective, this issue is of secondary importance because it is clearer that trails generally do not have significant adverse effects. Future analyses of different types of greenways and their effects on property values will further inform parks professionals who are working to establish and manage greenway systems.

Reference

Acharya, G. & Bennett, L. L. (2001). "Valuing open space and land-use patterns in urban watersheds." *Journal of Real Estate Finance and Economics, 22*(2/3), 221-237.

Betz, C. J., Bergstrom, J. C. & Bowker, J. M. (2003). "A contingent trip model for estimating rail-trail demand." *Journal of Environmental Planning and Management, (46)*1, 79-96.

Cesario, F. J. (1976). "Value of time in recreation benefit studies." *Land Economics.* Vol. 52, No. (1), p. 32-41.

Correll, M., J. Lillydahl, & L. Singell. (1978). "The effects of greenbelts on residential property values: some findings on the political economy of open space." *Land Economics.* Vol. 54, No. 2, p. 207-217.

Crompton, J. L. (2001). "Perceptions of how the presence of greenway trails affects the value of proximate properties." *Journal of Park and Recreation Administration 19*(3) 114-132.

Ecosystem Valuation. (2002). "Methods, Section 4: Travel Cost Method." Ecosystem Valuation website:
http://www.ecosystemvaluation.org/travel_costs.htm.

Eppley Institute for Parks & Public Lands, & the Center for Urban Policy and the Environment. (2001a). Summary Report, Indiana Trails Study, a study of trails in six Indiana cities. Bloomington, IN: Indiana University, Eppley Institute for Parks and Public Lands.

Eppley Institute for Parks & Public Lands, & the Center for Urban Policy and the Environment. (2001b). Monon Trail, Indianapolis, IN, Indiana Trails Study, a study of trails in six Indiana cities. Bloomington, IN: Indiana University, Eppley Institute for Parks and Public Lands.

Fabos, J. G. & Ahern, J. eds. (1996). *Greenways: The beginning of an international movement.* Amsterdam, Netherlands: Elsevier.

Flink, C. A. & Searns, R. M. (1993). *Greenways: A guide to planning, design, and development*. The Conservation Fund. Island Press. Washington DC.

Geoghegan, J. (2002). "The value of open spaces in residential land use." *Land Use Policy 19*, 91-98. Retrieved 4/12/02 from www.elsevier.com/locate/landusepol.

Geoghegan, J. et al. (1997). "Spatial landscape indices in a hedonic framework: An ecological economics analysis using GIS." *Ecological Economics* 23: 251-264.

Hunter, W., & Huang, H. (1995). "User counts on bicycle lanes and multi-use trails in the United States." *Transportation Research Record*, 1502, pp. 45-57.

Lindsey, G. (1999). "Use of urban greenways: Insights from Indianapolis." *Journal of Landscape and Urban Planning.* (594) pp. 1-13.

Lindsey, G. & G. Knaap. (1999). "Willingness to pay for urban greenway projects." *Journal of the American Planning Association*, Vol. 65, No. 3 (Summer), pp. 297-313.

Lindsey, G., M. Maraj, & S. Kuan. (2001). "Access, equity, and urban greenways: An exploratory investigation." *Professional Geographer*, Vol. 53(3): pp. 332-346.

Lindsey, G. & D. Nguyen. (2002). "Urban trails heavily used in Indiana." Center for Urban Policy and the Environment, Indiana University Purdue University at Indianapolis (02-C06).

Lindsey, G. (2003). "Sustainability and urban greenways: Indicators in Indianapolis." *Journal of the American Planning Association,* Vol. 69, No. 2 (Spring), pp. 165-180.

Lindsey, G.& D. Nguyen (2004). "Use of greenway trails in Indiana." *Journal of Urban Planning and Development,* forthcoming.

Little, C. E. (1990). *Greenways for America.* Baltimore, MD: John Hopkins University Press.

Loomis, J. B. & Walsh, R.B. (1997). *Recreation economic decisions: Comparing benefits costs* (2nd ed.). State College, PA: Venture Publishing.

Luttik, J. (2000). "The value of trees, water and open space as reflected by house prices in the Netherlands." *Landscape and Urban Planning 48,* 161-167. Retrieved 4 / 11 / 02 from www.elsevier.com / locate / estoc.

Mahan, B. L. (1997). "Valuing urban wetlands: A property pricing approach" (IWR Report 97-R-1). Prepared for U.S. Army Corps of Engineers, Institute for Water Resources, Alexandria, VA.

McPherson, E. G. (1992). "Accounting for benefits and costs of urban greenspace." *Landscape and Urban Planning, 22,* 41-51.

Moore, R. L., Graefe, A. R. & Gitelson, R. J. (1994). "Living near greenways: neighboring landowners' experiences with and attitudes toward rail-trails." *Journal of Park and Recreation Administration, 12*(1), 79-93.

Moore, R. L. & Shafer, C. S. (2001). "Introduction to special issue trails and greenways: Opportunities for planners, managers, and scholars." *Journal of Park and Recreation Administration 19*(3), 1-16.

National Park Service, Rivers, Trails and Conservation Assistance. (1995). *Economic impacts of protecting rivers, trails, and greenway corridors.* A resource book. (Rev. 4th ed). U.S. Department of the Interior.

Orford, S. (2002). "Valuing locational externalities: A GIS and multilevel modeling approach." *Environment and Planning B: Planning and Design, 29,* 105-127.

PFK Consulting. (1994). *Analysis of economic impacts of the Northern Central Rail Trail.* (Prepared for Maryland Greenways Commission). Annapolis, MD: Maryland Department of Natural Resources.

Przybylski, M. & Lindsey, G. (1998). *Economic evaluation of major urban greenway projects: A brief review*. Indianapolis, IN: Center for Urban Policy and the Environment (98-C13).

Ready, R. & Abdalla, C. (2003). *The impact of open space and potential local disamenities on residential property values in Berks County, Pennsylvania.* University Park, PA: Department of Agricultural Economics and Rural Sociology.

Siderelis, C. & R. Moore. (1995). "Outdoor recreation net benefits of rail-trails." *Journal of Leisure Research. 27*(4): 344-359.

Smith, D. S., & Hellmund, P. (1993). *Ecology of greenways: design and function of linear conservation areas.* Minneapolis, MN: University of Minnesota Press.

Tyrväinen, L. (1997). "The amenity value of the urban forest: An application of the hedonic pricing method." *Landscape and Urban Planning 37*, 211-222. Retrieved 4 / 11 / 02 from www.elsevier.com / locate / landurbplan.

USACE (U.S. Army Corps of Engineers Regulation ER 1105-2-100). (1990). Guidance for Conducting Civil Works Planning Studies. Section VIII, Chapter 6.