

# **Urban Deconcentration and Biodiversity Valuation in the Chicago Region**

*A Study of Some Benefits and Costs of Natural Area Recovery*

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## **Reader's Summary**

Nowhere is human influence on the environment and ecosystems more dominant than in metropolitan areas where the pervasive sway of the growth of population and the forces of technology have penetrated every nook and cranny. One of the most significant aspects of this human domination has been brought about by the use of land to produce marketable goods and services. This study is about some of the consequences for native areas of that land transformation in the Chicago metropolitan area.

These changing land uses raise complex ethical, biological, and ecological issues and choices; but what is of special interest for the study to follow are reasons for believing that, on strictly economic and utilitarian grounds, less than the public's desired amount of these wilderness areas has been preserved or recovered. That is, because of certain current limitations in the market and government systems affecting land use decisions, there exists an unsatisfied public preference for more open space in the natural or native state.

The study launches three economic approaches to the matter at hand. First is a selective review of the benefit and cost studies of urban sprawl and agricultural practices to see if natural areas have been properly accounted for. Existing data, while far from sufficient, indicate they are not. Second, the study proceeds to its own small sample survey of the public's willingness to pay for the recovery or improvement of natural areas. The results reveal that households on the average are willing to pay about \$20 per year in increased taxes for expansion of natural areas, an amount that could add up to \$50 million per year for the region. Third, the study looks at the costs of recovery of natural areas and finds a wide range dependent upon the initial conditions of and the ultimate objectives for the site. Such costs could range from \$3,500 to \$22,500 per acre as the objective varies from upland prairie to lowland wetlands.

Matching benefits to costs, and making assumptions to narrow the range of estimates, the study concludes that some 5,000 acres per year could be added to the region's natural areas increasing the welfare of this and future generations.

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(Acknowledgements and references are given at the end of this study.)

Richard F. Kosobud

### **Introduction**

Nowhere is human influence on the environment and ecosystems more dominant than in metropolitan areas where the pervasive sway of the growth of population and the forces of technology have penetrated every nook and cranny. One of the most significant aspects of this human domination has been brought about by the use of land to produce marketable goods and services. This study is about some of the consequences for native areas of that land transformation in the Chicago metropolitan area.

On the periphery of the metropolitan area, agricultural practices have been the most systematic agent for modifying land use; typically fields have been plowed for monoculture from roadside to roadside, dramatically displacing what had existed before. From the city center to the urban fringe, from parking lots to the free-standing single family house, the acreage of urban sprawl land uses is spreading more rapidly than population is growing, seemingly sweeping aside much in its way and earning the sobriquet of heedless urban sprawl.

The region's urban sprawl, and the scope of intensive agricultural practices of the farm belt surrounding it, have left only remnants in the way of native prairie grasses and flowers, woodlands, oak savannas, and the large stretches of wetlands that once characterized the area (Chicago Wilderness, An Atlas of Biodiversity 1997). These changing land uses raise complex ethical, biological, and ecological issues, and choices; but what is of special interest for the study to follow are reasons for believing that, on strictly economic or utilitarian grounds, less than the public's desired amount of these wilderness areas has been preserved or recovered. That is, because of certain current limitations in the market and government systems affecting land use decisions, there exists an unsatisfied public preference for more open space in the natural or native state.

In what follows, we explain the approaches used to investigate these matters, provide a summary of results, furnish a full account of the detailed methods and results, and, lastly, express our conclusions, and recommendations.

### Approaches of the Study of the Chicago Region

The study launches three economic approaches to the matter at hand. First is a selective review of benefit and cost studies of urban sprawl and agricultural practices to see if natural areas have been properly accounted for. While there exist pieces of evidence here and there on these matters, no convincing or generally accepted accounting appears to be available. The scattered evidence is assembled to see what can be made of it, and to identify the important gaps that need filling. Note that urban sprawl and agricultural practices in and of themselves need not be destructive of natural areas, but present day market calculations and government policies rarely account for the impacts of low density development or intensive agriculture on these areas.

Second, the study proceeds to its own small sample survey of the public's willingness to pay for the recovery or improvement of natural areas. If successful, this part of the study would provide a measure of the benefits of these activities thus helping to fill an important gap. If appropriate use is to be made of the public's scarce resources and if private resources are to be

forthcoming, these benefits must be balanced against the costs of recovery. Therefore, the study proceeds in the third approach to a summary of recovery and restoration cost estimates available from reliable sources in the region.

One brief comment is required at this stage, following up the point about the scarcity of resources available for public purposes. The study's sharp focus on wilderness areas does not imply a view that other pressing concerns should be crowded off the metropolitan area's agenda; concerns such as improved human health, better educational services, and expanded minority youth employment opportunities deserve priority attention. Rather, the view is that careful benefit-cost analysis can help guide us to the best allocation of effort to these problem areas.

### Summary of Results

It is important for purposes of this study to ask whether the private and public benefits and costs of urban deconcentration, especially as they concern wilderness areas, are fully and fairly reflected in contemporary market and government decisions on the use of land. The answer is, subject to many qualifications and caveats about the adequacy of data, that they are not. While this is true also of the bearing of urban sprawl on other aspects of metropolitan life, the implication in economic terms for natural areas is that there are inefficiencies in the present sprawl pattern the correction of which could improve the general welfare.

One inefficiency is that the private costs of low-density development, defined as 3 dwelling units per acre or less, are not fully borne by the occupants. A leading cause is provided by the federal tax code that subsidizes homeownership costs to an extent far greater than the subsidies provided for public housing and rental assistance in the center city. As a consequence, the building fields are tilted toward low-density development that can be destructive of natural areas.

Further, unplanned low-density developments impose increased direct neighborhood and community facility costs not all of which are taken from the pockets of residents in outlying

areas. These subsidies have been estimated to range up to \$2,000 per unit and over in regions like Chicago's, which means that other taxpayers shoulder these expenditures (Persky and Wiewel 1995).

In addition, the monetary costs paid by automobile owners are estimated to be a fraction, say three-quarters, of their true burden, due to subsidies, among others, for roads, parking, and accident costs (Office of Technology Assessment 1996). If public or non-monetary factors are added in—for water pollution and flood control, air quality impacts, opportunity costs of land used for roads—motor vehicle users paid an even smaller fraction of the total costs even excluding the value of time lost in congestion (Johnson 1995). Low-density land uses oriented to the car are thus favored with adverse implications for open space and wilderness areas.

The powerful tools of local governments over land use, ranging from zoning ordinances to building codes, can and often do favor land uses that further urban deconcentration and fail to provide sufficient open space and wilderness areas to meet the general demand. This latter point is attributable to the "public good" character of these native spaces, the enjoyment of which by some does not diminish the enjoyment by others, including future generations. The local government's jurisdiction and tax base rarely encompasses all the beneficiaries, which makes it difficult to provide the optimum amount of wilderness areas.

There are also benefits, both private and public, to urban deconcentration that must be examined if we are to understand the reasons for this pattern in most major metropolitan areas. Among them are flexibility from the use of the car in shopping, commuting and recreation, the increased range of choice of public goods and services available from numerous local governments, and the satisfaction of apparently strongly-held preferences for lower density life-style. The consequence is that were all private benefits and costs of land use choices fully allocated to the appropriate individuals, and were all public benefits and costs properly internalized, and were these changes reflected in new market prices and government tax rates, many people would, in all probability, still opt for lower density living. That is, urban

deconcentration would continue to a significant extent, as is recognized in many projections of the future region.

Yet, on the margin, the region could be different in twenty years time as a result of selected cost reallocations and implementable public policies. Among the changes wrought that would favor natural areas would be modified prices of varying development densities, altered prices of transportation modes, increased provision for such areas in local and state government budgets and policies, and enhanced private contributions.

Such a difference would depend ultimately upon the public's preferences for allocating scarce resources to wilderness area recovery and extension, and upon the costs for recovery and expansion efforts. As mentioned, to help fill information gaps in these areas, this study carried out a sample survey of public preferences in the region, and collected recovery and improvement cost data from a number of regional sources.

The survey of a carefully selected, nonrandom sample of residents revealed a significant willingness to pay for new wilderness recovery and extension activities. The personal interviews were carried out in a manner to acquaint the respondent with the topic and to prepare the respondent for a thoughtful answer. The sample mean willingness to pay was a \$37.80 per year increase in annual property tax payment, or equivalent increase in rent, all accruing to the appropriate government agencies for this effort. The mean adjusted for the nonrandom sample was \$19.67. Applied to the close to 3 million households of the region, this estimate indicates that up to 59 million dollars per year could become available for land acquisition, soil preparation, weeding, seeding, maintenance, and other measures. A public well informed about such activities is an essential prerequisite for such a projection.

The amount respondents were willing to pay increased with income and educational attainment which indicates that wilderness recovery has some of the characteristics of a "superior" good. The amount also decreased with the age of the respondent. These results, while new for wilderness projects in the region, are consistent with other studies. When asked if a further increase would be supported several years later for additional activities, the respondents

were on the average favorably inclined, but at a reduced level of support, as one might expect if respondents were thinking seriously about the question and alternate uses of their funds. Any actual referendum designed to tap this support would be well advised to explain carefully the uses of tax funds to enhance wilderness areas, as was done in the sample survey.

To satisfy this newly revealed demand requires use of additional scarce resources; that is, costs would be involved. The extent of recovery or improvement that could be achieved would depend in part on how high the costs were for improvement per acre, and the rise in costs as efforts continued. The study collected data from a number of sites and sources yielding a wide range of estimates that varied according to the objectives of the managers and the initial conditions of the site. Such expenditures per acre can be quite large at the beginning of an operation, a reasonable range being \$3,500 to \$22,500, when soil movement, grading, seeding, weeding, and stimulation of growth are required. Expenditures per acre decline appreciably as the size of the wilderness site increases. They also decline appreciably as the site reaches stability and only maintenance is needed.

Balancing these preferences and costs we are able to conclude, first, that an expansion and improvement of the region's wilderness space over present efforts in this direction is supportable in strictly economic terms. Second, and more concretely, we find that about 5,000 additional acres per year could be added to existing native areas. This would be an increase over presently planned efforts of this nature, and would represent an addition to our present stock of capital in the form of indigenous biodiversity. It would mean an increase in the annual stream of human-valued "services" emanating from that stock, adding to our welfare, and to the welfare of future generations.

Recognizing that these results and estimates are subject to a band of error, and recognizing even more that certain benefits and costs have escaped this study--and that some of them will escape any economic study--we need to provide a more detailed explanation of our methods if these results and estimates are to be taken seriously. We now turn to this more detailed explanation in the next sections.

## **The Region's Deconcentration and Its Consequences for Wilderness Areas**

Private decisions affecting 3,800 square miles of land are being made currently by close to three million households, thousands of private enterprises, and hundreds of not-for-profit institutions in the region. This is also a metropolitan area that contains close to 300 different municipalities and over 1,000 separate tax districts many of which play important roles in determining land use through direct ownership, zoning ordinances, building codes, direct regulation, land use plans, transportation designs, and the like. In many ways this is a remarkable decentralized system of markets and governments that can give play to a wide range of the individual's preferences, and capacities to satisfy those preferences. The autonomy afforded by the market provides much room for individual choice without answering to a higher power, the anonymity afforded by the market provides for the pursuit of self interest without justification to a higher authority, and the fine-grained pattern of local governments allows for choice among a variety of government provided goods and services, and tax rates.

In other ways, important questions can be raised about the present ability of this system to fully serve the welfare of its residents with respect to land use. Externalities or spillovers from market activities that affect individual welfare and business operation, but are not reflected in prices, can deflect the region from its potential. Examples include impacts of urban land uses that adversely affect the hydrologic or water cycles of ecosystems, that limit the appropriate extent of habitat for species, or that disburse pollution to unwilling victims. Not all of these impacts are yet addressed by effective public policies.

Externalities or spillovers arising from government actions can also lead to welfare losses. Examples include zoning upstream wetlands for development or underproviding an adequate amount or range of public goods and services, including natural areas. That is, both market and government failures have a bearing on natural areas and biodiversity.

It must be stated clearly at the outset that our test is whether these market or government failures could lead to a more efficient allocation of land to competing uses. By "more efficient

allocation" we have a specific meaning in mind: could an alteration of existing land uses with more wilderness space be devised that would increase the general welfare, some residents being sufficiently better off to more than compensate others made worse off. How that land use alteration could be brought about is discussed in a later section. If we were attempting fairness or equity rather than efficiency tests, we should, or we ought to, specify the values by which we aim to make some groups better and others worse off.

There is no question that there are vital issues that require fairness or equity valuations and analysis if the general welfare of the region is to be better served. A simple way to bring them to the fore is for the reader to draw a veil of ignorance over his or her present situation in the region, and only drop the veil after assuming the situation of the poor or of the under-represented minority. Now where does one live, what access to wilderness areas does one have, and what disadvantages does one encounter? To make policy relevant remarks on these matters requires a different method, a different valuation approach, and a different study.

In this study, we now turn to a review of the direct and indirect benefits and costs of urban deconcentration that bear on wilderness areas as revealed in studies of the Chicago region.

### Is Chicago's Deconcentration Pattern Inevitable?

What is happening to the Chicago area appears to be happening in a general way to metropolitan areas elsewhere. Figure 1 on the next page depicts a relationship of residential density that varies from the city center to outlying fringes. Density declines as one travels to the edge. This relationship shifts over time reflecting urban deconcentration as city center densities decrease and outlying places are built-up. This is shown by our estimate of the relationship in 1950 and in 1990 for the Chicago region.

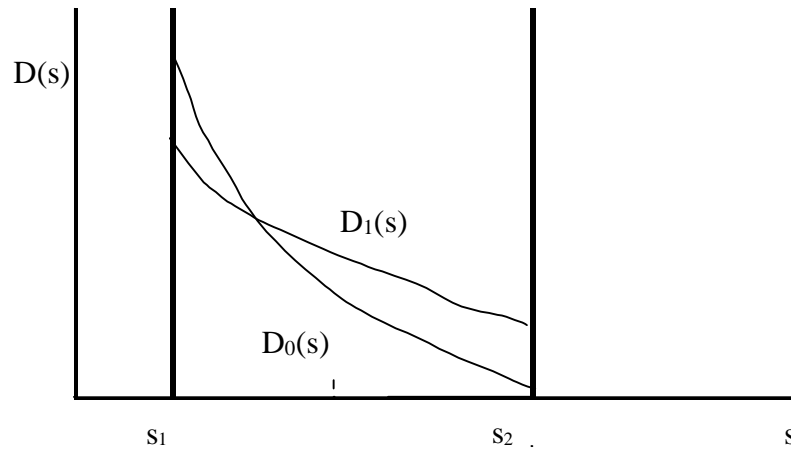


Figure 1: Chicago's Urban Deconcentration  
 $D(s)$  = population density related to spatial distance from  $s_1$ , the center city, to  $s_2$ , the region's outlying edge.  
 $D_0(s)$  is the initial relationship,  $D_1(s)$  the later.

Note that blips or bumps in densities due to subcenters have been smoothed out. This shift is happening in many other metropolitan areas (Mills 1996), but with important variations in the curves. For example, European cities tend to be more densely settled than those in the U.S are.

While this shift may be attributed to higher incomes, increased education, and changes in transportation and information technologies, these patterns are not an economic law but a reflection of the many benefits and costs of locational decisions, both residential and non-residential. They can change as benefits and costs change. The general flattening of the curve over time observed in many countries that vary in institutions and regulations does not reveal whether the region is becoming more efficient, or more fair, in serving the welfare of its residents. Studies that emphasize only the costs of urban sprawl - or only the benefits - may miss important underlying regulations, decisions, and patterns that affect the use of land for residential and other purposes. This study will attempt a selective examination of both benefits and costs with a focus on implications for wilderness areas.

## The Direct Benefits of the Region's Deconcentration

Everyone knows that land costs less per acre on the region's fringe than elsewhere, other things equal. Our own examination of the 1995 Olcott's Land Values and Blue Book of Chicago reveals a price per unit area (acre) of residential land that begins at an index value of 100 along the Lake and declines below 20 on the fringe with blips along the route as we move through a more or less polycentric metropolitan area with important subcenters. The main point for our purpose is that the availability of low prices can satisfy the preferences of local households with a demand for low-density living.

Typically, this demand for low-density living is part of a package of related preferences that include living where the real crime rate is less and living where full use can be taken of the car's advantages. The depth of these preferences should be recognized. The car provides for these households flexibility in transportation and independence from time tables, frequently lower door to door travel times, a handy aid to shopping, inexpensive long-distance travel especially for families, and comfort (Office of Technology Assessment 1995). The three-car garage has made its appearance in over ten percent of local residences, and the number is increasing.

Modern information technology would appear to make living and working in outlying areas, even in far-away small towns, more feasible, if that is the preference. Examples are reported in the local press, but it remains to be seen what role this factor will, in fact, play in furthering urban deconcentration.

Fringe or suburban living also provides households with choices among many local governments and the varied basket of government goods and services they provide. A range of educational, recreational, and security services, among others, can be selected. Urban sprawl may not be rigidly linked to a multiplicity of local governments, but the association seems strong. Local governments, including park and forest preserve districts, can provide natural areas, although, as we shall see, the adequacy and diversity of these areas can be questioned.

Associations of households in outlying areas also have the option of "privatizing" certain government services; for example, solid waste removal, security, and even the provision of wilderness spaces.

### The Indirect or Social Benefits of the Region's Deconcentration

The multiplicity of local governments offering different baskets of government goods and services adds to the efficiency of the region in satisfying households with varying preferences. The household benefits both by avoiding one government's basket it does not like and by choosing another government's basket it does. Such multiplicity can create competitive pressures for efficient and democratic local governmental policies.

Employers, in a deconcentrated region, may benefit by having more locational options that can draw workers from afar who have adaptable transportation capabilities. Employers may also gain by having more flexible work schedules that employees can accommodate. Efficient superstores catering to shoppers with cars may find outlying locations more advantageous (Downs 1994).

There is little quantitative evidence on how important these and other indirect benefits are. The fact that the second income earner in a family living in an outlying area, generally a woman, is willing to accept lower wages than she would receive in the city center for comparable work provides an inkling; one estimate puts the difference in wages between \$2,000 and \$3,000 annually for the Chicago region, a benefit that accrues to employers (Persky and Wiewel 1997).

Recognition of the depth of the reasons for the trend to sprawl is reflected in the recent projections through 2020 of population, households and employment, and their distribution, by the Northeastern Illinois Planning Commission and the Chicago Area Transportation Study. These agencies foresee continued decentralization even though modified by what are viewed as implementable government policies (NIPC and CATS 1997).

In sum, direct and indirect benefits are not trivial, and under present institutional and market systems, contribute to unbounded low-density development detrimental to wilderness areas. If all the costs of such development, for residents and employers, were properly incorporated into locational decisions, which would include the loss of wilderness areas of all types, there would be little more to be said on efficiency grounds. That is not the case, and we turn to a consideration of costs.

### The Direct Costs of the Region's Deconcentration

As in the case of benefits, this study considers both direct (priced) and indirect (unpriced) costs of urban deconcentration. For direct costs, the key question is whether residents and employers locating in outlying areas bear the full costs of their decisions. For indirect or spillover costs, the key questions turn on their magnitude, and incidence (whom do they fall upon). For direct costs, both the house itself and the necessary infrastructure raise important issues of subsidy.

Homeownership is more prevalent in less dense areas, and it is clearly favored by the federal income tax code. Deductions of mortgage interest payments, deferment of capital gains, and exclusion of property tax payments mean that the general taxpayer is shouldering part of these expenditures. Compounding this subsidy is the finding that the capital gains deferment acts to encourage selling a house in the city to buy a more expensive one in the suburbs, and so on (Bier and Maric 1994). For a middle income family weighing a rental unit in the city versus owning a free-standing single family house on the outskirts, the value of this subsidy has been estimated to be at least \$350 per year (Persky and Weiwel 1996).

The location and type of development is also affected by the shifting of the costs of infrastructure: there is the provision of water, lights, and sewers in the neighborhood; the construction of roads and schools in the community; and the furnishing of waste disposal, security, energy, and communication services in the region. Table 1 summarizes three recent

and careful studies that reveal the difference in supporting facility costs between unplanned low density and planned higher density development. These numbers expressed as percentage reductions in costs for planned development likely bracket the Chicago region.

The multiplicity of governments in the region raises the possibility that such costs may be shifted to taxpayers other than the low-density residents. The technique of fiscal impact analysis attempts to answer this question by estimating the relation between tax payments by land uses of various types and the required support and "servicing" costs for these uses within a particular local government's domain. The weight of such studies indicates that residential sprawl does not pay its own way compared with higher density residences as revealed in Table 1. Schemes such as "exactions" designed to pass these costs fully on to the house buyer often fail because costs are difficult to relate in a convincing manner to the particular residence. The practice of using average costs in pricing utility services also means existing residents pay for newcomers (which may explain some of the anti-growth sentiment). The subsidies of Table 1 do nothing to restrain urban sprawl.

TABLE 1  
Relative Infrastructure Costs: Unplanned and Planned

Cost Category	Low Density			
	Unplanned Development Index = 100	Planned Development as a percent of 100		
		Study 1	Study 2	Study 3
Roads	100	40	73	75
Schools	100	93	97	95
Utilities	100	60	92	85

Sources : Study 1, Duncan 1989; Study 2, Frank 1989; and Study 3, Burchell 1995.  
Reported in OTA 1995, Table 8-6, p.205.

Fiscal impact analysis, which has its limitations due to the difficulties of including all costs over varied time periods, also indicates that industrial and commercial facilities contribute more to the revenue side of the municipal budget than they require on the expenditure side. This finding has been confirmed for the Chicago area (Oakland and Testa 1995), but has to be modified if residential development in the municipality is attracted by job creating facilities

(DuPage County Development Department 1991). In a politically fragmented region like Chicago, the extra tax revenues of commercial and industrial development may accrue to one municipality while the extra servicing costs of housing for the newly employed are borne by another. Hence incentives--read subsidies--for locating these commercial and industrial facilities are not uncommon at the local level. Such incentives, which can easily escalate in the games localities play, distort prices that affect the locational decision. The result is that such facilities can be drawn from the city center to outlying areas.

Examples of such subsidies are easy to come by. To cite just the familiar and best documented: Sears received over \$100 million in its move to the "Prairie Stone" location in Hoffman Estates and Motorola received substantial subsidies for its plant in Harvard, Illinois, not only from the state but also from Commonwealth Edison in reduced power rates. The movement of employment to outlying areas exemplified by these cases has been a factor in the deconcentration of the region.

The locational distortions caused by incentives of the type described could be offset if incentives simply matched the surplus tax revenues paid by enterprises; but, the outcome where incentives exceed benefits is not unlikely in the bidding wars that take place. States in their incentive schemes rarely try to make center city sites attractive; rather, the effort appears to be to match or better the fashionable outlying locations offered elsewhere. Federal facility locational policies have been known to be based on inducements favorable to outlying areas also.

The use of land for purposes that bring property tax revenue to local governments would appear to bias decisions away from open space and wilderness areas that do not bring in such revenues. Here fiscal analysis could make a contribution by estimating the enhancement value of open and wilderness spaces. Do they enhance the value, hence tax base, of adjoining property so as to more than offset whatever loss results from wilderness spaces not paying taxes?

Several studies reveal evidence of enhancement values but the range of uncertainty surrounding the magnitude suggests that no simple formula applies (Fausold and Lilieholm

1996). Open areas in the form of active recreation space can detract from neighboring values, and if open space is allowed to deteriorate its impact declines. Too few new wilderness areas in the Chicago territory are yet in place and fully developed to provide reliable information on their impacts on neighboring values. Developments such as Prairie Crossing and Mill Creek, when finished and fully settled, may provide a guide.

A good measure of enhancement value could be obtained by recording the market value of conservation easements that restrict development on a parcel of land. This study found too few of these presently available for the Chicago region to provide useful estimates. The enhancement value of natural areas is a urgent topic awaiting more data, and more detailed study.

It has already been noted that the car owner typically pays less than the monetary or direct costs of making that mode possible, frequently no more than two-thirds. The remaining third placed on the general taxpayer results in some proportion being a subsidy. As car ownership is associated with low density dwelling, this subsidy acts to further urban sprawl. Public transportation is also subsidized, but this subsidy accrues also to suburban and ex-urban residents who have the option of using this mode in various ways (including park and ride).

To summarize this section, our survey of the direct costs reveals a significant subsidy not borne by those living on the outskirts, but it remains to balance that subsidy against the fact that some of those dwellers on the average accept lower wages than they could receive for comparable work elsewhere. That is, the inefficiencies of locational decisions induced by subsidies may be offset by the willingness of low-density dwellers to "pay" for subsidies by accepting that lower wage. Before making that calculation, we consider the indirect or social costs of sprawl.

## The Indirect or Social Costs of the Region's Deconcentration

The concept of indirect costs or spillovers is doubly appropriate when applied to the impacts of low-density development on water quality and hydrological systems. The region's water quality and watersheds have long been affected by and sensitive to land uses. It is well known that the massive amount of fresh water available in Lake Michigan has had its quality impaired at different times and in different ways by direct run-off, seepage, and windblown pollution. Many of these non-priced consequences of market failures have yet to be fully remedied by government policies or private action. Wilderness areas, which include wetlands, have an important role to play in this context.

More compact land uses have been shown to result in significantly less effluent run-off due to such factors as more efficient use of chemicals for treatment of lawns. Compact land uses also result in less destruction of wetlands that serve as pollutant filters. Table 2 summarizes one important study that shows that compact development can yield reductions up to 40% of phosphorus and nitrogen loading, a meaningful reduction in the bio-chemical oxygen demand placed on running water, and a lessening of the discharge of toxic heavy metals. Nitrogen, a key nutrient for plants and animals, when over-supplied leads to nitrogen saturation with harmful consequences. Attaching monetary estimates to impacts such as these in the Chicago region requires much more detailed data than is presently available, but the amounts could be noteworthy.

TABLE 2

Water Quality Improvements Due To Compact Development

Pollutant	Percentage Change Due To More Compact Development
Bio-chemical oxygen demand	-27.7
Total phosphorus	-43.5
Total nitrogen	-42.6
Zinc	-21.9
Lead	-10.2

*Source:* New Jersey Office of State Planning 1992 as reported in OTA 1995.

The role of wetlands is of special interest in the region as their loss affects not only water quality but also habitat for wildlife and the region's propensity to flood. For important regional rivers such as the Des Plaines, building over wetlands upstream in the watershed has had unfortunate consequences downstream. Recent federal legislation and the part now played by the U. S. Army Corps of Engineers and associated federal agencies in wetlands management has altered and constrained the rate and location of wetland destruction. Mitigation banking by which development over wetlands can proceed, providing that "comparable" wetland areas are preserved or created elsewhere, has both supporters and critics. Chicago's sprawl up to the present has clearly imposed indirect hydrologic costs on residents in critical watershed locations. These social costs will continue even if new constraints on wetland loss have eliminated additional future harm. While sufficient data are lacking to estimate the total magnitude of these impacts, the benefits of restoring or creating additional wetland areas can be estimated by survey techniques, as we shall discuss shortly.

Turning now to air quality it would seem obvious that urban sprawl leads to bad air due in part to excessive use of the car. It is not so obvious. The car contributes much to worsening

air quality by generating close to half of hydrocarbon, a quarter of carbon dioxide, and a fifth of nitrogen oxide emissions in the region. However, the number of cold starts and the hours in use of the vehicle, which are parts of the problem, do not decrease appreciably in higher density areas. The improvement in Chicago's air quality achieved so far, still short of moving the region out of the severe non-attainment category, has been achieved mainly by a cleaner car--reformulated gasoline, improved inspection and hence maintenance of vehicles, and more efficient engines with better catalytic converters--by higher standards for stationary source emitters, and by the development of environmental markets to cap pollution of stationary sources cost-effectively. Reconstructing the region on a more compact basis, everything else the same, is not likely to affect air quality much compared with the above policy measures (New Jersey Office of State Planning 1992). Dramatic changes in the use of transportation modes could have a favorable impact, but skeptics would argue that it would be unwise to hold one's breath until mass transportation assumes a more significant role. Proposals that may bring changes in the long-run are worthy of discussion but are outside the scope of this study.

The urban region being surrounded by productive agriculture raises the possibility that urban sprawl may have a social cost in adversely affecting the amount of farmland and the food supply. Subsidies to homeownership being larger than subsidies to farmers tip the scale of land values toward the former use, other things equal. However, the gain in land productivity in agriculture in the Midwest has been impressive and that reason alone has led to an actual reduction in acreage given to crops. This latter force, if it continues, can be expected to more than offset the impact of urban uses of farm land.

Urban sprawl, or suburban crawl, is often identified as one of the culprits affecting commuting time. In a region with many governments it is difficult to coordinate traffic flows in outlying areas as every house and commercial activity wants direct access to local roads, thus creating interference. Congestion costs thus imposed are defined as the extra travel time imposed on others when the individual driver sets out from the garage. However, it is also possible to show that high density areas suffer from congestion as trips are more frequently made on heavily traveled roads, which offsets their shorter distance (Ewing 1994).

The net effect of compact versus sprawl densities on congestion costs remains a complex calculation. The most clear cut indirect cost of travel under urban sprawl is the burden placed on low and moderate income families who are excluded from living, but not working, in outlying areas by various restrictive features of residential zoning (Downs 1995). Estimates of these welfare losses due to their extra commuting times, outside the scope of this study, would add to the total of indirect costs.

The loss of wilderness areas could be a significant indirect cost of development as the market, and governments, can fail to account for these losses for reasons already discussed. To correct these failures some economic valuation is needed so that the proper "price" can be placed on these areas enabling a comparison to be made against alternative uses of urban land. A monetary measure is almost a necessity if public or private resources are to be allocated rationally to the competing uses.

Can some measures of the existing efficiency of the region in providing wilderness spaces be found? Enhancement values or conservation easement prices could furnish a guide if they were available, but as we noted, they are not. Another measure could be available in the travel time or costs people incur in viewing natural areas. While data are scarce, at best, for the region, we can scan information from other areas such as the US Forest Service survey of the public preferences in Northeastern U. S. Selected results are reproduced in Table 3 in which respondents gave their willingness to pay for a "recreational visit day" for various outdoor activities. Note that the wilderness activity was passive enjoyment of natural area vegetation and wildlife.

TABLE 3

Average Willingness To Pay For Various Outdoor Activities

Outdoor Activity	Average Willingness To Pay (1987 dollars)
Fishing	138.55
Hunting	81.91
Winter sports	77.50
Wilderness	40.52
Hiking, horseback riding, and water travel	29.71
Camping, picnicking, and swimming	21.54
Mechanized travel and viewing scenery	18.86

*Sources* : U.S. Forest Service 1990. Payment is for a recreational visit day.

The results of Table 3, and other studies in this vein, seem difficult to apply, directly or indirectly, to Chicago regional residents, nor do they cast light on key questions of concern to us: what would the public pay for additional wilderness areas in the region? Answers are better obtained by a survey designed explicitly for the region.

#### Summary of the Benefits and Costs of Urban Deconcentration

While there is clear evidence that direct costs of low-density development are shifted in part elsewhere, there is evidence that this subsidy is partly offset by such factors as low-density

dwellers accepting lower wages thus paying to realize their preferences. The matter appears more clear-cut in considering the balance of indirect cost and benefits. Use of land at 3 dwelling units or less per acre leads to such inefficiencies as impairing the hydrological functioning of the region, generating pollution in this regard, and probably adding to the congestion costs of commuting. However, attaching dollar amounts to this balance would be a difficult and controversial task: it is hard to come up with a ringing quantitative indictment of the consequences of Chicago's urban sprawl (see the careful study of Persky and Wiewel 1996).

If there were a ringing indictment of urban sprawl, in the view of this author, it would most effectively be based on fairness criteria such as the exclusion of low income and under-represented minority families from residence and employment in outlying areas.

Our main concern has been the impacts of development on wilderness areas, and our main conclusion is that there are good reasons, and scattered evidence, to support the argument that wilderness and open spaces have been underprovided, and thus constitute a social cost. The extent of that loss, and the remedies to repair that loss are unfortunately not clear from existing information. There is little point in trying to force strong focused conclusions based on weak scattered evidence. Trying to fit all these pieces into a monetary balance sheet of benefits and costs, and certainly the pieces dealing with wilderness areas, leaves gaps so frequent and large that researchers are well advised to try to fill them before doing the sums. In this spirit, we turn to a new survey of resident preferences.

## **Benefits of Recovering Wilderness Spaces: Resident Preferences**

### Introduction and Summary

Our review of existing studies of government and market decisions affecting the use of land did reveal that wilderness spaces were likely to be underprovided, but did not find much convincing evidence of the magnitude of the deficiency nor of the benefits of additional space. Neither conservation easements nor enhancement values, nor other data, are yet available in sufficient amount to make credible estimates. Therefore, we turn in this second section to a survey that does provide such information.

Our survey results based on interviews with almost 200 residents reveal an interest in wilderness spaces and a broad base of financial support for improved or additional space. A large majority of the sample, 91%, reported a willingness to pay for that expansion; the sample mean was \$37.80 per household per year. This amount increased with income and educational attainment, and decreased with age. Attitudinal variables were important determinants of the amount.

Adjustments of the estimates for the non-randomness of the sample yielded a revised mean of \$19.67 for the population as a whole. Multiplying this times 3,000,000 households in the region gives an upper bound of \$59,010,000 for annual spending which could provide for a range of additional wilderness spaces, once we factor in the costs of improvement, recovery, and land acquisition. This is the upper range of the major findings. The survey revealed valuable additional findings on the views of respondents.

Carrying out a survey for a non-marketed good on a limited budget in a complex human dominated region, markedly pluralistic with respect to population background and values and highly decentralized with respect to markets and governments, requires some advanced thought, and considerable explanation. While details on the survey methods and protocols are available

from the author, the major features of the effort are described below as an essential aid in interpreting particular results.

The major features to be described include a more precise statement of the aims of the survey, a description of the sample and questionnaire design, an explanation of the interviewing arrangements, and an account of the statistical and adjustment methods used to obtain results. Surveys of hypothetical choices of this type have been subjected to a good deal of analysis and critique. Every effort was made to follow the guidelines for contingent valuation surveys laid down by a panel of experts convened by the National Oceanic and Atmospheric Administration (NOAA 1995).

### Specific Survey Objectives

The main purpose was to determine the welfare benefits to the regional population from additional wilderness spaces by asking a sample of residents their willingness to pay for such increments. Such amounts, if credible, provide a good economic measure of individual welfare gains as they reveal the preferences of respondents for spending in that direction as compared to spending on other goods and services which afford them satisfaction. We thereby tease out a valuation of or demand for a public good that can be compared with the costs of supplying that good. By asking for attitudinal and socio-economic information, we can estimate how this demand changes in relation to other variables.

The panel of experts already mentioned recommended a referendum type question, with which many citizens are familiar, that asks whether the respondent would be willing to pay a certain amount in increased taxes to obtain a quantity of a public good. We followed this format to the extent possible as it has the great merit of being incentive compatible; that is, there is little if any motivation to try to free ride or exaggerate in the answer. To try to free ride and refuse payment could lead to defeat of the referendum; the wrong outcome for the strategist. To exaggerate and support the proposal could lead to passage of the referendum and, again, the wrong outcome for the strategist.

## Sample Design

The constraint of a limited budget meant that the desirable sample size of at least 1,000 randomly selected respondents, who could yield estimates of willingness to pay within a sampling error of three percent, had to be abandoned. Instead a nonrandom sample of about 200 carefully selected respondents enabled us by use of new adjustment techniques to make estimates of population means, although with a larger sampling error.

The respondents were selected for variation in income, education, and age. To economize on survey costs, they were interviewed in a Loop office building by pre-arrangement (to obtain middle class respondents from outlying areas), in the Pilsen community (to obtain working class respondents), in selected private and public agencies, and in student classes. Thanks are due to many cooperating organizations with special thanks to the Federal Reserve Bank of Chicago. The desired wide variation in key socio-economic characteristics of respondents was thus obtained and utilized to obtain estimates of the population preferences in a manner soon to be explained.

## Questionnaire Design

Four types of questions were asked. The first was designed to familiarize the respondent with wilderness areas and the survey objectives. In this category were a series of important questions designed to obtain attitudes towards wilderness space and biodiversity. Questions were asked about the importance of natural area preservation, about the rights of species to exist, and about the rights of future generations to enjoy natural areas. Respondents were asked whether natural areas have an educational value, and then a recreational value. Large majorities had a favorable attitude or view of these aspects of natural areas. Finally, in this group of questions, respondents were asked their opinion about whether the region is currently a healthy ecosystem and whether the region has enough natural areas. Respondents were about evenly divided on these two questions.

The next type was composed of two central questions that asked about the respondent's willingness to pay a higher annual tax (or equivalent rental amount) per year to obtain new or improved areas. These questions were asked after providing essential background information to the respondent that included definitions and data on existing wilderness areas in the total region. The respondent was reminded also that money so spent could not be spent on other desirable goods or services bringing out the budget constraint that we all confront in an era of scarce resources.

After pre-testing the questionnaire, it was decided not to ask about the willingness to spend for a specific acreage of wilderness space or about specific sites. Few respondents, as well as most of the rest of us, have a clear idea as to a particular quantity and type of new wilderness space that ought to be or might be developed, although we could favor a variety of efforts or activities along these lines. The questionnaire posed this matter in the following way: "The revenue from the referendum could enable the local government to fit several smaller pieces together into a viable habitat, create new areas some of which would be closer to neighborhoods that have little native vegetation, and better maintain existing natural areas."

Pre-testing also indicated that asking for a tax of a particular dollar amount, sometimes recommended, caused problems for respondents who wondered why that amount was specified. Not having a good reference amount in mind, we provided the respondent with a range of amounts, from zero to three increments ending with \$50, and then an open-ended amount--essentially a payment card. Anchoring the lowest amount at zero seemed sensible as it was stressed that no right answer was requested. This enabled the respondent to say no to the referendum.

We mentioned two willingness-to-pay questions. In an effort to appraise how seriously the respondent was thinking about preferences for wilderness space, we asked a follow up question about a similar referendum several years later. Answers based on good feelings but not on preferences might result in the same or even larger amounts in the second round. Most

respondents gave lower amounts, as we shall report shortly, indicative to us of their careful consideration of the many other demands on the household budget.

Our initial intention was to survey respondents living around specific sites and develop questions around the site and its characteristics. Several considerations militated against this design. It would be very expensive to carry out given the variety of sites. Moreover, pre-testing indicated that respondents did not often express preferences for kinds of sites be they prairie flowers and grasses or woodlands. Equally important was our discovery that an important part of the valuation of respondents was passive in nature. That is, there was a "non-use" preference component that resulted in a willingness to pay for the existence of wilderness space in the region even if the respondent had no intention of visiting a specific or any site. These considerations led us to design the questions to be more general in nature.

The third type of question attempted to probe the respondent's experience with natural areas by asking about visits to parks and sites inside and outside the region. A little more than a third of the respondent's reported trips to natural areas within the region; a little less than half reported trips outside. To our surprise these answers had little statistical power to explain willingness to pay for more wilderness places.

The fourth type sought socio-economic information. As a final question in this category respondents were asked if they would like to be sent a copy of the results. This gave the interviewer the follow-up opportunity to ask if there were any remaining questions about the survey. Those respondents who asked for a copy of the study to be sent to them turned out to have a significantly higher willingness to pay than those who did not.

### Interview design

Consideration was given to a mail, telephone, or personal interview, the costs of which increase significantly in that order. In this instance the most expensive technique was chosen.

We believed it was important to read explanations of wilderness areas and the background information to the respondent in order to make sure that we could minimize misunderstanding. Personal interviews are best in this respect. In addition, we wanted to present each respondent with the wilderness brochure entitled "It's Called Chicago Wilderness." The pictures and list of sponsors in that brochure seemed to us to add to the understanding and credibility of the survey. The expert panel had strongly recommended this interview design choice for these and other reasons. Having made this decision, we had to accept the trade-off that fewer interviews could be carried out.

Five interviewers, four graduate students and the author, did the interviewing after a period of training which included a discussion of the survey objectives and pre-testing of the questionnaire.

### Survey Results

Tables 4, 5, and 6 reveal age, household annual income, and educational attainment characteristics of respondents in relation to their willingness to pay for wilderness spaces. This sample is too young, too low in income, and too highly educated when compared with the general population and requires adjustment, which we shall undertake shortly. Payment amounts increase generally with income except for the large amounts expressed by the lowest income group composed in large part by students. Payment amounts increase with educational attainment except for the large amounts reported by the small number of respondents with less than a high school degree (business owners in this case). The age variable is more complex reflecting other related matters such as marital status and the presence of children. The tendency for amounts to decline with age becomes more apparent when the influence of these related matters is taken into account.

TABLE 4

Willingness to Pay For Natural Area Recovery by Age Of Respondent

Age (in years)	Willingness to Pay an Annual Tax (in 1997 \$)		
	First Round Mean	Second Round Mean	Ratio: First to Second
30 or less (n=71)	37.96	23.14	1.64
31 to 40 (n=43)	32.63	16.02	2.04
41 to 50 (n=43)	39.30	24.65	1.59
51 to 60 (n=22)	46.82	18.18	2.58
Over 60 (n=5)	20.00	3.00	6.67

*Source:* Urban Concentration and Biodiversity Valuation survey data. There were 184 respondents providing complete information. These means are calculated from the sample and are not adjusted to reflect the nonrandom character of the sample design. Adjusted data are explained in the text. The second round mean is obtained from answers to the question about another tax within a few years which would finance wilderness activities similar to the first round tax.

TABLE 5

Willingness to Pay For Natural Area Recovery by Income

Income Category (in 1997 \$)	Willingness to Pay an Annual Tax (in 1997 \$)		
	First Round Mean	Second Round Mean	Ratio: First to Second
Less than 20,000 (n=33)	31.52	25.91	1.22
20,000 to 39,999 (n=54)	23.24	13.76	1.69
40,000 to 69,999 (n=53)	47.42	24.51	1.93
70,000 to 89,999 (n=18)	44.17	26.67	1.66
90,000 and over (n=25)	52.60	17.20	3.06

*Source:* Urban Concentration and Biodiversity Valuation survey data. There were 183 respondents providing complete information. These means are calculated from the sample and are not adjusted to reflect the nonrandom character of the sample design. Adjusted data are explained in the text. The second round mean is obtained from answers to the question about another tax within a few years which would finance wilderness activities similar to the first round tax.

TABLE 6

Willingness to Pay For Natural Area Recovery by Educational Attainment

Educational Attainment	Willingness to Pay an Annual Tax (in 1997 \$)		
	First Round Mean	Second Round Mean	Ratio: First to Second
Less than high school degree (n=4)	41.25	26.25	1.57
High school degree (n=15)	18.00	11.40	1.58
College attendance (n=102)	33.33	22.28	1.50
Graduate school attendance (n=66)	48.97	20.89	2.34

*Source:* Urban Concentration and Biodiversity Valuation survey data. There were 187 respondents providing complete information. These means are calculated from the sample and are not adjusted to reflect the non-random character of the sample design. Adjusted data are explained in the text. The second round mean is obtained from answers to the question about another tax within a few years which would finance wilderness activities similar to the first round tax.

The amounts reported in the tables for another, later round of payments decreases in each instance from the first round. Equally interesting is the trend of the ratios (ratio of first to second rounds) which, while always greater than one, tends to increase with few exceptions as income, education, and age increase. That the second round payment amount declines may be interpreted to be the diminishing benefits that a second round of increases in wilderness spaces may bring to respondents, who may be appraising alternative uses of their income in the light of the first round expenditure. That the ratio of first to second rounds payments generally increases with income, education, and age may reflect the more informed calculation respondents are making in expressing their preferences for a sequence of wilderness activities.

A multiple regression relationship will play an important role in analyzing our survey data both in providing an idea of the relative significance of variables explaining payment amounts, and in furnishing a method for adjustment of the nonrandom sample. The regression equation is given in Table 7A where the dependent variable is the first round payment amount and the explanatory variables are listed in column 1. The scaling of all variables is explained in the table 7B. The coefficients for income and educational attainment (school) variables are of the expected positive sign and significant at conventional levels (t-values are larger than 2.00). They indicate the increase in payments in dollar amounts as the variable moves up its scaled values. The age variable is of the expected negative sign but cannot be considered significant. It is retained because the expected sign is right, and some later adjustment for the youthfulness of the sample is required. The age variable has turned out to be negative in many other studies.

The last three variables are coded as shown in table 7B. "Balance" and "exist" are attitudinal variables that are highly correlated to each other and close to significance in their explanatory power. The "copy" variable is reflective, in our view, of the respondent's concern for wilderness space and interest in obtaining more information. Requesting a copy of the final study is associated with a large increase of \$16 in willingness to pay.

The equation of Table 7A can serve as a "valuation function" for adjusting the sample for non-randomness and thus obtaining valuable estimates of the payment values for the regional population (Harrison and Lesley 1996). Two important assumptions have to be made in order to obtain these important findings. First, the coefficients or parameters of the equation will be assumed to be those of an equation fitted to a random sample of the population; that is, they will be considered to be the true coefficients. This correspondence seems plausible as the survey sample design obtained a substantial variation in the characteristics of respondents, which is what is required to obtain useable estimates of the coefficients (see tables 4, 5, and 6).

TABLE 7 A

## Parameter Estimates for Equation Explaining Willingness to Pay for Wilderness Activities

Variable	Degrees of Freedom	Parameter Estimate	Standard Error	t - Value
Constant	1	7.57	19.52	0.39
Income	1	8.58	3.03	2.83
Age	1	- 1.10	3.14	-0.35
School	1	10.24	4.89	2.09
Balance	1	-15.63	8.04	-1.94
Copy	1	15.97	6.77	2.36
Exist	1	-11.09	6.61	-1.68
Root MSE	41.17	R - Square	0.16	
Dep Mean	38.69	Adjusted R - Square	0.13	

Source : Urban Concentration and Biodiversity Valuation survey data. There were 159 respondents providing complete information. Variable definitions and coding conventions are explained in table 7 B .

TABLE 7 B

## Variable Definitions and Coding

Dependent Variable	Explanatory Variables		
	Income	Age of Respondent	Educational Attainment
Willingness to pay (payment coded in \$ amounts)	(household 1996)		(School - degree not necessary)
0	< 20,000 = 1	< 20 = 1	< High school = 1
10	20,000 to 39,999 = 2	20 to 39 = 2	High school = 2
25	40,000 to 69,999 = 3	40 to 69 = 3	College = 3
50	70,000 to 89,999 = 4	60 and over = 4	Graduate = 4
Other	90,000 and over = 5		
	Balance	Copy	Exist
	(Natural areas help maintain a balance or diversity of nature)	(Would you like to receive a copy of the study?)	(Native species have a right to exist)
	Strongly agree = 1	Yes = 1	Strongly agree = 1
	Somewhat agree = 2	No = 0	Somewhat agree = 2
	Do not agree = 3		Do not agree = 3

Second, the mean values of the explanatory variables for the regional population, obtained from census data, will then be inserted into the equation replacing sample values to give us our average payment from a random sample of the larger population. Specifically the mean value for educational attainment of the survey sample was 3.2 (a college degree) whereas a high school degree was true for the regional population. The mean survey value for household income was 2.7 (a little over \$30,000) whereas the larger population value was over 3 (that is, a little over \$40,000). Similarly the age variable had to be raised. Carrying out these adjustments yields an estimate of \$19.67. Our assumption is that the equation fitted to a larger sample would have yielded this result.

Another adjustment may be required because of a possible bias that we named the "ballot box" effect. While the interviewing technique stressed that there was no correct answer to the payment question, and encouraged respondents to answer with the amount they preferred, the interviewer collected the questionnaire at the close of the interview raising the possibility that the respondent would overstate the amount preferred in order to please or impress the interviewer.

To test this possibility, a small sample of graduate student respondents (11) was interviewed with the standard interview technique, and then asked again to give their payment amounts on an unsigned slip of paper which was placed in a "ballot box." Comparison of the mean amounts of the two data collection techniques revealed a reduction of one-third for the amounts in the ballot box compared with the interview process!

This result was a little unsettling in its magnitude, as it would lead to a further reduction in the mean payment value to \$13.18. This reduction is believed to be too large. The graduate students were interviewed in class in the first pass with their instructor collecting the results. Perhaps the fact that the instructor would at the end of the term grade the student could be a temptation to exaggerate in that first pass. This bias would not be present in the ordinary interview. Nevertheless, the reduced amount could be taken to be a lower bound.

We arrive at the end of the survey with increased knowledge of resident preferences for increased wilderness space. This preference increases significantly with education and income. This preference is also significantly increased by positive attitudes toward biodiversity, and by an expression of interest in knowing more about wilderness. If the first two influences are the product of continuing trends in society, they hold out hope of increased support in the future. If the last two influences are the product of efforts to stimulate the population's positive response to nature, then they form the basis for wilderness programs to inform and stimulate the public about the value of efforts to increase natural areas.

We also arrive at the end of the survey with increased knowledge of the resident willingness to pay for more or improved wilderness space. As an upper bound, the amount annually could range up to \$59,000,000. As a lower bound, the amount could be in the neighborhood of \$39,000,000.

#### Validity Checks and Benefit Estimate Caveats

Despite the care with which a survey is carried out and the findings analyzed, the concerned researcher will invariably check for corroborative results. Although as we have mentioned, there are few studies of this character and precious little data, there are indirect pieces of evidence that can be recast in our framework and used for comparison purposes. We have selected a few examples that bear on our work.

The DuPage County electorate approved in late 1997 a bond issue for \$75,000,000 to be spent over a number of years by the county's Forest Preserve District. By no means was this all to be allocated to wilderness spaces or improvements, but some of it would be so spent. Annualizing the principal and interest payments indicates that the DuPage County household assumed a financial obligation each year in the neighborhood of \$16, not too far from our estimates. Other bond issues have been put before the electorate in referenda format with some passages and some defeats. A close analysis of these results, while outside the scope of this study, would be of great value in understanding how the issue can be presented to the electorate.

A study released in May 1997 sponsored by the Forest Preserve District of Will County reported that 59% of respondents surveyed were willing to pay \$5 per year for prairie landscaping, although user fees were the preferred means of raising funds in this instance. Other important determinants of preferences were not separately reported. If we adjust this amount for Will County data on age, education, and income, this value would come closer to our findings.

A striking confirmation is to be found in the results of efforts to bring more open space to localities in New Jersey. For example, voters in Randolph Township, a middle to lower middle class community, approved a tax increase that would yield \$25.60 per year from the average household for these purposes (Hanley 1998).

Interesting attendance data reported by Patty Jelen, Marketing Manager of Morton Arboretum, can be made to reveal one type of preference for natural areas. Records kept by the Arboretum show that 54% of visitors come from the seven towns adjacent to the site, 38% from the other suburbs and city, and 8% from outside the metropolitan region. Almost all come by car. This declining schedule of visits as distance increases may be interpreted as the deterrence created by increasing transportation costs. If the average household travels about ten miles to the site, we may estimate the average automobile cost to be \$7 to \$8 dollars to which we must add the entrance fee of \$7 (\$3 on Wednesdays). The total indicates a willingness to pay for visits to natural areas that is close to our finding. Similar calculations may be made for the Chicago Botanic Garden. We gain confidence in our results from this survey of related but indirect evidence.

However, we do not want to leave the reader unaware of the caution that must be exercised in making use of these results. The questionnaire dealt with complex matters that may not be familiar to all respondents. In explaining the decline in wilderness areas as the region grew, the interviewer may have predisposed the respondent toward a favorable payment, although every effort was made not to give "value cues" in this regard. There exist incentives for respondent misrepresentation in surveys in general. Not to appear stingy is one such motivation;

furthering a cause by under-responding is another. The referendum type question used in this survey is the most effective means to minimize these biases.

It is our conclusion that we have obtained results of value in assessing the demand for wilderness space. If we are going to have useful things to say about the quantity and character of such space, we must now turn to data on the resource costs of recovery.

## **Costs of Recovering Wilderness Spaces**

### Introduction and Summary

Having knowledge of resident preferences for increasing wilderness space is only half the story. To secure such an increase will invariably require the use of scarce resources financed either from public or private purses. If preferences tell us something about the demand-side, we now seek information on the cost or supply-side.

There is symmetry here. Resident demand or preferences in our framework are additions to individual welfare from increased space. Similarly, supplying additional space requires using people, machinery, and materials, resources that could be put to other valued purposes, and therefore represents a subtraction from individual welfare. Attempting to balance these welfare losses and gains is a difficult and often uncertain quantitative enterprise. Other considerations can play an important and sometimes overriding role. Our more modest goal in this section, as in the others, is to aim to provide some policy relevant information that could be considered together with more political objectives.

The competitive markets for private commodities like computers and chronometers resolve issues of welfare gains and losses reasonably well, the prices and quantities balance costs and benefits at about the right point. Recovering natural areas in the metropolitan area is another matter. As the space has the character of a public good or common resource, the task of discovering recovery costs is greatly complicated, as was true in discovering preferences. Market prices are not always available for measurement of the costs of resources used for recovery. In addition, the nature of biodiversity and ecosystems, the essence of natural space, should put us on guard that there will be a very wide range of factors to be taken into account.

The ecologist will not permit the economist to define a standard unit of wilderness space, nor should the economist insist. Recovering prairie grasses and flowers, or wetlands, or oak savanna, or woodlands, just to mention broad distinctions, will likely require varying

expenditures and different types of resources. Furthermore, expenditures can be expected to increase if the land must be cleared of existing development. A goal of re-creating a wetland from a paved-over parking lot will be typically much more expensive than restoring a wetland on open space or conserving a deteriorated wetland with some intact features. Similar considerations apply to prairie and other natural areas. It must be emphasized again that our purpose in estimating costs, as was true in our efforts to estimate benefits, is to obtain numbers within a general framework and not to obtain numbers for particular sites.

Yet, certain recovery activities are generally similar for most sites. Plans must be drawn up and permits obtained. Land must be acquired or altered. Soil must be prepared, often alien or aggressive species must be removed, indigenous species seeded or planted, weeded and monitored, and then maintained. These common activities form the basis for an interesting and informed range of cost estimates available from public and private practitioners of recovery efforts in the Chicago area.

If one had to pick a reasonable range for costs from these estimates for a summary, one could say that a range of \$3,540 to \$22,500 per acre per year for the initial recovery period seems defensible, excluding land acquisition and heavy soil preparation expenditures. How to interpret this wide range will be addressed shortly. Once a site has reached "equilibrium," costs fall off for such maintenance activities as periodic burning and the range narrows from \$200 to \$3,000 per acre per year.

After soil preparation, recovery efforts are very labor intensive. There seems to be little room for "standardizing" the work effort as so much depends on the type of vegetation, the breaks of the weather, the influence of events from outside impinging on the site, and the like. It is unlikely, therefore, that productivity gains will significantly affect future costs. Volunteer efforts so important in recovery programs are not included in these cost estimates for reasons to be discussed shortly.

Land acquisition is an important expenditure aspect. Again, there is a large variation in the prices to be paid for land to gain additional space. Prices of open and farmland on the periphery depend on location features like access to transportation. Other things equal, estimates ranged from \$5,000 to \$24,000 per acre, recalling that an acre is about the size of a football field. Prices vary by county. Land in Chicago can be much more expensive; to restore a Lake Michigan front block to a wilderness state could take up to \$2,000,000, if anyone is interested in bringing prairie to Sheridan Road.

While the range of costs is clearly very wide, the value of the data will become apparent as the reasons for the variation are examined. Even then, care will have to be taken in making use of these estimates. The interpretation of them depends on details of definitions and sources, to which we turn. After that, the study will bring together the benefits and costs of recovery efforts in order to reach a conclusion on the extent or number of acres of new natural areas that this study indicates should, or could, be provided in the Chicago region.

### Recovery Cost Details

As already mentioned, the character of the wilderness space, the goals of recovery, and the condition of the site all have a bearing on costs. Moreover, wilderness sites are frequently planned in conjunction with other open space uses such as picnicking, sports, etc. It becomes hard if not impossible to allocate the share of labor and capital effort that goes to each site or portion of a site. Few, if any, managers keep a separate set of cost accounting books for a specific site. The fact that many organizations, each with their own expenditures, will typically be involved in activities at a site does not make for clarity in cost accounting. Market prices are not always readily available for some activities, a serious limitation when considering the contributions of volunteer labor.

All is not lost as many experienced ecologists and workers in the area have a sense of costs. Private practitioners or consultants in the area also have experience in bidding and

carrying out projects which can provide guidelines. Some estimates bordered on proprietary information and others were given after a promise of confidentiality. These considerations reinforced the decision not to organize data by site but rather to organize data by activity.

The activity estimates presented in Table 8 are identified by source number only. Some of the sources contacted for these estimates are listed in the footnote but no identification of estimate by source is intended. Note that both public agency and private practitioners or consultants were contacted.

The activity classification of the table may not be used by all sources but it captures major elements of the recovery effort. The first activity of planning, designing, and incurring transactions costs is frequently overlooked in recovery discussions. It can be important. Transactions costs include obtaining the necessary permits from all levels of government. Private developers incorporating wilderness spaces in their plans have commented on the complexity and extent of transactions costs, especially if wetlands are involved and mitigation banking is chosen as an option. Private consultants may be moving into this area to provide a service to developers.

The amounts of these preparatory activity costs are reported by private agencies to range up to \$2,000 an acre during the initial year. Having few estimates, that number is put forth as probably being an upper bound. Public agencies improving their existing sites also incur planning and design costs although these tend to get buried in general overhead.

Among recovery activities, soil preparation or movement can be expensive involving higher capital and higher hourly labor costs. The larger estimates, up to \$100,000, refer to complex and probably unique wetland endeavors. Also, in one case a valuable prairie patch was moved from one site to another requiring considerable soil movement. The range for this activity is the largest of all categories, the high value being twenty times the low. The range is such that estimating a measure of central tendency must be done with extreme care so as not to overestimate the expenditures in this category, an important topic soon to be discussed.

TABLE 8

## Costs of Wilderness Recovery by Activity (1997 dollars per acre per year)

Source Number	Preparatory Activity	Recovery Activity			Maintenance Activity		
		Soil Preparation	Spraying & Clearing	Seeding & Planting	Weeding & Monitoring	General Upkeep	Burning
1			140	3,000	200		200
2				4,250			475
3		100,000	500 to 1,200	300 to 1,000			
4				4,000			750
5				12,500 to 17,500			
6		30,000					750
7		60,000	2,500	1,000 to 2,500			750
8			3,000 to 5,000				1,000 to 3,000
9	2,000	5,000 to 50,000		5,000 to 15,000			
10		45,000 to 80,000				1,000 to 3,000	
11						300 to 500	
12				1,500 to 2,500		750 to 1,000	200

Note: Preparatory and soil preparation activities are expected to last about a year, remedial activity about 3 to 5 years, and maintenance activity thereafter. Excludes land acquisition costs and the efforts of the volunteers. Definitions: Preparatory costs include obtaining local, state, and federal permits when required. Soil preparation includes hydrological work and management. Selected sources (alphabetically): Applied Ecological Sources, Inc., The Chicago Park District; Conservation Forum Design, Inc., Forest Preserve Districts in the region; Don Hey and Associates; and the U.S. Army Corps of Engineers.

Removal of aggressive invading or inhibiting species is an important activity that requires resources if the site is to reach stated goals. The range here is also large, from \$140 to \$5,000, depending largely on the initial condition of the site. This activity is likely to require thoughtful explanation to the general public, which may want to know why something green is being replaced by something else green. A possibility is to build into the preparatory activity a cost item for public information.

Seeding and planting, sometimes of plugs, can be a costly item when seeds of native vegetation are sought. Sites with restoration goals are likely to be more costly than sites with conservation or landscaped wilderness objectives in mind. The range of values from \$300 to \$17,500 reflects this difference.

Once the initial recovery efforts are accomplished, taking perhaps three to five years, the costs fall off as maintenance activities get underway. Weeding and monitoring and general upkeep range from \$200 to \$3,000 an acre with burning falling in the same range. There are threats to a wilderness area after recovery that require attention. Invasive species are one, animals like deer nibbling on new growth are another. In a human dominated ecosystem, it would be incomplete not to mention the impacts of *Homo sapiens*--for example, the matter of polluted air and water, salt from roads, and possible vandalism.

The rapid decline in average recovery costs, as the size of the site increases, is worthy of special note. The decrease is so rapid that Figure 2, which follows, depicts the relationship on log-log scale. For example, as the size of the site increases from 100 to 1000 acres, the average cost per acre decreases from about \$7,000 to \$1,000. That is, total costs increase little in this interval. What it means in costing a site is that one can recover twice as much acreage without incurring expenditures for twice as many resources, and so on. People and equipment can be deployed more efficiently on larger sites than smaller.

There are several significant implications for our study in this decline in costs as acreage increases. First, in estimating the costs of recovery, the size of the site must be kept clearly in

mind. Second, marginal costs of recovery are declining more rapidly than average. This does not imply that one large site is preferable to many smaller ones. Public access and enjoyment of sites must be taken into account. However, if we use only average costs in estimating the size of any one site, we may underestimate the optimum acreage of that site.

This economic relationship of costs to area can also be utilized in a useful exercise with the biological relationship of biodiversity to habitat area. The former relationship is written as

$$C = dA^{-e},$$

where C is the average recovery cost, and d and e are parameters. A is the site acreage. The negative exponent measures the decline in average cost. The latter relationship is often written as

$$S = fA^g,$$

where S is the number of species, f and g are parameters, and A is habitat area (site acreage). The positive exponent measures the increase in number of species as habitat area increases. The inference is that we can obtain expansion of a wilderness site at decreasing average cost per acre and in the process potentially gain additional species at decreasing cost per specie! This may be shown more clearly by dividing the latter relationship by the former to obtain

$$\frac{S}{C} = \left( \frac{f}{d} \right) A^{(g+e)}.$$

If (g + e) is greater than one, which is likely, we obtain more species per dollar expenditure for recovery as the acreage of habitat (wilderness space) increases.

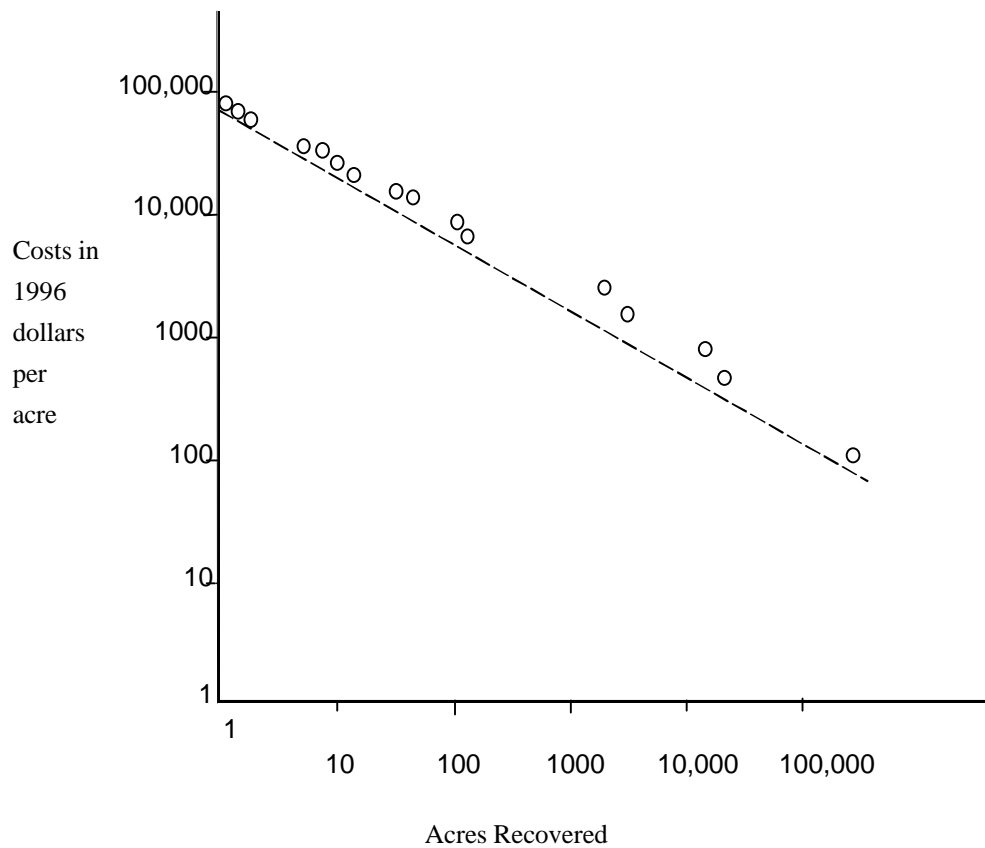


Figure 2 : Average Initial Costs of Recovery by Acreage of Site. Log log scale.

Source : DuPage County Forest Preserve District. Applied Ecological Services Report submitted May 14, 1996, p.17.

Excludes land acquisition expenditures.

### Land Acquisition Costs

Acquiring land for wilderness purposes means withdrawing it from other uses and thus constitutes an opportunity cost or welfare loss like the use of other resources. Recall that we are not estimating at this point the benefit from the use of land or other resources for wilderness purposes.

Land is treated separately for two reasons. First, not every wilderness project requires land acquisition, although every acre of public land converted to recovery should be given an "opportunity cost" value. Second, the expenditure for a parcel of land is a one-time payment for a flow of future habitat "services" for wilderness species. That is, we may not want to allocate the entire price of land to the first year or two of recovery efforts in estimating the cost. We may instead want to allocate a measure of the flow of services of land to recovery for the initial period, say, its rental value per year. That is, the initial price is annualized.

The value of land is determined by the value of its potential uses and therefore increases, generally, as we move closer to the center city and closer to transportation and other amenities. Table 9 on the next page reveals how much these factors vary, and hence how much land prices vary. Open and farmland on the fringe ranges from \$5,000 to \$24,000 per acre not so much because respondent sources cannot agree, but because location matters. Open land varies by county again reflecting location features. The land price gradient in the city is dramatic as the table shows. What we have done under City Land, part 4 of the table, is follow land prices per front foot by moving west from the lake along Belmont Avenue. Expanding wilderness areas in the built-up city could be expensive.

If the objective is to estimate annual recovery costs, then the fact that land owners could insist on a pure rent of up to 20% on appraised value would translate the values of the table into annual costs of \$1,000 to \$4,800 per acre. If the objective is to estimate the acres that can be acquired by a bond issue, then the land acquisition price is appropriate.

TABLE 9

Open and Farm Land Prices on the Fringe of  
the Metropolitan Area (in 1994 dollars per acre)

SOURCE		ESTIMATES		
1		16,000	to	24,000
2		5,000	to	10,000
3	Farm land with no locational advantages			
	Cook County			5,000
	DuPage County			4,500
	Lake County			4,000
	Kane County			4,000
	Will County			2,300
4	City Land			
	Lake front (up to \$7,000 per front foot)		up to	2,000,000
	Belmont & Racine (up to \$4,000 per front foot)		up to	750,000
	Franklin Park (up to \$900 per front foot)		up to	240,000

*Sources* : Source 1 and 2 data are from local experts. Source 3 and 4 are from Olcotts'  
Land Values and Blue Book of Chicago and Suburbs, 1994.

## Recovery Cost Caveats

This study has in hand a range of cost estimates that indicate that recovery activities require resources, and on occasion considerable resources, if they are to be done right. Before weighing the costs of these resources against the benefits of natural areas there are important qualifications and extensions to consider.

The range of costs is very wide containing as it does on the high side the re-creation of wetlands and on the low side the conservation of upland natural areas. In the middle is the restoration or landscaping of prairies and oak savanna and the like. It would be a mistake to apply the high- or low-side estimates to the wrong natural area, a mistake we will try to avoid in the concluding section.

Turning now to volunteer efforts, it is important to note that they provide a measure of public interest in recovery and an invaluable resource in carrying out many of the recovery activities. How should these efforts be treated from the cost accounting point of view? Should the monetary value of their contributions be subtracted from the costs of certain of the activities listed in Table 8? This is a possible calculation if volunteer efforts replace people employed at market rates for the task. The cost accountant would counsel us to include in this calculation expenditures for recruitment of volunteer labor and for their training and supervision.

Up to 5,000 volunteers, probably more if a complete count were carried out, have labored in the fields, streams, and woods to help recover natural areas in the region. Some estimates of the monetary value of this contribution have been made based on assumed hourly rates of pay, say, \$11.00. This estimate seems highly suspect given the variety of tasks, many of them biologically sophisticated, at specific sites. Much volunteer labor is highly skilled, to say the least.

However, to pursue this reasoning further assume that a volunteer contributes 20 days at 8 hours per day during the year. If we apply the \$11.00 rate, we obtain \$8,800,000 as the annual value for 5000 volunteers. If ten volunteers worked one summer on a ten-acre site, the contribution could be valued at \$17,600 in total or \$1,760 per acre per year. One could and should apply different hourly rates for different activities at different sites. To the extent that volunteer work replaces people earning wages, such estimates could be thought of as a subtraction from the costs of Table 8.

Turning next to another important issue: Should recovery costs and subsequent maintenance of natural areas be compared with like costs for alternative uses of open space in parks such as lawns, picnic tables and barbecue pits. Roadside spaces offer the same choice where turf or non-natural landscaping can be chosen. Data has been assembled showing that turf planting and maintenance, including mowing and watering, can require considerable expenditures that for some activities exceed those for natural areas (Patchett 1997). The Illinois State Highway Authority and Illinois Department of Transportation (IDOT) are reported to save money on roadsides planted with hardy indigenous prairie flowers and grasses compared with turf or lawns that must be mowed, watered, and maintained (Chien 1998). IDOT reports costs from \$35 to \$45 acre for mowing that occurs three times a year, and has reduced mowed acres along roads by more than half by increasing planting of wildflowers and prairie grasses.

Should we modify the cost data for natural areas by computing the net costs or difference between open space in lawns and in natural vegetation? These net costs would be very interesting estimates when prepared for particular sites. Again, our general purposes are not well served by making this computation. We have not asked respondents in the benefit portion of this study for their preferences for lawns and related items compared with natural vegetation. That is, we have not asked for the net benefits for alternated uses of land. Such a survey could be of interest when carried out for particular sites.

In implementing the general objective of this study we have obtained estimates of the benefits and costs of natural areas defined on a consistent basis. We are now in a position to match these two factors.

## **Final Summary and Conclusions**

A restatement of our major purposes may be helpful before presenting our conclusions about such a complex matter as wilderness space recovery in a human dominated, fissiparous metropolitan area. What we have sought is a grasp of the relationship of resident natural area preferences to the costs of recovery of these areas. That is, we have sought estimates of the benefits and costs that could yield a quantitative measure of desired additions to natural areas. We have not been able to obtain exactly what we need which would be a measure of the gains to individuals of an increment of such space less the costs of that increment. What we have are survey data on public preferences that can be converted to estimates of the value of additional space. These can be matched with estimates of the average costs of such additions. Putting these data together can yield interesting aggregate estimates of the gains from an increase in acreage not too different from the ideal measures. That is one result of the study that will be discussed in this concluding section.

While welfare gains and losses were not estimated for particular sites, a good deal of information on these sites was gathered. We have organized this site information into a rating index that gives weight to wilderness values, recovery costs, and public accessibility that can supplement our aggregate findings. This topic will also occupy us in this section.

To stop there leaves some of the most interesting questions about furthering biodiversity unanswered. How can the reservoir of public support be tapped given the present state of information on the matter and the present scarcity of resources for many other worthwhile activities? What "tools" are available to public agencies to translate this support, and cost, information into concrete programs? Should private efforts be increased to achieve these wilderness goals? Some comments on these difficult issues conclude this section.

## How Much More Wilderness Space Will the Public Support?

Turning first to the question of additional space, we shall have to present ranges, and rather wide ones at that, of estimates of preferences for and costs of more wilderness space. To do otherwise would suggest false precision of estimates that are, in fact, smudged over by the diversity of ecosystems and by the variation in types of recovery efforts that we have discussed.

From the section on survey results we can obtain a range of from \$39 million to 59 million per year as the estimate of the metropolitan public's willingness to pay for more wilderness areas. This range is due to both sampling variation and adjustments for a nonrandom sample.

From the section on costs, we can obtain again a wide range of results that can be conveniently summarized as follows (all in dollars per acre):

- a. Initial land acquisition costs 5,000 to 24,000
- b. Initial soil preparation costs 5,000 to 100,000
- c. Recovery activity costs 3,340 to 17,500
- d. Maintenance activity costs 200 to 3,000.

The wide cost ranges are due to more than variety of sources; they are due to the type of site, wetlands being the most expensive to restore, to the initial condition of the site, as well as to numerous other factors. However, our objective is not served by distinguishing the type of site. Rather, we are thinking of a mix of natural areas—a fixed market basket of wetlands, prairies, oak savanna, and the like. Our objective is to determine the size of the market basket that the public would prefer. Therefore, the best solution to the wide range is to estimate the modal costs for each major activity for sites of ten to fifty acres, among the most common sizes, and then

sum to get a modal cost for a market basket mix. of natural areas of varying type.. We have information of this nature to narrow the range of estimates.

Suppose two-tenths of the extra funds available from new public support were allocated to new land acquisition, one-tenth to major soil preparation largely for wetlands recovery, and seven-tenths to other recovery activities for newly acquired land, for land readied by soil preparation, and for land already in open but not wilderness state. These proportions are not far from past experience. We can apply these proportions to the average of the costs of recovery just given, but the distribution of costs within each activity is skewed to the right by the high costs of certain sites. It would be unwise to use the mean of all these costs in view of the undue impact of a few high cost estimates. We may make proper allowance for their influence by using the modal or most frequent value of the distribution of cost estimates. Several of our sources gave us their judgement that the modal or most frequent cost estimate for each of the three activities, excluding maintenance activity, was in the vicinity of \$10,000. This provides a modal estimate of \$10,000 per acre for the sum of the three activities (this being the sum of the modal costs for each activity weighed by the proportion that activity is of total costs).

If we take, from our sample survey, the average total of the willingness to pay of Chicago residents per year to be \$50 million, we can divide by \$10,000 to arrive at an estimate of 5,000 acres to be added to natural areas the first year. That is the size of the market basket of various natural areas that would meet the preferences of the region's population. It is very difficult to calculate a sampling error for an estimate prepared in this way but using low and high willingness to pay yields a range of 4,000 to 6,000 acres.

5,000 acres represents re-allocating about .2 percent per year of the region's present total space in the first year. But note that maintenance expenditures, not taken into account up to this point, now play a role. The tax revenues for natural areas continue each year, but adding the same acreage of natural areas year by year would overlook the maintenance and monitoring costs for recovered spaces. That is, an increasing part of each year's tax revenues would have to be allocated to maintenance of the expanding space of wilderness. This is a very important point

because poorly maintained natural spaces could quickly undermine any restoration or conservation program.

We estimate the modal expenditures per acre for maintenance to be about \$2,000 per acre. This means that about twenty percent of each acre's cost would have to be set aside for maintenance expenditures over the future horizon. As acreage of new or restored natural areas expands, maintenance expenditures increase, thus bringing the expansion of space eventually to a halt. That is, after a number of years most of the constant annual flow of revenues available for natural area use is devoted to maintenance and monitoring activities. If twenty percent of such aggregate expenditures are deducted each year for the prior year's expansion of space, it is easy to calculate that the total expansion in the region of natural areas will converge to 25,000 acres given the continuing annual flow of \$50,000,000. If more space should later be desired, then additional public funds would have to be forthcoming.

By the year 2020 this would mean that about one percent of the region's total acreage has been reallocated to natural areas. If the region's present reserve of wilderness-type space is about 200,000 acres, as some estimates have it, then this addition represents about a 12.5 percent growth over the next twenty years.

#### What Kinds of Wilderness Space Should be Added?

An aggregate wilderness acreage is a dry and abstract quantity not very reflective of the values of nature: the almost inexhaustible variety of living things, the wide spectrum of colors that fill the palate, and the broad range of rewards, both intellectual and esthetic, awaiting the close observer. Each site provides its own assortment of these values.

This study did not attempt to obtain information on benefits and costs of particular sites for the numerous reasons already mentioned. However, the author did visit many sites and talked to many people from different backgrounds about these and other sites so that a good deal of opinion and data became available. At the risk of being presumptuous, the author has

arranged this material, as he has interpreted it, in Table 10, shown on the next page. The table must be interpreted as a list of sites the author's study brought to his attention, and not a cross-section of interesting sites.

TABLE 10

## Ratings of Selected Natural or Wilderness Sites: Wilderness Values, Recovery Costs, and Accessibility Features

Site Name & Acreage	Natural Area Value Rating (10 high to 1 low)	Recovery Cost Rating (10 high to 1 low)	Accessibility Rating (10 high to 1 low)	Total Rating	Site Description, Main Management, and Location
Marquette Park 2 acres	3	2	10	15	Relocation of Prairie. Chicago Park District. 87 <sup>th</sup> and Kedzie, Chicago
Origin ("Bubbly Creek") 3 to 10 acres	3	4	10	17	Riverside wilderness and recreation. Chicago Park District. Pilsen Community, Chicago.
Lathrop Homes 2 or more acres	2	7	10	19	Open and wilderness space in public housing. Chicago Housing Authority. Diversey at the River, Chicago.
Gompers Park about 5 acres	4	4	10	18	Wetlands space. Chicago Park District. Foster and Pulaski, Chicago.
North Park Village Nature Center, up to 9 acres out of 46	4	5	10	19	Variety of natural spaces. Dept. of the Environment, Chicago. Pulaski at Peterson.
Montrose Point up to 20 acres	10	6	10	26	Prairie and Magic Hedge bird sanctuary. Chicago Park District. Lake front at Montrose.
Beaubien Woods up to 15 acres	5	5	9	19	Varied wilderness and recreational spaces. Cook County Forest Preserve District. Near Altgeld Gardens public housing project.
Wooded Island about 16 acres	8	5	10	23	Oak savanna and wetlands. Chicago Park District. Jackson Park.
Prairie Wolf Slough 40 acres	6	5	5	16	Wetlands, upland prairie, oak savanna. Lake County Forest Preserve District.

TABLE 10—Continued

Ratings of Selected Natural or Wilderness Sites: Wilderness Values, Recovery Costs, and Accessibility Features

Site Name & Acreage	Natural Area Value Rating (10 high to 1 low)	Recovery Cost Rating (10 high to 1 low)	Accessibility Rating (10 high to 1 low)	Total Rating	Site Description, Main Management, and Location
Lucent Technologies 50 acres	4	5	7	16	Landscape prairie. Private. Lucent Technologies, Inc. 30 acres in Naperville, 20 acres in Lisle.
Tellabs 50 acres	4	5	6	15	Landscaped prairie. Private. Tellabs, Inc. Bolingbrook, IL.
Vestal Grove (Somme Prairie Grove) about 15 acres	10	3	10	23	Restored oak savanna. Cook County Forest Preserve District. Dundee & Waukegan, Northbrook, IL.
Bunker Hill Prairie	9	4	10	23	Prairie. Cook County Forest Preserve District. West of Edens Expressway and Carpenter.
Prairie Crossing up to 200 acres	4	5	4	13	Varied wilderness spaces with housing. Private. Shaw Homes, Inc. Grayslake, Inc.
Middle Fork Savanna up to 200 acres	6	5	4	15	Varied wilderness space. Lake County Forest Preserve District.
Mill Creek Development up to 200 acres out of a larger development area	5	5	4	14	Varied wilderness spaces with houses and related facilities. Private. Shodeen, Inc. Near Geneva and Batavia, IL.
Prairie Stone up to 90 acres out of a total of 786	4	4	7	15	Landscaped prairie with commercial facilities. Sears Roebuck & Co. Hoffman Estates, IL.

TABLE 10—Continued

Ratings of Selected Natural or Wilderness Sites: Wilderness Values, Recovery Costs, and Accessibility Features

Site Name & Acreage	Natural Area Value Rating (10 high to 1 low)	Recovery Cost Rating (10 high to 1 low)	Accessibility Rating (10 high to 1 low)	Total Rating	Site Description, Main Management, and Location
Elgin-O'Hare Expressway Corridor I-355 Corridor (Expressway right-of- way spaces)	3	5	9	17	Wetlands and prairie landscaping along the expressway. Illinois Dept. of Transportation.
Swallow Cliff woods <u>up to 800 acres</u>	9	4	7	20	Prairie and woodlands. Cook County Forest Preserve District.
Waterfall Glen Forest Preserve about 2,500 acres	9	4	5	18	Varied wilderness space. DuPage County Forest Preserve District. Adjoining Argonne National Laboratories.

Notes: Sites are simply those which the author has visited or discussed extensively. They are arranged, roughly, from small to large acreage. Ratings based on author's travels and discussions with a cross-section of respondents. Wilderness value rating is a quality index based on the author's information on species concentration and endangered or threatened species presence plus uniqueness of space (e.g. tall grass prairie or oak savanna), plus hydrological significance (flood control or water quality). Recovery cost rating is based on the author's information on resources used over the past few years for recovery activities as discussed in the prior section. Accessibility rating is based on the author's information on population diversity surrounding the site, availability of public transportation, and presence of "signage" or other information describing the site to visitors. The total rating is not a priority ranking, as many sites have not been listed, but rather a sum that indicates that each of the 3 major features are given equal weight. The reader is invited to change the numbers, or devise major features of her or his own. It must be emphasized that many organizations have participated in recovery efforts at most of these sites. Only the site owner or main manager is listed.





Twenty sites are listed with diverse ecosystem content and are arrayed roughly from small to large acreage. They are rated by three criteria, each from one to ten. The first criterion is the wilderness value or the uniqueness and significance of the ecosystem. The rating is based on the number and status of species at the site. If any species found on the site are threatened or endangered, that qualifies for a high rating. If the site contains an ecosystem that has international significance--for example, tall grass prairie, oak savanna, or habitat for migratory bird use-- that qualifies for a high rating. If the site has significance for flood or water quality control, that qualifies for a high rating.

The second criterion rates recovery cost as we have discussed the matter earlier. A high rating is assigned if the recovery cost is low per acre.

The third criterion is an accessibility rating that is a kind of proxy for the benefit or welfare gain from the site. This rating is based on the population density within easy travel time from the site. Recall the high proportion of visitors to the Morton Arboretum who lived in the adjoining townships. The availability of public transportation to the site also adds to the rating. Finally, the amount of information at the site on its interesting features--the "signage"--adds to the rating.

Sites such as Montrose Point, Vestal Grove, Bunker Hill, and Wooded Island rate high in total points. The accessibility criterion affects adversely the rating of many interesting sites that are less accessible. The total ranking is not intended to be a priority listing. Rather, the aim is to suggest the desirability of achieving a balance of sites recognizing that they serve several purposes, not one.

### How to Tap the Reservoir of Public Financial Support?

One lesson from this study's survey of public willingness to pay is that any request for support, any referendum on a bond issue, requires, if it is to have a good chance of success, that it be accompanied by a complete and clear explanation of the uses of the funds. The attractions that biologists and ecologists find in biodiversity are honed

by education and career practice. The public being asked to open its purse may or may not have these values clearly in mind at the moment. Other valuations are not to be downgraded by they recreation, relaxation, entertainment, or simply idle curiosity. Vivid and wide ranging explanations of the place of humankind in nature's realm are much to be desired in any wilderness program designed to tap public support, in the view of the author.

Bringing the public's attention to the values of wilderness sites is both a matter of effort, and art. Certain examples seem capable of further development. Montrose Point, accessible to many and relatively low in recovery cost, can serve as one example. The site enables the public to enjoy a view of sea, sky, and city towers while also walking through a landscaped prairie and watching, during the migratory season, vast numbers of birds of great variety. That many birds migrate at night is a problem, but some clever entrepreneur may be able to develop infrared light observation booths. Even without such gadgetry, the site has enormous potential for stimulating the public.

That some plants have the remarkable ability to absorb metals that are toxic to humans opens up another opportunity for the wilderness program. Alpine pennycress does well in soils contaminated with zinc and cadmium. Some mustard plants, although tropical in origin, are effective phytoremediators. Perhaps varieties can be developed for the region. If native hyperaccumulating species were found with good agronomic qualities, think of the possibilities. A field of native plants busily detoxifying contaminated areas in the region would make a picture no newspaper, or reader, could resist. Not that all or even most wilderness spaces must serve commercial ends, but we should not keep it a secret if some of them help to purify the water, or to clean the air, and, in the future, to detoxify the land.

Assuming the public to be properly prepared for a request for support, there exist a number of "tools" to be used to translate that general support into public action. How effective these tools are, and whether additional tools need to be explored are important topics for other detailed studies. Several comments bear on the findings of this study.

The record of bond issues for open land development or improvement seems reasonably good in the region. A systematic survey is in order, but recent results are consistent with our findings. This major tool requires careful planning and informed timing, as is well known. However, public bond issues are not the only means of tapping financial support and serving wilderness ends.

Conservation easements enable public agencies to influence development without affecting the present use of land. Purchase of such easements provides a means for controlling land use adjacent to public wilderness areas. A systematic survey of this topic could be of great help. Tax incentives and covenants of various kinds may play an enhanced role in preserving wilderness space.

Facilitating land acquisition through park donation ordinances, through the giving of tax breaks for future donations, or through the provision of donations with life estate contracts, all represent measures that ought to be appraised for their future role.

The willingness to pay of the public can be also tapped by private campaigns. The flexibility of this approach has much to recommend it. Private organizations can make full use of the autonomy and anonymity of the market when engaging in land transactions. This means they can carry out the preferences of their supporters without answering to other authorities and they can act as buyers or sellers without revealing their intentions in the transaction. Hence, they can secure savings in land acquisition.

Private organizations have played an important role in achieving the present stage of wilderness development in the region. This study finds that they can increase that role. Preferences for wilderness space increase with the educational attainment and income of households. These households comprise the segment of the public that private organizations can reach most effectively. Devising a campaign to reach these households at the present time seems well within their capabilities. It would set an example for the rest of the population for whom wilderness space gets a lower priority rating.

Such efforts of private organizations could be, and some are presently, closely coordinated with public agencies. Land acquired by one means or another and recovered by private organizations could then be turned over to public agencies for permanent maintenance. If the goals of the wilderness program are to be reached, and this study finds reasons to be optimistic about achieving those goals, it will require the combined efforts of many parties.

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