



REPORT TO COUNCIL

City of Sacramento

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CONSENT
June 23, 2009

Honorable Mayor and
Members of the City Council

Title: Trust for Public Land Report: "How Much Value Does the City of Sacramento Receive from Its Park and Recreation System?"

Location/Council District: Citywide

Recommendation: Receive and file.

Contact: J.P. Tindell, Park Planning & Development Manager, 808-1955

Presenters: Not applicable

Department: Parks and Recreation

Division: Park Planning & Development Services

Organization No: 19001121

Description/Analysis

Issue: Sacramento has been a participant in a national study completed by the Trust for Public Land (TPL). This study measured what the value of a park system is to a city. Other cities who participated in the study were Washington, D.C., San Diego, Boston, and Philadelphia. Studies of Wilmington, Delaware and Denver, Colorado are currently in process. Cities participating early in this process are helping develop a methodology for measuring a park system's value. This methodology will be able to be used by any U.S. city.

Staff is returning to City Council to share the results of the study.

Policy Considerations: Participation in the study is consistent with Department and City management goals to improve methods of measurement of the value of City services. Providing parks and recreation facilities is consistent with the City's strategic plan to enhance livability in Sacramento's neighborhoods by expanding park, recreation, and trail facilities throughout the City.

Committee/Commission Action: The Parks and Recreation Commission (PRC) was informed of the opportunity to participate in the study on September 8, 2005. The publication was presented to the PRC on May 7, 2009.

Environmental Considerations:

California Environmental Quality Act (CEQA): There are no environmental considerations associated with consideration of this information report.

Sustainability Considerations: The Trust for Public Land study is consistent with the goals, policies, and targets of the City Sustainability Master Plan (SMP) and the Parks and Recreation Sustainability Plan (PRSP). The study showed that the park system provided "environmental savings" through improved air quality and reduced stormwater treatment. It has been identified that (1) stormwater run-off carries pollutants and is a problem in urban areas and (2) parkland provides pervious areas which provide important contributions to the reduction of wastewater treatment.

With only 28% of the system's parkland currently covered by tree canopy, it is possible to provide further improvement to the City's air quality by planting additional trees at City parks.

Rationale for Recommendation: The impetus for the study by the Trust for Public Land's Center for City Park Excellence came about from the lack of quantitative research into the economic benefit of parks in specific urban areas. The study provided much needed quantitative research which may be used when making decisions about urban infrastructure investment.

Economic values were measured in seven topic areas: direct use, real estate, health, tourism, air pollution mitigation, storm water runoff mitigation, and social cohesion. The study determined that, though not every portion of the system can be measured, the Sacramento Parks and Recreation system is an important asset to the City and its citizens. Annually, the Sacramento Parks and Recreation system provides \$370.9 million in cost savings to its citizens and \$1.2 million in cost savings to City government. (The Sacramento Parks and Recreation system covers all public parkland within the current city limits, and therefore includes properties of the State, County and City.) It also creates \$3.0 million in revenue for government and it increases its citizens' wealth by \$16.4 million.

Financial Considerations: The study showed that the park system saved government overall over \$1.2 million in 2007 through the improvement of air quality and the reduction of stormwater treatment, \$359,000 and \$842,000 per year respectively. In addition, it provided these governmental agencies with \$3 million in revenue from the

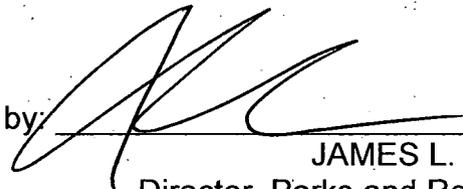
additional property tax assessed on properties with increased value because of their proximity to a park.

Citizens also received savings of nearly \$371 million through direct park usage (e.g., participating in team sports, free entertainment, etc.), health benefits derived from being more active (decreased risk for heart disease and diabetes), and creating a more cohesive community by increasing our social capital.

Professional Services Agreement #2006-0328 was executed in an amount not to exceed \$40,000. This payment was provided to TPL for their services as a consultant to the City in data collection, program oversight, and analysis of results.

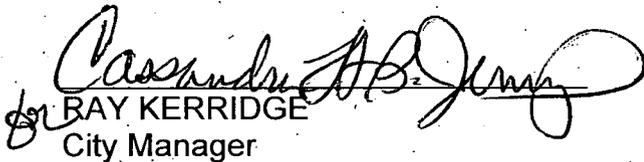
Emerging Small Business Development (ESBD): Not applicable.

Respectfully Submitted by:



JAMES L. COMBS
Director, Parks and Recreation

Recommendation Approved:



RAY KERRIDGE
City Manager

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Attachment 1

Background Information

Through contacts with both the Trust for Public Land (TPL) and the California Park and Recreation Society (CPRS), Sacramento was suggested in 2005 as a potential participant in TPL's national study to quantify the economic value a park system brings to a community, and how a system contributes to a more successful city. Sacramento is considered a representative of "medium sized" cities for the purposes of this study. Ultimately, a City Park Value Model will be available to any city.

Other cities who participated in the study were Washington, D.C., San Diego, Boston, and Philadelphia. For an analysis of the five participating cities, a report, "Measuring the Economic Value of a City Park System," may be found online:

http://www.tpl.org/content_documents/ccpe_econvalueparks_rpt.pdf. Studies of Wilmington, Delaware and Denver, Colorado are currently in process.

The Department regularly uses TPL publications as professional resource documents, particularly those produced by their Center for City Park Excellence. For this study, Professional Services Agreement #2006-0328 was executed in an amount not to exceed \$40,000. This payment was provided to TPL for their services as a consultant to the City in data collection, program oversight, and analysis of results.

This was a joint effort between staff from the Sacramento Convention and Visitors Bureau, Sacramento Tree Foundation, County of Sacramento, California Park and Recreation Society, California State Parks, California Travel and Tourism Commission, and various City departments.

This report will be posted on the TPL and City websites, and be shared with other jurisdictions.

*A Report by The Trust for Public Land's
Center for City Park Excellence for the
City of Sacramento Department of Parks and Recreation*

How Much Value Does the City of Sacramento Receive from Its Park and Recreation System?

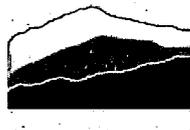


How Much Value Does the City of Sacramento Receive from Its Park and Recreation System?

A Report by
The Trust for Public Land's
Center for City Park Excellence
for the City of Sacramento Department of Parks and Recreation

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The numerical calculation sheets, as well as the technical methodology sheets, are available from The Trust for Public Land, Center for City Park Excellence, 660 Pennsylvania Ave. S.E., Washington, D.C. 20003, or they can be directly accessed online at: www.tpl.org/SacramentoParksValue.

Executive Summary

The parks and park programs of Sacramento—from the American River Parkway to McKinley Park to William Land Park—provide Sacramentans with so many joys and benefits that many residents would not want to live in the city without them.

Although the system was not created specifically as an economic development tool, there is a gradually growing realization that the parks of Sacramento are providing the city with hundreds of millions of dollars of value. This value has now been defined. Not every aspect of a park system can be quantified—for instance, the mental health value of a walk in the woods has not yet been documented and is not counted here; and there is no agreed-upon methodology for valuing the carbon sequestration value of a city park—but seven major factors are enumerated: clean air, clean water, tourism, direct use, health, property value, and community cohesion. While the science of city park economics is in its infancy, the numbers reported here have been carefully considered and analyzed.

Two of the factors provide Sacramento with direct income to the city's treasury. The first consists of increased property tax receipts due to the rise in property value of certain residences because of their proximity to parks. This value came to \$417,000 in fiscal year 2007. The second consists of sales tax receipts from tourism spending by out-of-towners who came to Sacramento primarily because of its parks. This value came to \$2.6 million. Beyond the tax money, these factors also bolstered the collective wealth of Sacramentans—by \$7.2 million in realized property value that year and by \$9.2 million from net income from tourists.¹

Three other factors provide Sacramento residents with direct savings. By far the largest is through the human value of directly using the city's free parkland and recreation opportunities instead of having to purchase these items in the marketplace. This value came to \$345.6 million in 2007. Second is the health benefit—savings in medical costs—due to the beneficial aspects of exercise in the parks. This came to \$19.9 million. And third is the community cohesion benefit of people banding together to save and improve their neighborhood parks. This "know-your-neighbor" social capital, while hard to tabulate, helps ward off all kinds of anti-social problems that would otherwise cost the city more in police, fire, prison, counseling, and rehabilitation costs. This value came to \$5.5 million, based on available data for 2006.

The last two factors also provide savings, but of the environmental sort. The larger involves water pollution reduction—the fact that the trees and soil of Sacramento's parks retain rainfall and thus cut the cost of treating stormwater. This value came to \$842,000 in 2007. The other concerns air pollution—the fact that park trees and shrubs absorb and adsorb a variety of air pollutants. (Through adsorption, pollutants adhere as a thin layer of molecules to plant leaves and stems.) This value came to just under \$359,000.

The park system of Sacramento thus provided the city government with direct revenue of more than \$3 million and with cost savings of more than \$1.2 million in 2007. In addition, it provided residents with savings of nearly \$371 million in that year. Finally, it added to the general wealth of the citizenry by more than \$16 million.

¹ The full increase in property wealth due to parks is estimated at \$71.9 million, and an estimated 10 percent of park-proximate dwelling units were sold during the year.

Annual Value of the Sacramento Park and Recreation System	
<i>Summary</i>	
Revenue-Producing Factors for City Government	
Tax Receipts from Increased Property Value	\$417,000
Tax Receipts from Increased Tourism Value	\$2,613,000
Total, Revenue-Producing Factors	<u>\$3,030,000</u>
Wealth-Increasing Factors to Citizens	
Property Value from Park Proximity (annualized)	\$7,200,000
Profit from Tourism	\$9,225,000
Total, Wealth-Increasing Factors to Citizens	<u>\$16,425,000</u>
Cost-Saving Factors to Citizens	
Direct Use Value	\$345,597,000
Health Value	\$19,872,000
Community Cohesion Value	\$5,525,000
Estimated Total, Citizen Cost-Saving Factors	<u>\$370,994,000</u>
Cost-Saving Factors for City Government	
Stormwater Management Value	\$842,000
Air Pollution Mitigation Value	\$359,000
Total, Cost-Saving Factors for City Government	<u>\$1,201,000</u>
Center for City Park Excellence. The Trust for Public Land. 2008.	

Acknowledgments

This report was commissioned by the City of Sacramento's Department of Parks and Recreation.

The principal author was Peter Harnik. Principal researcher was Linda Keenan with assistance by Ben Welle. Major consultation on the underlying economic formulas for this study was provided by:

- David Chenoweth
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- John Crompton
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- Sarah Nicholls
Ph.D., Department of Park Recreation & Tourism Resources, Michigan State University

- David Nowak
Ph.D., U.S. Forest Service Northeast Research Station, Syracuse, N.Y.
- Dan Stynes
Ph.D., Department of Park, Recreation and Tourism Resources, Michigan State University

Additional consultation was provided by:

- Denise Castronovo
Mapping Sustainability, LLC., Jupiter, Fla.
- Barry Zeplowitz
Barry Zeplowitz & Assocs., Buffalo, N.Y.

For a list of local officials who assisted in gathering data for this study, see Appendix I.

Background

Cities are economic entities. They are made up of structures entwined with open space. Successful communities have a sufficient number of private homes, commercial establishments, and retail outlets to house their inhabitants and give them places to produce and consume goods. Cities also have public buildings—libraries, hospitals, arenas, city halls—for culture, health, and public discourse. They have linear corridors—streets and sidewalks—for transportation. And they have a range of other public spaces—parks, plazas, trails, sometimes natural, sometimes almost fully paved—for recreation, health provision, tourism, sunlight, rainwater retention, air pollution removal, natural beauty, and views.

In successful cities the equation works. Private and public spaces animate each other with the sum greatly surpassing the parts. In unsuccessful communities, some aspect of the relationship is awry: production, retail, or transportation may be inadequate; housing may be insufficient; or the public realm might be too small or too uninspiring.

Since cities are economic entities, their parks also have an economic dimension. Finance may not be a paramount reason to walk in the woods or play a game of tennis, but it is a significant factor when it comes to public and private decisions regarding investments in urban infrastructure. It is for this reason that the Center for City Park Excellence has undertaken a study of the economic value of urban park systems generally, and Sacramento's specifically.

Methodology

Based on a two-day colloquium of park experts and economists held in October 2003 (see Appendix 2), the Center believes that there are seven attributes of Sacramento's park system that are measurable and that provide economic value to the city. (For a listing of studies done on these issues by participants in the colloquium as well as others, see Appendix 3.)

What follows is a description of each attribute and an estimate of the specific economic value it provides.

1. Removal of Air Pollution by Vegetation

Air pollution is a significant and expensive urban problem, injuring health and damaging structures. The human cardiovascular and respiratory systems are affected with broad consequences for health-care costs and productivity. In addition, acid deposition, smog, and ozone increase the need to clean and repair buildings and other costly infrastructure.

Trees and shrubs have the ability to remove air pollutants such as nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone, and some particulate matter. Gases are absorbed by leaves, and particulates adhere to the plant surface, at least temporarily. Thus, vegetation in city parks plays a role in improving air quality, helping urban residents avoid costs associated with pollution.

In order to quantify the contribution of park vegetation to air quality, an air pollution calculator was designed to estimate pollution removal and value for urban trees. (The Methods for Air Pollution Model are provided in the technical methodology sheets.) This program, which is based on the Urban Forest Effects (UFORE) model of the U.S. Forest Service, is location-specific, taking into account the air pollution characteristics of a given city. (Thus, even if two cities have similar park forest characteristics, the systems could nevertheless generate different results based on differences in ambient air quality.)

First, land cover information for all of Sacramento's parks was obtained through analysis of aerial photography. (While Sacramento and every other city have street trees and numerous other trees on private property, this study measures only the economic value of trees on public parkland.) Of 5,223 acres of parkland, 28 percent was found to be covered with trees.

Then the pollutant flow through Sacramento within a given time period (known as "pollutant flux") was calculated, taking into account the concentration of pollutants and the velocity of pollutant deposition. The resistance of the tree canopy to the air, the different behavior of different types of trees and other vegetation, and seasonal leaf variation are taken into account by the calculator.

The calculator uses hourly pollution concentra-

Sacramento Parkland Characteristics		
Type of Cover	Acres	Percent
Parkland with Tree Canopy	1,462	28.0%
Other Pervious Surface	2,512	48.1%
Impervious Surface	1,022	19.6%
Water	227	4.3%
Total	5,223	100.0%

Source: Mapping Sustainability, LLC, 2008

tion data from cities that were obtained from the U.S. EPA.² The total pollutant flux was multiplied by tree-canopy coverage to estimate total pollutant removal by park trees in the study area. The monetary value of pollution removal by trees is estimated using the median U.S. externality values for each pollutant. (The externality value refers to the amount it would otherwise cost to prevent a unit of that pollutant from entering the atmosphere. For instance, the externality value of preventing the emission of a short ton of carbon monoxide is \$870; the externality value of the same amount of sulfur dioxide is \$1,500.)

The result of the Air Quality Calculator for the park system of Sacramento (see Calculator 1) is an economic savings value of \$359,000.

2. Reducing the Cost of Managing Urban Stormwater

Stormwater runoff is a significant problem in urban areas. When rainwater flows off roads, sidewalks, and other impervious surfaces (surfaces that do not absorb water), it carries pollutants with it. In some cases—cities with systems that separate household sewage from street runoff—the rainwater flows directly into waterways, causing significant ecological problems. In other cases—cities with combined household and street systems—the rainwater runoff is treated at a pollution control facility before going into a waterway. However, if a storm is large, the great amount of runoff overwhelms the combined system and flows untreated into rivers and bays. Fortunately, Sacra-

mento’s system consists mostly of separated pipes, thus reducing spillage of sewage; however, in larger storms street runoff still fouls waterways.

Parkland reduces stormwater management costs by capturing precipitation and/or slowing its runoff. Large pervious (absorbent) surface areas in parks allow precipitation to infiltrate and recharge the groundwater. Also, vegetation in parks provides considerable surface area that intercepts and stores rainwater, allowing some to evaporate before it ever reaches the ground. Thus urban green space functions like a mini-storage reservoir.

A model has been developed to estimate the value of retained stormwater runoff due to green space in the parks. Inputs to the model consist of geographic location, climate region, surface permeability index, park size, land cover percentages, and types of vegetation. Because of data challenges, the model is not perfect and thus gives only a preliminary indication of value for the park system of the city of Sacramento.

First, Sacramento’s land cover data—trees, open grassy areas, impervious surface, etc.—were obtained through analysis of aerial photographs. This analysis reveals that the city’s park system is 76.1 percent pervious. The rest consists of impervious roadways, trails, parking areas, buildings, hard courts, and also water surface. (While the model has the sensitivity to distinguish between the different effects of such vegetation types as conifers, palms, and shrubs, the sensitivity of the aerial photographs was not great enough to make that kind of determination.)

Second, the same photographs were analyzed for the amount of perviousness of the rest of the city of Sacramento—in other words, the city without

² The data are from 1994, the most recent available at the time to the U.S. Forest Service, author of the Air Quality and Stormwater Calculators.

its parkland. It was determined that Sacramento (without its parks and not counting surface water) is 50.9 percent pervious. The pervious private land consists primarily of residential front yards and backyards as well as private natural areas such as cemeteries, university quadrangles, and corporate campuses.

Sacramento Parkland Perviousness

Type of Cover	Acres	Percent
Pervious	3,974	76.1%
Impervious	1,022	19.6%
Water Features	227	4.3%
Total	5,223	100.0%

Source: Mapping Sustainability, LLC, 2007.

Third, the amount and characteristics of rainfall were calculated from U.S. weather data. Sacramento has a characteristic Mediterranean climate with precipitation confined to five winter months; it receives an average of 1752 inches of rain per year. The model, which combines aspects of two other models developed by researchers with the U.S. Forest Service, uses hourly annual precipitation data to estimate annual runoff.

**City of Sacramento Perviousness
(Without Parkland or Water Surface)**

Type of Cover	Acres	Percent
Total Pervious	29,109	50.9%
Total Impervious	28,124	49.1%
Total (without water or parks)	57,233	

Source: Mapping Sustainability, LLC, 2007.

Next, the reduction in runoff was calculated. That is done by comparing the modeled runoff with the runoff that would leave a hypothetical site of the same size but with land cover that is typical of surrounding urban development (i.e., with streets, rooftops, parking lots, etc.).

The final step in determining the economic value of a park system's contribution to clean water

is calculating what it costs to manage stormwater using traditional "hard infrastructure" (concrete pipes and holding tanks). This cost turns out to be a difficult number to ascertain and is not known by the Sacramento Stormwater Management Program. It is known, however, that the city's annual budget for water treatment in fiscal year 2008 was \$37.8 million. Thus, by knowing the amount of rainfall the city receives, it is possible to make an estimate about the cost of treatment. This came out to be \$0.0204 (2.0 cents) per cubic foot.

By plugging these rainfall, parkland, imperviousness, and treatment cost factors into the formula, we obtain an annual Park Stormwater Retention Value of \$842,000 for Sacramento. (For details, see Calculator 2.)

It should be noted that there is another possible methodology for determining stormwater savings due to parkland. Instead of looking at annual rainfall and the annual operating costs for the system, we could look at the one-time capital costs associated with constructing the system to handle single large storms. This may be more relevant considering that the U.S. Environmental Protection Agency is tightening its regulations and requiring more construction for clean water. The Center for City Park Excellence is presently analyzing this different approach.

3. Hedonic (Property) Value

More than 30 studies have shown that parks and open space have a positive impact on nearby residential property values. Other things being equal, most people are willing to pay more for a home close to a nice park. Economists call this phenomenon "hedonic value." Hedonic value also comes into play with other amenities such as schools, libraries, police stations, and transit stops. (Theoretically, commercial office space also exhibits the hedonic principle; unfortunately, no study has yet been carried out to quantify it.) The hedonic value of a park, incidentally, is separate from its direct use value; property value increases even if the resident never goes into the park.

Hedonic value is affected primarily by two factors: distance from the park and the quality of the

Cost of Treating Stormwater in Sacramento (per cubic foot)

1	City acreage that is impervious (including impervious parkland)	29,145 acres
2	Average annual rainfall per year	1752 inches
3	Cubic feet of rain per acre	63,598 cu. ft.
4	Cubic feet of rain falling on impervious city land (line 1 x line 3)	1,853,589,149 cu. ft.
5	Annual expenditure on water treatment	\$37,836,000
6	Cost-of-treatment per cubic-foot (line 5 ÷ line 4)	\$0.0204

park itself. It has been found that proximate value ("nearby-ness") can be measured up to 2,000 feet from a large park. Most of the value, however—whether the park is large or small—is within the first 500 feet, and in the interest of being conservative we have limited our valuation to this distance. It has also been found that people's desire to live near a park depends on the characteristics of the park. Beautiful natural resource parks with great trees, trails, meadows, and gardens are markedly valuable. Parks with excellent recreational facilities are also desirable (although sometimes the greatest hedonic value is a block or two from the park rather than directly adjoining it, depending on issues of noise, lights, and parking). However, less attractive or poorly maintained parks are only marginally valuable. Parks with dangerous or frightening aspects, such as unsafe equipment or a high crime rate, can also reduce nearby property values.

Determining an accurate park-by-park, house-by-house hedonic value for a city is technically feasible but prohibitively time-consuming and costly. It is thus necessary to make an extrapolation from previous studies, plugging average historic national hedonic values into the specific housing and park situation of the city under study. But this has a problem, too. Although sales data are available, only a small percentage of dwellings sell in any given year. In order to be comprehensive we must rely on assessment data. But assessments, unlike sales prices, focus on items like bedrooms, bathrooms, structure age, and size but ignore hedonic value. Also, because of the effect of the Proposition 13 tax limitation law³ in California, assessments in Sacramento are extremely variable and sometimes widely diverge from sales prices. Thus an extrap-

lative methodology was formulated to arrive at a reasonable estimate.

Using computerized mapping technology known as GIS, we identified all residential properties within 500 feet of every significant park in Sacramento. ("Significant" was defined as one acre or more; "park" included every park in the city, even those owned by a county, state, federal, or other agency.) According to records of the Sacramento County Assessors Office, there are about 124,000 residential properties (dwelling units) in the city of Sacramento. Using GIS, we determined that there are 28,517 (or 23 percent of the total) dwelling units within 500 feet of a park in the city; these dwelling units have a combined assessed value of \$1,438,394,000.

Unfortunately, because of data and methodology problems, it has not been possible thus far to determine which of Sacramento's parks are "strongly positive," "slightly positive," and "negative"—i.e., adding significant value or slight value or subtracting value to surrounding residences. We are continuing this line of research, but thus far—despite interviews with park professionals, park users, realtors, and assessors as well as an extensive analysis of crime data—we have not been able to make justifiable judgments on park quality. While new methodologies are being tested, we have chosen to assign the conservative value of 5 percent as the across-the-board amount that parkland adds to the assessed value of all dwellings within 500 feet of parks. (This number is an average of the high [15 percent], medium [5 percent], and low [-5 percent] values that will be used when park quality can be established.) The result for 2006 was \$71.9 million in value due to park proximity.

We then used the residential property tax rate

³ Proposition 13 is an amendment to the state constitution passed in 1978 to roll back property assessments to their 1976 values (the "base year value") and limit property tax increases to 1 percent of their assessed value. Proposition 13 also limits property valuation to 2 percent per year unless the property was sold.

to determine how much extra tax revenue was raised by the city of Sacramento based on the extra property value due to parks. With a tax rate (sometimes referred to as a “millage”) of \$0.58 per \$100 in assessed value, the result of the Property Value Calculator for the city of Sacramento is \$417,134. (For computations, see Calculator 3; for details, see technical methodology sheets.)

It is also important to recognize that, while the tax millage brings in actual dollars to the city, the overall increased value of the near-park properties is a different kind of “real” number. Thus, because of parks, there is an increase in aggregate “property wealth” of Sacramentans of \$71.9 million. If it is assumed that approximately 10 percent of Sacramentans sell their dwellings every year, then the proximate park value realized at the time of sale is \$7.2 million.

To restate: the direct municipal tax value is of direct benefit to the city government; the park effect property value benefits a large number of individual Sacramento residents.

[Note: It is worth emphasizing that this hedonic estimate is conservative for three reasons. First, it does not include the effects of small parks (under an acre) although it is known that even minor green spaces have a hedonic effect. Second, it leaves out all the hedonic value of dwellings located between 500 feet and 2,000 feet from a park. Third, it does not include the potentially very significant hedonic value for commercial offices located near downtown parks.]

4. Direct Use Value

While city parks provide much indirect value, they also provide more tangible value through such activities as team sports, bicycling, skateboarding, walking, picnicking, bench sitting, and community gardening. Economists call these activities “direct uses.”

Most direct uses in city parks are free of charge, but economists can still calculate value by determining the consumer’s “willingness to pay” for the recreation experience in the private marketplace. In other words, if parks were not available in Sacramento, how much would the resident (or “consumer”) pay for similar experiences in commercial facilities or venues? Thus, rather than income, the direct use value represents the amount of money residents save by not having to pay market rates to indulge in the many park activities they enjoy.

The model used to quantify the benefits received by direct users is based on the “Unit Day Value” method as documented in Water Resources Council procedures (1979) and by the U.S. Army Corps of Engineers planning manual (2004). The Unit Day Value model counts park visits by specific activity, with each activity assigned a dollar value. For example, playing in a playground is worth \$3.50 each time to each user. Running, walking, or in-line skating on a park trail is worth \$4.00, as is playing a game of tennis on a city court. For activities for



Clunie Pool, McKinley Park

which a fee is charged, like golf or ice skating, only the "extra value" (if any) is assigned; i.e., if a round of golf costs \$30 on a public course and \$65 on a private course, the direct use value of the public course would be the difference: \$35. Under the theory that the second and third repetitions of a park use in a given period are slightly less valuable than the first use (i.e., the value to a child of visiting a playground the seventh time in a week is somewhat lower than the first), we further modified this model by building in an estimated sliding scale of diminishing returns for heavy park users. Thus, for example, playground value diminished from \$3.50 for the first time to \$1.93 for the seventh time in a week.

The number of park visits and the activities engaged in were determined by a telephone survey of residents (with an accuracy level of plus-or-minus 4 percent). Residents were asked to answer for themselves; for those adults with children under the age of 18, a representative proportion was also asked to respond for one of their children. (Nonresidents were not counted in this calculation; the value to the city of nonresident uses of parks is measured by the income to local residents from what these visitors spend on their trips. This is covered under income from out-of-town visitor spending.)

The result of the Direct Use Calculator for Sacramento for the year 2007 is \$345,597,000. (For computations, see Calculator 4.)

While it can be claimed that this very large number is not as "real" as the numbers for tax or tourism revenue, it nevertheless has true meaning. Certainly, not all these park activities might take place if they had to be purchased. On the other hand, Sacramentans truly are getting pleasure and satisfaction—all \$350 million worth—from their use of the parks. If they had to pay and if they consequently reduced some of this use, they would be materially "poorer" from not doing some of the things they enjoy.

5. Helping to Promote Human Health

Several studies have documented the large economic burden related to physical inactivity. Lack of exercise is shown to contribute to obesity and its many effects, and experts call for a more active lifestyle. Recent research suggests that access to parks can help people increase their level of physical activity. The Parks Health Benefits Calculator measures the collective economic savings realized by city residents because of their use of parks for exercise.

The calculator was created by identifying the common types of medical problems that are inversely related to physical activity, such as heart disease and diabetes. Based on studies that have been carried out in seven different states, a value of \$250 was assigned as the cost difference between those who exercise regularly and those who don't. For persons over the age of 65, that value was doubled to \$500 because seniors typically incur two or more times the medical care costs of younger adults.

The key data input for determining medical cost savings is the number of park users indulging in a sufficient amount of physical activity to make a difference. This is defined as "at least 30 minutes of moderate to vigorous activity at least three days per week." To determine this, we conducted telephone park use surveys of activities and of their frequency, dividing respondents by age. This telephone survey—the same one carried out for direct use data (above)—had an accuracy rate of plus-or-minus 4 percent. In order to modify the results to serve the health benefits study, low-heart-rate uses such as picnicking, sitting, strolling, and bird-watching were eliminated. Also, all respondents who engaged in strenuous activities less than three times per week were dropped. Based on the survey and the computations, we found that about 78,000 Sacramentans engage actively enough in parks to improve their health—72,000 of them being under the age of 65 and about 6,000 of them above 65. The calculator makes one final computation, applying a small multiplier to reflect the differences in medical care costs between the State of California and the United States as a whole.

The health savings from park use for the residents of Sacramento for the year 2007 is \$19,872,000. (For computations, see Calculator 5.)

6. Income from Out-of-Town Park Visitor Spending (Tourists)

The amenities that encourage out-of-towners to visit a city include such features as cultural facilities, heritage places, arenas, and parks as well as special events that take place there, like festivals and sports contests. Though not always appreciated, parks play a major role in Sacramento's tourism economy.

To know the contribution of parks to the tourism economy requires knowledge of tourists' activities, the number of park visitors, and their spending. Unfortunately, there is a severe shortage of data on park visitation and on the place of origin of park visitors. (By definition, local users are not tourists—any spending they do at or near the park is money not spent locally somewhere else, such as in their immediate neighborhoods.)

The principal park agency in Sacramento, the city's Department of Parks and Recreation, has little information on out-of-town visitor activity and spending. We thus sought visitation numbers and expenditures from other sources and then made estimates on the percentage of trips that are entirely or substantially due to parks or a park. Based on data from the Greater Sacramento Convention and Visitors Bureau, we calculated that in 2006 about 5.2 million leisure visitors stayed overnight in the region and that 58 percent of those stayed in the city of Sacramento. Of those, 24 percent visited a park (including Old Sacramento State Park and the State Capitol grounds), yielding a total of about 736,000 overnight tourists who visited a park. Through a similar computation, we determined that about 608,000 day tourists visited a park. (Unfortunately, there are no data on business travel to Sacramento.) Knowing the average spending level of those tourists and making an estimate that one-fifth of all park visitors come to Sacramento *because* of a park, we determined that total park-derived tourist spending came to \$26.1 million. (This conservative methodology assures that we did not count the many tourists who came to Sacramento for other reasons and happened to visit a park without planning a visit.) With an average tax rate on all tourist expenditures of approximately 8.25 percent,⁴ tax revenue to the

city from park-based tourism is \$2,156,000. (For computations, refer to Calculator 6.)

In addition, since 35 percent of every tourist dollar is considered "profit" to the local economy, the citizenry's collective increase in wealth from park-based tourism is \$9,225,000.



McKinley Park

7. Stimulating Community Cohesion

Numerous studies have shown that the more human relationship webs a neighborhood has, the stronger, safer, and more successful it is. Any institution that promotes relationship-building—religious institution, club, political campaign, co-op, or school—adds value to a neighborhood and, by extension, to the whole city.

These human webs, for which the term "social capital" was coined by Jane Jacobs, are strengthened in some communities by parks. From playgrounds to sports fields to park benches to chessboards to swimming pools to ice skating rinks

⁴ This averages taxes paid by overnight visitors who stay in hotels with day-trippers who do not. The full sales and transient tax rate is higher than 8.25 percent, but this is the portion that goes to the City of Sacramento rather than to other jurisdictions such as the State of California.

to flower gardens, parks offer opportunities for people of all ages to communicate, compete, interact, learn, and grow. Perhaps more significantly, the acts of improving, renewing, or even saving a park can build extraordinary levels of social capital in a neighborhood that may well be suffering from fear and alienation partially due to the lack of safe public spaces.

While the economic value of social capital cannot be measured directly, it is possible to tally up a crude proxy: the amount of time and money that residents donate to their parks. Sacramento has thousands of park volunteers who do everything from picking up trash and pulling weeds to planting flowers, raising playgrounds, teaching about the environment, educating public officials, and contributing dollars to the cause.

To arrive at the proxy number, all the financial contributions made to park foundations, conservancies, and “friends of parks” organizations in Sacramento were tallied. Also added up were all the hours of volunteer time donated to park organizations; the hours were then multiplied by the value assigned to volunteerism in California—\$20.36 per hour—by the organization Independent Sector.

The result of the Social Capital Calculator for the city of Sacramento in 2006 (the most recent year available) is \$5,525,000. (For computations, see Calculator 7; for details, see technical methodology sheet.)

Conclusion

While reams of urban research have been carried out on the economics of housing, manufacturing, retail, and the arts, until now there has been no comprehensive study of the worth of a city’s park system. The Trust for Public Land believes that answering this question—“How much value does an excellent city park system bring to a city?”—can be profoundly helpful to all the nation’s urban areas. For the first time, parks can be assigned the kind of numerical underpinning long associated with transportation, trade, housing, and other sectors. Urban analysts will be able to obtain a major piece of missing information about how cities work and how parks fit into the equation. Housing proponents and other urban constituencies will potentially be able to find a new ally in city park advocates. And mayors, city councils, and chambers of commerce may uncover the solid, numerical motivation to strategically acquire parkland in balance with community development projects.

Determining the economic value of a city park system is a science still in its infancy. Much more research and analysis must be undertaken. But this study, one of the first of its kind ever published, is offered as a mechanism to begin a great conversation about the present and future role of parks within the life—and economy—of Sacramento.



Independence Field
Pannell Meadowview Community Center Park

Appendix 1

The following individuals were extraordinarily helpful in finding and providing data and analysis for the city of Sacramento. We thank them for their assistance.

Jane Adams, *California Parks & Recreation Society*
 Angela Anderson, *Sacramento City Department of Utilities*
 Janet Baker, *Sacramento City Department of Parks & Recreation*
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 Dan Giammona, *Sacramento City Department of Parks & Recreation*
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 Pat Singer, *Sacramento Department of Utilities*
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 Erik Vink, *Sacramento Office, The Trust for Public Land*

Appendix 2

The following individuals took part in the colloquium "How Much Value Does a Park System Bring to a City" in October 2003.

Susan Baird, *Denver Department of Parks & Recreation, Denver, Colo.*
 Kathy Blaha, *The Trust for Public Land, Washington, D.C.*
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 Glenn Brill, *Ernst & Young, New York, N.Y.*
 Valerie Burns, *Boston Natural Areas Network, Boston, Mass.*

Patrice Carroll, *Philadelphia Managing Director's Office, Philadelphia, Pa.*
 Donald Colvin, *Indianapolis Dept of Parks and Recreation, Indianapolis, Ind.*
 Ernest Cook, *The Trust for Public Land, Boston, Mass.*
 John Crompton, *Texas A&M University, College Station, Tex.*
 Dick Dadey, *City Parks Alliance, New York, N.Y.*
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 Jennifer Wolch, *University of Southern California, Los Angeles, Calif.*
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Appendix 3

Resources Related to the Economic Value of Parks

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The Trust for Public Land conserves land for people to enjoy as parks, gardens, and other natural places, ensuring livable communities for generations to come.

The mission of TPL's Center for City Park Excellence is to make cities more successful through the innovative renewal and creation of parks for their social, ecological, and economic benefits to residents and visitors alike.

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Packet of Attachments

**Technical Documents Describing Methodology
for Calculations Used in**

***“How Much Value Does the City of Sacramento
Receive from its Park and Recreation System?”***

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Attachment 1

Methods for Air Pollution Model

Methods and analyses conducted for this program are based on the Urban Forest Effects (UFORE) model developed by Nowak and Crane (2000). For each city, the pollutant flux (F ; in $\text{g m}^{-2} \text{s}^{-1}$) is calculated as the product of the deposition velocity (V_d ; in m s^{-1}) and the pollutant concentration (C ; in g m^{-3}):

$$F = V_d \cdot C$$

Deposition velocity is calculated as the inverse of the sum of the aerodynamic (R_a), quasi-laminar boundary layer (R_b) and canopy (R_c) resistances (Baldocchi et al. 1987):

$$V_d = (R_a + R_b + R_c)^{-1}$$

Hourly meteorological data from local airports were used in estimating R_a and R_b . The aerodynamic resistance is calculated as (Killus et al. 1984):

$$R_a = u(z) \cdot u_*^{-2}$$

where $u(z)$ is the mean windspeed at height z (m s^{-1}) and u_* is the friction velocity (m s^{-1}).

$$u_* = (k \cdot u(z-d)) [\ln((z-d) \cdot z_o^{-1}) - \psi_M((z-d) \cdot L^{-1}) + \psi_M(z_o \cdot L^{-1})]^{-1}$$

where k = von Karman constant, d = displacement height (m), z_o = roughness length (m),

ψ_M = stability function for momentum, and L = Monin-Obuhkov stability length. L was estimated by classifying hourly local meteorological data into stability classes using Turner classes (Panofsky and Dutton 1984) and then estimating L^{-1} as a function of stability class and z_o (Zannetti 1990). When $L < 0$ (unstable) (van Ulden and Holtslag 1985):

$$\psi_M = 2 \ln[0.5(1+X)] + \ln[0.5(1+X^2)] - 2 \tan^{-1}(X) + 0.5\pi$$

where $X = (1 - 28 z L^{-1})^{0.25}$ (Dyer and Bradley 1982). When $L > 0$ (stable conditions):

$$u_* = C_{DN} \cdot u \{0.5 + 0.5[1 - (2u_o / C_{DN}^{1/2} \cdot u)^2]^{1/2}\}$$

where $C_{DN} = k (\ln (z/z_0))^{-1}$; $u_0^2 = (4.7 z g \theta^*) T^{-1}$; $g = 9.81 \text{ m s}^{-2}$; $\theta^* = 0.09 (1 - 0.5 N^2)$; T = air temperature (K°); and N = fraction of opaque cloud cover (Venkatram 1980; EPA 1995). Under stable conditions, u^* was calculated by scaling actual windspeed with a calculated minimum windspeed based on methods given in EPA (1995).

The quasi-laminar boundary-layer resistance was estimated as (Pederson et al. 1995):

$$R_b = 2(Sc)^{\frac{2}{3}}(Pr)^{-\frac{2}{3}}(k \cdot u^*)^{-1}$$

where k = von Karman constant, Sc = Schmidt number, and Pr is the Prandtl number.

In-leaf, hourly tree canopy resistances for O_3 , SO_2 , and NO_2 were calculated based on a modified hybrid of big-leaf and multilayer canopy deposition models (Balducchi et al. 1987; Balducchi 1988). Canopy resistance (R_c) has three components: stomatal resistance (r_s), mesophyll resistance (r_m), and cuticular resistance (r_t), such that:

$$1/R_c = 1/(r_s + r_m) + 1/r_t$$

Mesophyll resistance was set to zero $s \text{ m}^{-1}$ for SO_2 (Wesely 1989) and 10 s m^{-1} for O_3 (Hosker and Lindberg 1982). Mesophyll resistance was set to 100 s m^{-1} for NO_2 to account for the difference between transport of water and NO_2 in the leaf interior, and to bring the computed deposition velocities in the range typically exhibited for NO_2 (Lovett 1994). Base cuticular resistances were set at $8,000 \text{ m s}^{-1}$ for SO_2 , $10,000 \text{ m s}^{-1}$ for O_3 , and $20,000 \text{ m s}^{-1}$ for NO_2 to account for the typical variation in r_t exhibited among the pollutants (Lovett 1994).

Hourly inputs to calculate canopy resistance are photosynthetic active radiation (PAR; $\mu E \text{ m}^{-2} \text{ s}^{-1}$), air temperature (K°), windspeed (m s^{-1}), u^* (m s^{-1}), CO_2 concentration (set to 360 ppm), and absolute humidity (kg m^{-3}). Air temperature, windspeed, u^* , and absolute humidity are measured directly, or calculated, from measured hourly NCDC (National Climatic Data Center) meteorological data. Total solar radiation is calculated based on the METSTAT model with inputs from the NCDC data set (Maxwell 1994). PAR is calculated as 46 percent of total solar radiation input (Monteith and Unsworth 1990).

As CO and removal of particulate matter by vegetation are not directly related to transpiration, R_c for CO was set to a constant for in-leaf season ($50,000 \text{ s m}^{-1}$) and leaf-off season ($1,000,000 \text{ s m}^{-1}$) based on data from Bidwell and Fraser (1972). For particles, the median deposition velocity from the literature (Lovett 1994) was 0.0128 m s^{-1} for the in-leaf season. Base particle V_d was set to 0.064 based on a LAI of 6 and a 50-percent resuspension rate of particles back to the atmosphere (Zinke 1967). The base V_d was adjusted according to in-leaf vs. leaf-off season parameters.

Each city was assumed to have a tree/shrub leaf area index within the canopy covered area of 6 and to be 10% evergreen (Nowak, 1994). Regional leaf-on and leaf-off dates were used to account for seasonal leaf area variation. Particle collection and gaseous deposition on deciduous trees in winter assumed a surface-area index for bark of 1.7 (m^2 of bark per m^2 of ground surface covered by the tree crown) (Whittaker and Woodwell 1967). To limit deposition estimates to periods of dry deposition, deposition velocities were set to zero during periods of precipitation.

Hourly pollution concentration data (1994) from each city were obtained from the U.S. Environmental Protection Agency (EPA). Hourly ppm values were converted to $\mu\text{g m}^{-3}$ based on measured atmospheric temperature and pressure (Seinfeld 1986). Missing hourly meteorological or pollution-concentration data are estimated using the monthly average for the specific hour. In some locations, an entire month of pollution-concentration data may be missing and are estimated based on interpolations from existing data. For example, O_3 concentrations may not be measured during winter months and existing O_3 concentration data are extrapolated to missing months based on the average national O_3 concentration monthly pattern. For some cities local pollution data were not available for some pollutants, so data from other regional monitors were used [Table 1].

Total pollutant flux (g m^{-2} of tree canopy coverage per year) is multiplied by tree-canopy coverage (m^2) (supplied by the model user) to estimate total pollutant removal by trees in the study area. The monetary value of pollution removal by trees is estimated using the median externality values for the United States for each pollutant. These values, in dollars per metric ton (t) are: $\text{NO}_2 = \$6,752 \text{ t}^{-1}$, $\text{PM}_{10} = \$4,508 \text{ t}^{-1}$, $\text{SO}_2 = \$1,653 \text{ t}^{-1}$, and $\text{CO} = \$959 \text{ t}^{-1}$ (Murray et al. 1994). Externality values for O_3 were set to equal the value for NO_2 .

Table 1. Location and Type of Surrogate Monitors Used for Cities with Missing Pollution Monitors

<i>City Name</i>	<i>Surrogate Monitor</i>	<i>Pollutants</i>
Albany, NY	Buffalo, NY	NO ₂
Albuquerque, NM	El Paso, NM	SO ₂
Chico, CA	Sacramento, CA	SO ₂
Columbus, OH	Cincinnati, OH	SO ₂
Fresno, CA	San Diego	SO ₂
Omaha, NE	Kansas City, MO	NO ₂
Pasadena, CA	Los Angeles, CA	O ₃ , PM ₁₀ , SO ₂
Santa Maria, CA	San Jose, CA	CO, NO ₂ , SO ₂
Seattle, WA	Portland, OR	NO ₂
South Lake Tahoe, CA	Sacramento, CA	SO ₂
Visalia, CA	Fresno, CA	SO ₂

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Attachment 2

Technical description of the Storm Runoff Reduction Model

By Qingfu Xiao, Department of Land, Air, and Water Resources, University of California, Davis and E. Gregory McPherson, Center for Urban Forest Research, USDA Forest Service, Pacific Southwest Research Station

INTRODUCTION

This model is based on research that led to development of two models: the Small Watersheds Model TR55 (United States Dept. of Agriculture, 1986) and the Single Tree Rainfall Interception Model (Xiao et al., 1998; Xiao et al., 2000a). Parks alter surface runoff because of their effects on land cover and interception. Large pervious surface areas in parks allow surface water to infiltrate and recharge the ground water. Also, vegetation in parks provides considerable surface area that temporally intercepts and stores rainwater, allowing some to evaporate before it becomes overland flow. Although the effects of different land cover types on runoff have been well documented in the literature (Moglen and Beighley, 2002), the effects of tree canopy and other park vegetation have not been considered to the same degree. For example, the runoff curve number used in TR-55 only considers grass cover for open space (e.g., park) (United States Dept. of Agriculture, 1986). Existing vegetation (e.g., trees and shrubs cover) in a park can intercept considerable rainwater (Xiao et al., 2000b). Most of the intercepted rainwater will never reach the ground surface and produce surface runoff. Research reported that rainfall interception may exceed 59% for old growth forests (Baldwin, 1938). Urban green spaces function like mini-reservoirs that create additional storage for rainwater. Trees/shrubs directly reduce the amount of precipitation that reaches the ground surface, while grasses and ground covers provide foliar and woody surfaces to which water adheres.

We assume that the problem domain is a park in small urban watershed and the goal is to quantify the runoff reduction for a typical hydrological year attributed to the park's existing park green space (i.e. trees, shrubs, grass, and other vegetation). The park's runoff reduction is calculated from baseline runoff for a hypothetical site with the same land area as the park, but with land cover that is typical of surrounding development. We adjust the baseline site's surface permeability index (the ratio of the total pervious surface area to the total study area) based on the mix of surrounding land use to create the baseline. The model requires basic site information (i.e., location, area, land cover, and vegetation cover) provided by the user. The total amount of storm runoff and the amount and value of runoff reduction due to the existing park or proposed green space are shown in the spreadsheet template. The model was designed for Washington, D.C. and Boston, MA but can be adopted for use in other geographic regions.

METHODS

Storm Runoff

Urbanization covers large natural pervious areas with impervious areas and causes large volumes of excess storm water runoff because of reduced surface detention storage and infiltration. The excess runoff causes flooding, water pollution, and groundwater recharge deficits. The important hydrologic role of parks in the urban landscape has been well described but not quantified in detail. Parks reduce runoff in three ways. The large pervious surfaces provide pathways for surface water infiltrate and recharge groundwater. Vegetation (trees, shrubs, and grasses) in the parks intercepts rainfall, thus reducing net precipitation. Vegetation in the park increases landscape surface roughness that reduces surface runoff flow rate.

TR-55, developed by the Soil Conservation Service's (SCS), has been widely used for calculating storm runoff of small watersheds. Precipitation, soil, and surface cover are considered to determine the amount of runoff from a given storm. This method is based on a dimensionless hydrograph and is widely used to estimate runoff for small watersheds. Assuming the impervious covers in the park are unconnected directly to the drainage system, the TR-55 assumes a relationship exists between accumulated total precipitation (P), direct runoff (Q), and infiltration occurring after runoff begins (F), as well as an initial abstraction I_a :

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \quad (1)$$

where S is potential abstraction which is related to runoff curve numbers CNs by $CN = 1000 / (S + 10)$. I_a can be estimated as $0.2S$. Substituting $0.2S$ for I_a into equation (1) gives:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \quad (2)$$

In urban watersheds, land use, soil, and land cover type have the most influence on the CN. Parameters used for calculating runoff are discussed in detail in following sections.

Precipitation (P)

The amount of precipitation for a given storm event can be obtained from local (county or city) hydrologic manuals or from the *Precipitation-frequency atlas of the United States* (Hershfield, 1963; Miller et al., 1973). Research indicates that once a tree crown is saturated it provides little additional storage (Xiao et al., 2000a). Typically, saturation occurs after the first 1-2 inches of rainfall have fallen. This model estimates annual runoff reduction with hourly annual precipitation from each study city (Xiao et al., 1998). The annual typical weather year was determined based on historical precipitation and air temperature for each city (Xiao and McPherson, 2002). The typical weather year for Washington D.C. was 2004, when annual precipitation totaled 45 inches (1,154.4 mm) compared to the historical average of 43 inches (1088.4 mm). The year 2003 was selected as the typical weather year for Boston, when annual precipitation totaled 44 inches (1,035.8 mm). Precipitation data were preprocessed to isolate individual storm events, defined as followed by at least 24 hours without precipitation (Xiao et al., 1998). The amount of precipitation was recorded for each event. Storm events were designated to occur either during the leaf-on period (from March 15 to November 15) or the leaf-off season. In conjunction with the Forest Service's development of i-Tree (see www.iTreertools.org), we are in the process of developing similar rainfall data for reference cities

in 19 U.S. climate zones (Table 1, Figure 1).

Table 1. Climate Zones of the United States

Climate Zone	CITY	STATE
Northern Mtn & Prairie	Bismarck	North Dakota
Pacific Northwest	Portland	Oregon
Upper Midwest /New England	Minneapolis	Minnesota
New England	Portland	Maine
Temperate Interior West	Boise	Idaho
Midwest	Chicago	Illinois
Interior West	Salt Lake City	Utah
Northeast	New York	New York
Northern California	Sacramento	California
Lower Midwest	Wichita	Kansas
South Central	Memphis	Tennessee
Subtropical	Santa Monica	California
Lower South	Atlanta	Georgia
Southwest Desert	Phoenix	Arizona
Gulf Coast	Houston	Texas
Central Florida	Orlando	Florida
Tropical	Miami	Florida

Potential Retention Storage (S)

Potential retention storage S is related to the soil and cover condition of the watershed through the CN. The factors that mainly influence the CN are soil type, land cover type, hydrologic condition, and antecedent runoff condition.

The CN numbers are affected by both soil and land use type. Soils are classified into four different hydrologic soil groups to indicate the minimum rate of infiltration (Table 2). Soil names are from the USDA soil texture classification. Users input the percentage of the park area that is occupied by each soil group. Most park managers know what types of soils occur in their parks. However, the specific type of soil information is frequently available from soil maps and experts at the local Natural Resource Conservation Service.

Table 2. Hydrologic Soil Group

Soil Group	Soil textures
A	Sand, loamy sand, sandy loam
B	Silt loam, loam
C	Sandy clay loam
D	Clay loam, silt clay loam, sandy clay, silty clay, clay

Land Cover Type and Coverage

Land cover types are often classified as pervious (e.g., lawn, bare soil, unpaved road, unpaved sports area), impervious (e.g., paved parking lots, roads, paved sports area, building roofs), and water. For modeling purposes, park managers must determine the percentage of each land cover type as listed in Table 3. Land cover (LC) type estimates can be taken from aerial photographs using methods described by Miller and others (Miller et al., 1973).

Table 3. Land cover

Land cover type	Area (acre)
Pervious surface	LC_p
Impervious surface	LC_{ip}
Water	LC_w

Runoff CN Number

Table 4 lists runoff CN numbers used in the model for different land cover types and soil groups assuming average antecedent runoff conditions. The impervious surfaces were assumed to not be connected to the drainage system.

Table 4. Runoff curve numbers for urban areas

Land cover	Curve numbers for Hydrologic soil group			
	A	B	C	D
Pervious surface	39	61	74	80
Impervious surface	98	98	98	98
Water	100	100	100	100

The composite CN number of the study area is calculated based on a weighted average by area.

$$CN = \frac{LC_p \times CN_p + LC_{ip} \times CN_{ip} + LC_w \times CN_w}{LC_p + LC_{ip} + LC_w} \quad (3)$$

where CN_p , CN_{ip} , and CN_w are the CN number of the specific land cover (LC) type with its specific hydrologic soil group. The subscript p, ip, and w stand for pervious surface, impervious surfaces, and water bodies, respectively.

Base runoff

We evaluate the amount of runoff reduction associated with the park by subtracting from the amount of base runoff for the same small watershed with a permeability index typical of surrounding development. Thus, the base runoff Q_0 is the surface runoff of the same-sized small watershed as the park, but with lower permeability due to more intense development. It can be calculated by

$$Q_0 = \frac{(P - 0.2S_0)^2}{P + 0.8S_0} \quad (4)$$

The total impervious area for calculating base runoff was 51% for Washington D.C. based on an analysis of the city's land cover data (Personal communication, Peter Harnik, Trust for Public Land, 660 Pennsylvania Ave., S.E. Washington, D.C. 20003). Lacking specific data for Boston, we used the 51% value from Washington D.C. for Boston.

Canopy Rainfall interception

Interception of rainfall by green space cover keeps some rainfall from reaching the ground surface. Some raindrops pass through gaps in the tree/shrub canopy, reaching the ground as throughfall. Other raindrops are intercepted by the canopy surface and temporarily stored on leaves, branches, and stems surfaces. Part of this stored water flows down the trunk to the ground, some drips off the leaves and stems to the ground, and the rest evaporates to atmosphere. Water that evaporates is called interception loss or interception.

The canopy surface water storage (C) changes with time (t) and is described as

$$\frac{dC}{dt} = p - th - d - e \quad (5)$$

where p is rainfall rate, th is free throughfall, d is the drip from canopy, and e is evaporation from the wetted canopy surface or interception.

For a given storm event, once tree/shrub surfaces are saturated, the surface storage reaches dynamic equilibrium. Thus dC/dt in equation (5) approaches zero. The tree/shrub surface storage C_{tree} can be calculated from:

$$C_{tree} = SA \times S_c \quad (6)$$

where SA is the tree/shrub surface area, and S_c is surface water storage capacity. S_c varies with species and season. We assume a value of 0.0394 in. (1.0 mm) based on previous studies (Keim et al., 2005; Xiao et al., 2000a).

Converting the total vegetation interception to depth and subtract from gross precipitation yields net precipitation.

Vegetation Surface Area (SA)

We consider tree/shrub and grass surface areas differently. Tree/shrub surface area accounts for both leaf and stem surface areas. There are two ways to determine the total surface area (SA). Mathematically speaking, if we know the crown diameter D of each tree and its LAI (leaf area index) and SAI (stem surface index), the SA can be accurately calculated as

$$SA = \sum \pi \left(\frac{D}{2}\right)^2 \times (LAI + SAI) \quad (7)$$

This calculation will yield an accurate estimate of canopy surface area. However, specific information on species, crown diameter, LAI, and SAI for each tree is needed.

An alternative method uses tree vegetation coverage (CP). We assume that the park manager can provide information on the distribution of tree/shrub canopy cover by vegetation type as listed in Table 5. Open grown cover is distinguished from forest cover because of a different structure that influences rainfall interception. Forest cover has a richer understory than open grown tree/shrub cover, resulting in higher interception rates. Open grown cover is often actively managed turf areas with interspersed trees and shrubs, resembling a savanna landscape. Forest cover includes relict forests and other natural areas that are extensively managed. Vegetation cover data can be obtained from existing inventories, field sampling, or aerial photo interpretation.

Table 5. Vegetation Coverage

Vegetation type	Cover (acre)	
	Open grown	Forest
Broadleaf deciduous	(a)	(af)
Broadleaf evergreen	(b)	(bf)
Conifer	(c)	(cf)
Palm	(d)	(df)
Shrub	(e)	(ef)
Grass	(f)	(ff)
Total	(a+b+c+d+e+f+af+bf+cf+df+ef+ff)	

Table 6. Average leaf area indexes by tree type

Type	Open grown		Forest	
	LAI (leaf on)	LAI (leaf off)	LAI (leaf on)	LAI (leaf off)
Brdleaf Decid.	4.49	0.00	4.97	0.00
Brdleaf Evrgrn.	4.56	4.56	4.56	4.56
Conifer	5.10	5.10	6.82	6.82
Palm	2.58	2.58	2.58	2.58
Shrub	2.51	2.47	2.51	2.47

The average LAI by tree type are listed in Table 6. LAIs for open grown trees were calculated as mean values by tree type (e.g., deciduous, conifer) from 22 species of street trees

measured in Charlotte, NC (E. G. McPherson et al., 2005). LAI values were estimated using a digital photo processing method developed for isolated trees (Peper et al., 2001a; Peper et al., 2001b). SAI is assumed to be 1.7 for all tree/shrub types (Whittaker and Woodwell, 1967). For forest trees, LAIs were based on the available literature (Duursma et al., 2003; Franklin et al., 1997; Parker et al., 2004; Pu et al., 2003).

Turf grass and other ground cover, such as native wild grasses, and herbaceous perennials intercept rainfall and reduce runoff. Interception by grass and other ground covers is calculated using the same methods used for tree/shrub cover, except we assume a LAI of 4.9 (Madison, 1974) that remains constant through the seasons. The total surface grass and other ground cover's surface area is

$$SA_g = LC_g \times LAI_g \quad (8)$$

here LAI_g is the grass's LAI.

The total surface area of each vegetation type is the product of the sum LAI and SAI and their coverage area. It is calculated by

$$SA_{tree} = \sum (LC_x \times (LAI_x + SAI_x)) \quad (9)$$

where the subscript x indicates each different vegetation type.

The total surface area of the open grown vegetation is the summation of all surface areas of all vegetation types (e.g., SA_g+SA_{tree}). A similar calculation yields the total surface area for forest vegetation.

Calculation of Total Runoff and Runoff Reduction

Using equation (2), we have the total amount of runoff off the small watershed without a park (Q_{base}) and with a park (Q_{park}).

$$Q_{base} = \frac{(P_{base} - 0.2S_{base})^2}{P_{base} + 0.8S_{base}} \quad (10)$$

$$Q_{park} = \frac{(P_{park} - 0.2S_{park})^2}{P_{park} + 0.8S_{park}}$$

where the subscript base and park represents the base condition (e.g., no park) and current condition (e.g., with park).

S_{base} and S_{park} are linked to CN numbers that are dominated by soil and land cover conditions. We assumed that the soil was unchanged in both cases. The main factor affecting CN is land cover change associated more intensive development for the baseline.

For existing vegetation in the park, we treat rainfall interception as a reduction of net precipitation rather than a change in S. The P_{park} is calculated as

$$P_{park} = P_{base} - P_{int} \quad (11)$$

where P_{int} is the total depth of water intercepted by vegetation in the small watershed.

The annual runoff is calculated with equation (10) by summing runoff from each individual storm event. The storm event is determined use hourly precipitation data, thus the foliage period of each type of vegetation is taken into account.

Results are presented in units of depth (inches) and volume (cubic feet).

Runoff reduction

The runoff reduction QR by the existing park is estimated as

$$QR = \sum Q_{base} - \sum Q_{park} \quad (12)$$

The percentage reduction is calculated as

$$QR = \left(1 - \frac{\sum Q_{park}}{\sum Q_{base}}\right) \times 100 \quad (13)$$

Monetized Value of Storm Runoff Reduction Benefits

The social and environmental benefits that result from reduced runoff include reduced property damage from flooding and reduced loss of soil and habitat due to erosion and sediment flow. Reduced runoff also results in improved water quality in streams, lakes, and rivers. This translates into improved aquatic habitats, less human disease and illness due to contact with contaminated water, and reduced water treatment costs. Calculating the value of these benefits is difficult because ambient water quality and flood risk conditions vary considerably place to place. As these conditions vary, so should the relative benefit associated with a given amount of runoff reduction.

This model monetizes runoff reduction benefits with data provided by Peter Harnik (Center for City Park Excellence, Trust for Public Land, 660 Pennsylvania Ave., S.E., Washington, D.C. 20003, 202-543-7552, www.tpl.org). The monetized benefit value of \$0.04 per gallon for Washington D.C. was based on projected costs and water savings from the Water and Sewer Authority's 2002 Long-Term Control Plan (Table 7, *DC WASA Long-term Control Plan, 2002*). The benefit value of \$0.0036 per gallon for Boston was based on the annual cost of sewage treatment, where revenue covers the cost of annual debt service plus operating costs for the system (Table 8). This approach assumes that revenue per gallon equals cost per gallon.

Table 7. The Cost of Treating One Gallon of Stormwater in Washington, D.C. (in 2005 dollars)

Capital Construction Cost (assumed life expectancy, 20 years)	\$1,265,000,000	
Capital Cost, annualized (i.e., divided by 20)	\$63,250,000	
Annual O&M	\$13,360,000	
O&M plus Annualized Capital Costs		\$76,610,000
Total Annual Overflow (gallons)	2,490,000,000	
Predicted Reduction in Overflow (95% Reduction) due to Capital Construction (gallons)	2,365,500,000	
Cost per Gallon Reduced (2001 dollars)		\$0.0324
Cost per Gallon (2005 dollars)		\$0.0400

Table 8. Cost of Treating Sewage per Gallon in Boston

Annual Revenue from Sewer Fees, City of Boston	\$128,200,000
Gallons of Sewage Processed per Year	35,817,752,505
Revenue per Gallon Treated	\$0.00358

Avoided costs may not always be the best measure of social benefits, especially if current controls are overly costly or inadequate to control runoff. The costs used here are greater than (Washington D.C.) and less than (Boston) the average cost of about \$0.01 per gallon reported in other research (Maco et al., 2003; McPherson et al., 2002; McPherson et al., 1999a; McPherson and Simpson, 2002; McPherson et al., 2003a; McPherson et al., 2000; McPherson et al., 1999b; McPherson et al., 2004; McPherson et al., 2001; McPherson et al., 2003b; McPherson et al., 2005).

The total dollar benefit (B), total savings due to park runoff reduction, is calculated as

$$B = B_{\text{cost}} \times QR \quad (12)$$

where B_{cost} is the cost of treating one gallon of stormwater.

MODEL LIMITATIONS

The model does not include the spatial effects of topography and land cover types on overland flow, so it is not suitable for engineering purposes. Similarly, it does not account for depression storage that occurs in swales, lakes, wetlands, and other low-lying areas.

During large storm events, such as modeled here, rainfall exceeds the amount required to fill the storage capacity of tree crowns and other vegetation. The interception benefit for flood control is limited to interception loss and delaying the time of peak flow. Trees and other vegetation protect water quality by reducing runoff during less extreme rainfall events. Small storms, for which

vegetation interception is greatest, are responsible for most pollutant washoff. Therefore, urban forests generally produce more benefits through water quality protection than through flood control (Xiao et al., 1998). Because relatively few cities treat runoff or make substantial investments in water quality protection, avoided costs are difficult to quantify. The implied values calculated in this model may not provide a full or completely accurate accounting of water quality protection benefits.

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Attachment 3

ESTIMATING THE IMPACT OF PARKS AND OPEN SPACE ON PROPERTY VALUES AND THE PROPERTY TAX BASE

The Proximate Principle

The premise that parks and open space have a positive impact on proximate property values derives from the observation that people frequently are willing to pay a larger amount of money for a home close to these types of areas, than they are for a comparable home which is not proximate to such an amenity. This observation has been empirically validated in over 30 studies whose results have been reported in the literature. A review of those studies is available elsewhere and can be downloaded from that web site.¹

In effect, this represents a “capitalization” of park and open space land into increased property values for proximate landowners. It adopts the mechanism of market pricing to assess the value of parks. This process of capitalization is termed, “the proximate principle.” Conceptually, it is argued that the competitive market will bid up the value of property just equal to the capitalized value of the benefits that property owners perceive they receive from the presence of the park or open space. Economists refer to this approach as “hedonic pricing.” It is a means of inferring the value of a non-market resource (a park) from the prices of goods actually traded in the market place (surrounding residential properties).

An implication of this proximate principle is that impacted homeowners are likely to pay higher property taxes to government entities. The incremental amount of taxes paid by each property that is attributable to the presence of the park, when aggregated, are likely to substantially enhance the value of the tax base. If related to either the cost of acquisition and development of a park or open space, or to the annual maintenance and operating expenses, the annual increments of proximate value may be sufficient to meet or exceed either of those costs. The principle is illustrated by the hypothetical 50 acre park situated in a suburban community that is shown in Exhibit 1. It is a natural, resource-oriented park with some appealing topography and vegetation. The cost of acquiring and developing it (fencing, trails, supplementary planting, and some landscaping) is \$20,000 an acre, so the total capital cost is \$1 million. The annual debt charges for a 20 year general obligation bond on \$1 million at 5% are approximately \$90,000.

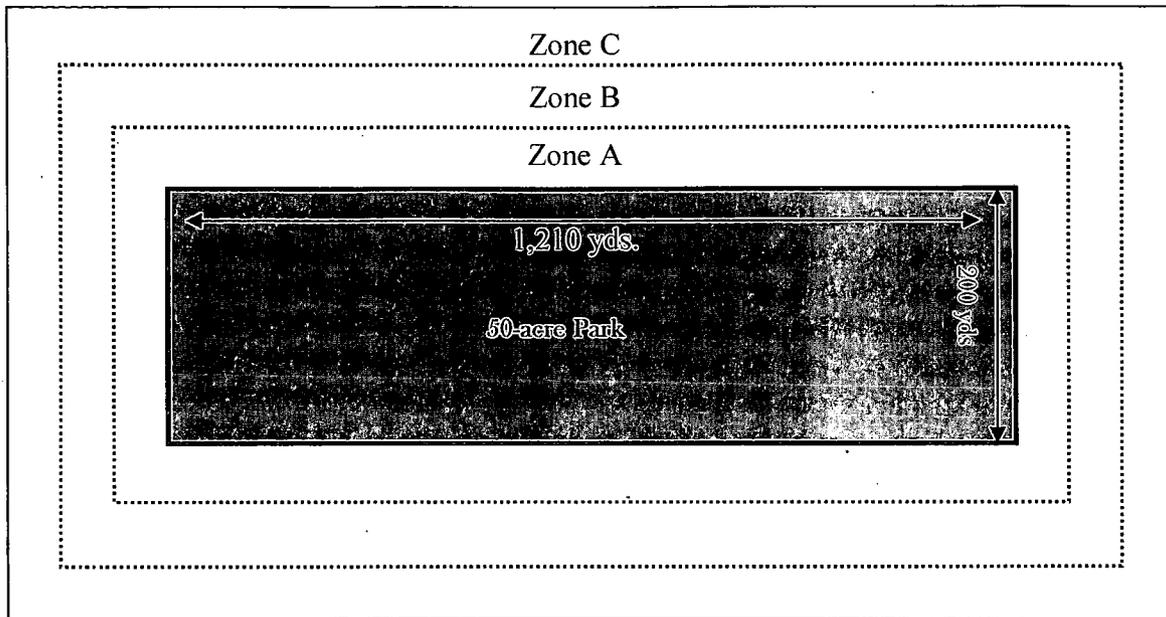


Exhibit 1 Layout of a 50 Acre Natural Park and Proximate Neighborhood Area

A projected annual income stream emanating from the park's impact on proximate properties was calculated using the following assumptions:

1. If properties around the park were 2,000 square foot homes on half-acre lots (40 yards x 60 yards) with 40 yard frontages on the park, then there would be 70 lots in Zone A (30 lots along each of the 1,210 yard perimeters and 5 lots along each of the 200 yard perimeters).
2. Total property taxes payable to city, county, and school district are 2½ of the market value of the property.
3. The market value of similar properties elsewhere in the jurisdiction beyond the proximate influence of this park is \$200,000.
4. The desire to live close to a large natural park creates a willingness to pay a premium of 20% for properties in Zone A; 10% in Zone B; and 5% in Zone C, and that there are also 70 lots in Zones B and C. (The review of empirical studies suggests these values are a reasonable point of departure.¹)

Based on these assumptions, Exhibit 2 shows the annual incremental property tax payments in the three zones from the premiums attributable to the presence of the park amount to **\$94,500**. This is sufficient to pay the \$90,000 debt charges.

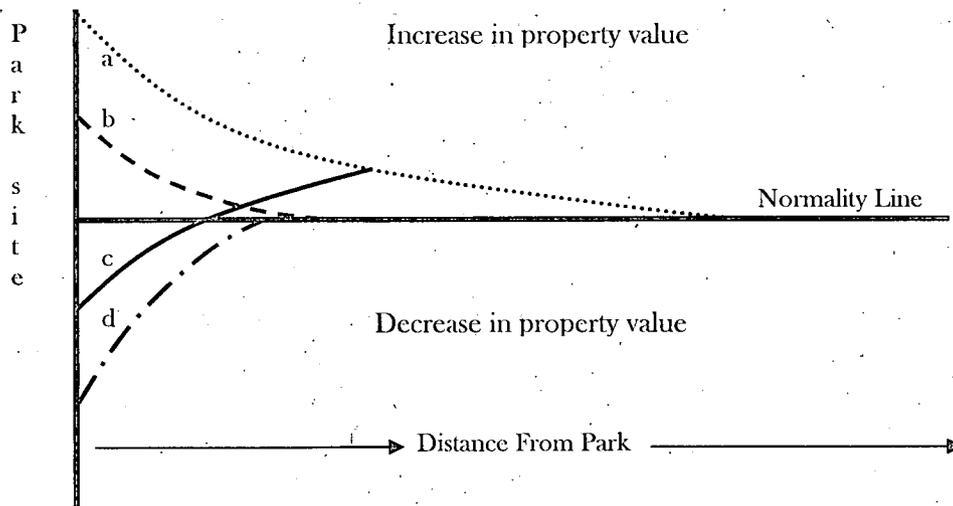
Zone	Market value of each home	Incremental value attributed to the park	Total property taxes at 2½ %	Incremental property taxes attributed to the park	Aggregate amount of property tax increments given 70 home sites
Outside the park's influence	\$200,000	\$0	\$4,000	\$0	\$0
A (15% premium)	\$230,000	\$30,000	\$6,000	\$750	\$52,500
B (8% premium)	\$216,000	\$16,000	\$5,500	\$400	\$28,000
C (4% premium)	\$205,000	\$8,000	\$5,250	\$200	\$14,000
					<u>\$94,500</u>

Exhibit 2 Property Taxes Pay the Annual Debt for Acquisitions and the Development of the Park

Diversity of Proximate Impacts

It is important to recognize that some parks and open spaces are more desirable than others as places to live nearby. Some spaces are flat, sterile green fields; others belong to another era and have not changed in design or intended uses, even though the demographics of proximate populations have changed, so they have become irrelevant; others embrace nuisances such as traffic congestion, noise, litter, vandalism, or ballfield lights intruding into adjacent residences; others are poorly maintained; others are dispirited, blighted, derelict facilities; and others attract undesirable elements who engage in socially unacceptable behavior. It is unlikely that such parks and open spaces will add proximate value. Indeed, it is likely that in some of these cases they would detract from property values.

Exhibit 3 Alternate Scenarios Reflecting the Range of Impacts that Parks and Open Spaces may Exercise on Property Values



Thus, Exhibit 3 shows four alternate scenarios reflecting the range of impacts that parks and open spaces may exercise on proximate property values. In scenarios "a" and "b" value benefit increments are relatively high close to a natural-resource park and diminish gradually with distance from the facility. Scenarios "c" and "d" suggest that any negative values are likely to be limited to properties in close proximity to the park and these will decay more rapidly than positive elements as distance from the park increases- that is, the positive curve is likely to be flatter than the negative curve. In scenario "c" the nuisance effect of traffic congestion, noise, ballfield lights et al. associated with the park dissipate after two blocks and properties in the three to five block range show a positive value.

Challenges in Deriving an Estimate of Proximate Impact

To undertake hedonic studies that calculate the impact of parks and open spaces on property taxes and the property tax base requires considerable skill in computer mapping and the use of statistical techniques, and it is time consuming. It is likely to be impractical for most park agencies to replicate studies of this nature. Nevertheless, many agencies seek a method of applying a valuation to parks that they can adapt for use in their own communities. An approach is offered here for doing this, but it is emphasized that this approach can only offer a rather crude "best guess" because of the difficulty of interpreting the results reported in the empirical studies that have calculated the proximate impact and adapting them to parks in different contexts. There are three challenges in making such adaptations.

The *first* challenge lies in the diversity of areas which are described by the rubric "parks." A park may be a one-tenth acre brick plaza with minimal planting, subjected to the noise and pollution of a large city center, or it may consist of several million acres of mountainous wilderness in Alaska; even within the 50 largest cities in the US, parks that are beloved by their residents range in size from the jewel-like 1.7 acre Post Office Square in Boston to the 16,283 acre South Mountain Preserve in Phoenix.² A park may be designed for recreational use with multiple floodlit athletic facilities, an array of cultural buildings and large paved parking lots, or a tranquil natural resource oasis with no improvements; or it may be a blighted eye-sore, or breathtakingly beautiful spectacle. In short, a park is a nebulous concept that defies standardization. For this reason, it is likely that the proximate impact of selected parks within the same community will be different, and it is unlikely that a selected park in one community will have the same proximate impact of another park in a different context.

A *second* challenge relates to the nature of the results reported in the empirical studies. It is difficult to directly compare these results because they have been ascertained in a variety of manners and have used a number of different measures of value.³ Among the variations are (i) the measure of property value, (ii) the measure of distance, and (iii) the comparison criterion.

Many of the studies, especially those completed before 1980, used assessed valuation rather than sales price as their *measure of property value*. Assessed values are doubtful surrogates for sales price in these kinds of studies because most tax assessors are unlikely to consider park proximity in their valuations. Assessed valuations tend to be rather gross measures that ignore subtleties like the proximate principle. They also tend to be lower than sales price as

tax assessors seek to avoid appeals from house owners challenging their assessments.

To *measure distance* from a property to a park some of the studies used a straight-line from the property to the park, whereas others measured the distance people would have to travel along roads or paths to access the park. This latter street network approach is more accurate and has been more frequently used in recent years since the widespread adoption of GIS mapping has made it easier. The distances over which impact was measured also varied from two or three blocks to half a mile or more.

Premiums associated with the proximate principle were presented in a variety of forms. Some were presented in absolute terms without a *comparison criterion*. For example, the Lee County, Florida, study⁴ reported an average premium across the county of \$6015 for homes within 200 feet of a park compared to a similar home outside the influence of the park's proximity. However, the proportionate magnitude of this premium is unclear because the mean value of homes in the area is not reported. If these were \$75,000 homes then the premium would be 8%, but if they were \$300,000 homes it would be 2%. The absence of an indicator of the proportionate magnitude of the premium makes it impossible to meaningfully transfer these data to other contexts.

The most useful information for transferability purposes is offered by studies such as the Portland (OR) example⁵ where proportionate property premiums are based on comparisons with similar properties outside the proximate impact area. In other cases, for example, the Austin (TX) study⁶, the premiums are based on average home prices within the impacted area which means they are likely to be substantially lower than if the comparison criterion was with like houses outside the impacted area.

A *third* challenge in identifying a premium value that may be transferable to park sites in other communities from the results of the empirical studies may be termed "the aggregation problem." A number of studies, for example, the Leon County⁴ and Portland⁵ articles, reported proximate premiums that were derived by averaging the impact across a large number of parks in a jurisdiction. Thus, in the Portland case, the premiums of \$1,214 and \$10,648 were averages derived from 115 urban parks and 34 natural parks, respectively. It was emphasized in the previous section that there are many situations in which the proximate premium may be negative reflecting the undesirable nature of the open space. When premiums are derived from averages across multiple parks, it is likely that results will be self-canceling to some extent, since the impacts at individual parks may range from high positive to high negative. From a transferability perspective, premiums derived from case studies of individual parks whose attributes are carefully described are more useful than those derived from averages across multiple parks.

The Calculation Parameters

The goal is to develop a relatively simple "plug and chug" formulary approach that can be used to derive an estimate of the proximate premium in a community. *It is assumed that there will be electronic access to the assessed values of property assigned by the tax assessor's office and that the community has a GIS mapping system.* It was noted earlier that market values are preferred to assessed values, but only assessed values are likely to be available. Since assessed values are invariably lower than market values, the resulting estimates should be viewed as "conservative." Without these two tools, estimates of the aggregate value of the proximate premium to the community are unlikely to be financially feasible.

The following parameters are suggested as reasonable points of departure for deriving

these premiums based on the empirical results reported in the literature.¹

Consideration #1. The area of proximate impact of a park should be limited to 500 feet or three blocks. The empirical results suggest this is likely to capture almost all the premium from small neighborhood parks and 75% of the premium from relatively large parks. The remaining 25% is likely to be dissipated over properties between 500 and 2000 feet. Disregarding this will lead to an underestimate of the proximate impact of large parks which may be substantial because while the premiums at these distances are relatively low, the number of properties within these parameters is relatively high. However, adopting this 500 foot parameter substantially simplifies the estimation task.

Consideration #2. Use all the parks in the city of one acre or more. It is not practical to carry out the hedonic analysis for parks of less than an acre in size. It is sufficient to note that the final calculation is conservative because it omits the many tiny park fragments that exist in every city.

Consideration #3. Each park needs to be graded. While it would be ideal to utilize a subtle and sophisticated scale – using such emotional responses as, “An exceptionally attractive, well maintained natural resource-based signature park with genuine ambiance and distinctive landscaping and/or topography, often mentioned in sales advertisements for nearby properties, which engenders a high level of community pride and passionate attachment” or “An unkempt, dirty, noisy park with dilapidated facilities and broken equipment that is rejected and avoided by the community” – it is not feasible to do this under the limitations of time and budget. As a more quantitatively defensible fallback we use comparative crime rates as a measure of park desirability or repulsion. But in order to avoid comparing safer and less safe neighborhoods, the methodology compares park crime against crime in the neighborhood directly surrounding the park.

Specifically, using police department statistics and GIS computerized mapping software, the crime rate for every park (along with a 100-foot buffer around the park) should be ascertained on a crimes-per-acre basis. [The 100-foot buffer corrects for the fact that for administrative purposes most park crimes are assigned a location taken from the address of the nearest dwelling – which is technically outside the park.] Then, using the same statistics, the “base” neighborhood crime rate is determined by measuring crimes per acre in the buffer area from 100 feet to 200 feet around each park.

Next, subtract the “Park Crime” rate from the “Base Crime” rate. This will yield three categories of parks: Parks with a positive value (“good parks”), parks with a zero value (“average parks”) and parks with a negative value (“bad parks”).

Consideration #4. Based on the results reported in the literature,¹ the premiums applied to all dwelling units within the 500 foot proximate area are:

Good parks:	+15%
Average Parks:	+ 5%
Bad parks:	(-)5%

After reviewing the literature,¹ these may appear low to some readers. Several of the most

recent, technically strong studies (for example, Portland,⁵ the Barton neighborhood in Austin,⁶ and the Dallas-Fort Worth metroplex⁷) reported premiums in the 16%-22% range. However, these were for the first block immediately adjacent to the park and the premiums declined for properties in the second and third blocks. The proportionate premiums suggested here are averages to be used for all properties within the 500 foot (three block) radius.

Consideration #4. Any incremental premium associated with utilitarian trails, i.e., trails that are not part of visually appealing park or open space land, would arise from access to the trail rather than from views of the amenity. Results from the limited number of empirical studies available at this point are indeterminate. There is agreement that trails are unlikely to exert a negative impact on proximate values, but at this time there is insufficient evidence to suggest there is a premium positive impact. This may emerge in the future as more studies are reported, but no proximate premium is recommended for them here.

Consideration #5. The technically strong empirical studies undertaken in Portland, Oregon,⁵ and College Station, Texas,³ suggest that the proximate premium associated with a golf course is likely to be around 25%. However, the premium decreases dramatically after one block. The premium is attributable almost exclusively to views and, unlike a park space, homeowners two or three blocks away are unable to use the space unless they play golf so their physical proximity to it has little utility. Thus, for golf courses, it is suggested that the 25% premium be limited to properties that are adjacent to it, i.e., a one block radius.

Steps in Calculating an Estimate of the Impact of Parks on the Property Tax Base

1. Identify all public parks of one acre or more, and grade the quality of each using the methodology described above.
2. Draw a 500 feet buffer around each park.
3. Aggregate the assessed value of all homes within each of the 500-foot buffers, using data from the local tax assessor's office.
4. Apply the percentage premiums suggested above (15%, 5% or (-)5%) to the appropriate group of parks.
5. Aggregate the premiums calculated in step 4. This figure represents an estimate of the overall change in property value attributable to the parks examined.
6. Multiply the aggregated premiums calculated in step 5 by the effective local property tax rates imposed by all taxing entities to estimate the total positive impact of parks on the property tax base.

A template for these calculations is attached.

Note: Values that the Proximate Capitalization Measure Fails to Capture

The aggregated proximate premium that these calculations produce offers only a partial indication of their economic value to a community. There are at least three additional sources of economic value attributable to park and open space amenities which are not captured by this capitalization approach.

First, the capitalization of park and open space value into property prices captures the "private" benefits that accrue to proximate homeowners, but it does not capture the "public" benefits that accrue to those outside the proximate influence from such features as wildlife

habitat, improved water quality, reduced soil erosion, reduced flooding, et al.

Second, there is evidence to suggest that investment in parks affects the comparative advantage of a community in attracting future businesses⁸ and desirable residential relocators such as retirees.⁹ However, the proximate capitalization approach does not capture the secondary economic impacts attributable to park provision that accrue from such sources.

Third, it was noted in point 1 of the Calculation Parameters, that relatively large parks rated positively by the scale in Exhibit 4 are likely to impact property values for distances beyond three blocks, and omission of these premiums may lead to underestimation of proximate impact that could be substantial.

In addition, large parks are likely to have value to populations beyond the radius that cannot be captured by proximate capitalization even if that radius is extended out to 2000 or 3000 feet. This occurs because some users of a large park are likely to come from beyond this radius, e.g. two or three miles distance. The benefits accruing to these users cannot be captured in capitalization calculations.

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Attachment 4

Calculating the Value of Direct Use

By Daniel J. Stynes

Valuing Recreation Use of City Parks

Direct park use values refer to the values to park visitors of the recreation opportunities provided in city parks and open spaces. To be considered a direct use, a person must come to the park to engage in one or more recreation activities. Direct use values do not cover the value of living near a park or simply knowing that a city park exists. Recreation uses range from active uses like hiking, golf or playing sports to more passive uses such as walking, socializing or sitting on a park bench.

Economists generally measure recreation use values in terms of the consumer's willingness to pay for the recreation experience (Loomis and Walsh 1997). The preferred economic measure of value is called "consumer surplus." Consumer surplus represents the net value to the user over and above their travel and other costs of participating. If we add any park admission or use fees paid by the visitor to their consumer surplus, we obtain their total willingness to pay to use the park.

It should be noted that park use values do not measure visitor spending or impacts on the local economy (jobs, income). While significant local economic impacts can result from park visitor spending, the costs of meals, lodging, equipment or souvenirs purchased during a park visit represent the value of these other goods or services rather than the value of the park use itself. Park use values capture just the value of the park experience to park users. In many cases no money is exchanged, so the value is based on what visitors would be willing to pay for the recreation opportunities provided.

Obtaining an economic measure of the value of city park use is difficult. Only some city parks charge admission fees and even when admission or special use fees exist they are often subsidized and do not therefore reflect the full value of the services provided. There is, however, a long history of research to determine recreation values in the absence of market prices.

Three methods were approved by the U.S. Water Resources Council (WRC) in 1979 to estimate recreation use values. Guidelines for applying the methods are published in the Federal Register (WRC 1979) and U.S. Army Corps of Engineers (2000) planning manuals.

- (1) The **travel cost method** uses the fact that visitors living at different distances from a park incur different travel costs to estimate a demand curve for a site. Consumer surplus is calculated as the area under this curve.
- (2) The **contingent valuation method** measures park users willingness to pay for recreation opportunities via direct questions, and
- (3) The **unit day value method** establishes average values per unit of use and applies these to total use to derive a total value for an activity or recreation area. Unit day values are

generally derived based on a combination of professional judgment and empirical studies that have used travel cost or contingent valuation methods.

The travel cost and contingent valuation approaches involve empirical studies of park visitors in specific situations. Unit day methods are commonly used to derive values for a wide range of situations without conducting additional research.

These three valuation methods have been widely applied to outdoor recreation activities outside of metropolitan areas (Rosenberger and Loomis 2001). Recreation valuation studies in urban areas are rare as research on city parks has been limited. There are also technical problems in applying travel cost and contingent valuation methods to city park uses, as the assumptions of these methods are less tenable in urban areas. The unit day value methods are therefore best suited as a general approach for estimating the values of city park use.

The East Bay Regional Park District has applied the unit day value approach to value use of their parks and trails. Per visit values established for the East Bay Regional park system were \$4.50 per visit for most park visits, but ranged from \$1.25 for trail uses to much higher per visit values for special uses such as boating (\$20), golf (\$42), and environmental education programs (\$25). The average value across all park uses in the East Bay study was \$6.52 per park visit and \$1.84 for trail uses. These values include both consumer surplus and admission/use fees.

The Unit Day Value Method for City Park Uses

The unit day value (UDV) method is documented in the Water Resources Council procedures (1979), the U.S. Army Corps of Engineers planning manuals (2004), and Loomis and Walsh's (1997) textbook. The unit day value method establishes an average value per unit of use for different recreation activities and experiences. Total value provided by an individual park or a park system is obtained by multiplying the average value per visit by the number of visits.

Total use value of a park = average value per visit * number of visits

The principal obstacles to applying the method are coming up with good estimates of the two primary inputs: (1) city park use and (2) an average value per unit of use.

Values per unit of use for individual parks and activities will vary depending on duration and frequency of use, the quality of facilities, and available substitutes in the area. Average values for a park system will depend on the mix of programs, activities and facilities and the percentage of use in higher or lower valued activities.

Many popular uses of city parks, such as playground activities, sports participation and passive uses like walking or sitting have not been the subjects of valuation studies. Hundreds of valuation studies have been carried out for activities like fishing, hiking, boating, and picnicking, although almost all of these studies have been conducted in rural settings (Rosenberger and Loomis 2000). Until further

research is conducted, we must therefore rely on some judgment to adapt existing unit day values to city park uses¹. The range of values established by the WRC provides a useful starting point.

Applying the Unit day value approach to City Parks

There are two primary inputs to the valuation procedure: (1) estimates of the amount and types of uses of city parks, and (2) estimates of the average value per unit of use. Variations on the recommended approach entail different ways to estimate these two inputs.

The simplest approach is to multiply an overall average value per visit times a system-wide estimate of the total number of visits. However, it is almost impossible to estimate an overall average value of a park visit without itemizing the number and types of uses included. The value of a short walk in a park or sitting on a park bench will be very different from the value of the use of a city golf course or a visit to the zoo. An average value for a city will depend on the proportion of uses that have higher versus lower per visit values.

We therefore recommend both a simple aggregate method and a more detailed procedure that itemizes the amount of use and value for individual activities or park types. The aggregate approach provides a "ballpark" estimate of the recreation use value of a city park system without requiring extensive data gathering. The aggregate method is recommended in cases where there is limited reliable information about park use and when a quick ballpark estimate is desired.

Cities with established systems for counting particular uses and a high percentage of user fee programs can develop more reliable use and value estimates by taking advantage of their use and fee information. For example, estimates of the number of rounds of golf provided on city courses or entrances to parks with admission fees will usually be more reliable than estimates of the use of neighborhood parks or playgrounds. Existing fees provide at least a minimum value for what users are willing to pay.

Estimating park use

Three common methods for estimating park use are:

- A) Population-based approach
- B) Site specific use counts
- C) Based on physical capacity and occupancy rates

¹ There are several factors that could cause values in urban park settings to be different than rural settings. Factors suggesting that city park values might be higher than corresponding activities in rural areas include the scarcity of open space and outdoor recreation opportunities in urban areas, the greater savings in travel costs when recreating near home, and, in some cases higher capital development and value added services in city parks. On the other hand, a greater variety of potential substitutes, congestion costs and in some cases lower environmental quality would tend to lower values. When use is dominated by a few regular participants, diminishing returns will also tend to lower the average values.

A. The **population-based method** is an aggregate approach that doesn't require use counts for individual parks or facilities. Park use is estimated based on the size of the resident population and estimates of the percentage of residents using the parks and their annual frequency of use. Non-resident use can be included by estimating the percentage of overall park use by non-residents.

$$\text{Resident park use} = \text{Population} * \text{Participation Rate} * \text{Frequency of participation} \quad (1)$$

where,

Population = the size of the resident population (from Census figures)

Participation rate = the percentage of residents who have used city parks at least once during the past 12 months.

Frequency of participation = the annual average number of days of city park use by those who visit a city park at least once during the year.

Participation rates and frequencies of participation can be estimated in household surveys².

Non-resident or tourist use includes all use by people who live outside the city. Tourist use can be estimated as a percentage of overall city park use.

$$\text{Tourist use} = \text{Resident use} * (\text{Percent of all use by tourists} / (1 - \text{Percent by tourists})) \quad (2)$$

B. The **site specific approach** requires counts of visitors to individual facilities. Use estimates are often available for city parks through reservations, registrations, vehicle and entrance counters or based on fees collected. Not all city park use will normally be covered by existing counting systems, but estimates are often available for higher valued and more prominent uses. Once all measured uses are accounted for, uses that are not covered by current use counts can be estimated as a percentage of overall use. Site specific use counts will include both resident and non-resident use.

To obtain an estimate of total park use:

1. Add up all existing use counts being careful not to count the same use twice. All use measures must be converted to a per person basis³.
2. Estimate the percentage of overall park use included in these counts.
3. Total use is given by:

$$\text{Total use} = \text{Measured use} / \text{Percentage of total use that is measured}$$

² If the surveys cover participation in general, the rates must be multiplied by a "market share" to estimate the portion of activity provided by the city park system.

³ For example, parks with vehicle counts must multiply vehicle counts by the average number of people per vehicle. If estimates of park use are based on admission fee collections, divide total revenue by an average per person fee.

Example: If a city park system counts 400,000 visits and estimates that about half of all use is counted, total use is $400,000/.50 = 800,000$ person visits.

C: Based on physical capacity: Use of some facilities can be estimated based on physical capacity and estimated use/occupancy rates. The specific formulas vary depending upon the activity/facility. The general approach can be illustrated for tennis court use.

Example: A city with 50 tennis courts available 100 days of the year has 5,000 potential court use days. If the turnover rate for each court is 5 groups of players per day with an average of 3 players per court and the courts are occupied 50% of the time, then total use can be estimated as:

$$\begin{aligned} \text{Tennis use} &= \text{courts} * \text{days per year} * \text{turnover rate per day} * \text{people at one time} * \text{occupancy rate} \\ &= 50 * 100 * 5 * 3 * .50 = 37,500 \text{ person.days of tennis} \end{aligned}$$

Rates for the number of people at one time, turnover, and occupancy can be determined by observational studies or small surveys. Where reservation systems are used, this information may be readily available.

Depending upon the available data and desired detail and accuracy desired, a combination of methods may be needed in a given situation.

Estimating per unit values

Given the wide range of city park uses and types of parks, deriving an overall average value covering all uses is difficult⁴. Based on the WRC unit day values, a range of \$2 - \$9 per visit is recommended for general park uses and \$10-\$40 for specialized activities⁵. Most recreational uses of city parks and open space fall into the general recreation use category, while specialized facilities such as golf courses and zoos can be classified as specialized uses. In some cases fees charged at private facilities can be used to help set per unit values for comparable publicly provided opportunities⁶.

⁴ An overall average value can be derived using the disaggregate approach by assigning values to distinct types of parks/uses and estimating the amount of use of each type.

⁵ The published ranges for FY2004 are \$3-\$9 for general uses and \$12-\$36 for special uses. The minimum value for city park uses is set at \$2 to accommodate lower values associated with some high frequency, short duration activities, such as daily walks in the park. The range for special uses has been rounded to \$10 to \$40.

⁶ Differences in quality of facilities and the range of services provided should be taken into account in establishing a market price. Estimates of consumer surplus must be added to these prices to obtain a total willingness to pay measure. If ample local opportunities are provided by other recreation providers (the private sector or federal, state and other public providers), the market price may be a reasonable approximation of the per unit value.

Table 1. Recommended Unit Day Values for Uses of City Parks

Type of Use	Minimum	Typical	Maximum
General park use	\$2.00	\$4.00	\$9.00
Special uses	\$10.00	\$20.00	\$40.00

The WRC unit day value system includes a point system for rating facilities and programs in order to establish where along the recommended range of unit day values a particular recreation opportunity falls. Such systems could be developed for the most important city park uses.

The overall average per unit value for a particular community depends on the quality of its park system and the range of facilities and services provided. Six important determinants of quality, willingness to pay, and value are:

- Environmental quality
- Number & quality of facilities/structures
- Quality of visitor experiences (crowding, safety, etc.)
- Value added programming – education, interpretation, instruction, supervision
- Level of maintenance and customer service
- Uniqueness of the opportunities/ Availability of substitutes

The quality of the natural environment, capital improvements, and special programs that add value to visitor experiences determine how much visitors are willing to pay. The quality and costs of substitutes are also important. Values of individual facilities are lower in the presence of many substitutes of similar or higher quality since consumers are not willing to pay more than the cost of the next closest substitute.

Illustrative application of the unit day value approach – Aggregate version

Table 2 illustrates a simple application of the unit day value method for a city park system serving 750,000 residents. Use by local residents is determined using the population-based method. If 60% of residents use the parks at least once per year and park users average 10 days of use per year, total resident use is 4.5 million person days. At an average value of \$4 per use occasion, the city parks provide \$18 million in use value to residents. If non-resident (tourist) use accounts for 10% of overall park use, using equation (2) above, tourist use is estimated at 500,000 visits valued at an additional \$2.0 million. Total direct use value of the park system is \$20 million.

Table 1. City Park Use Value Calculator: Aggregate Version

	Park Use	Value per unit	Total value
General Park Use by Residents			
Target Population Served	750,000		
Percent participating	60%		
<u>Average days of use per year</u>	<u>10</u>		
Total resident use	4,500,000	\$ 4.00	\$18,000,000
Tourist General Use			
Percent of overall use by tourists	10%		
Tourist Use	500,000	\$ 4.00	\$2,000,000
Total park use and value	5,000,000	\$ 4.00	\$20,000,000

The aggregate version of the unit day method is simple in terms of the number of calculations required, but estimating overall park use and an average value per use may be difficult without itemizing individual types of use or types of parks. The calculations for the disaggregate version are basically the same, but are carried out for individual activities or parks, focusing especially on uses for which good counts are available and choosing distinct unit day values for each type of use.

The Disaggregate Version

The first step in the disaggregate version is to divide park uses into a set of categories based on activities or park types. The categories should reflect the kinds of use estimates that are available and differences in value across distinct uses. Lower valued uses and uses for which counts may be relatively unreliable can be grouped together, while uses with good counts can be itemized and valued separately.

For each category of use, the amount of annual use and a per visit value are established. The value to park users for each type of use is the product of these two figures. The overall system-wide value is the sum of the values across each type of use. The activity or park type categories for carrying out this analysis will vary across communities, depending on the types of parks/programs provided in the community and also existing systems of counting uses and/or collecting fees.

Table 3 illustrates the calculations for a typical set of activity categories. This park system provides a total of 1.6 million individual use occasions valued at \$5 each for a total value of \$8.3 million. With the disaggregate approach distinct values can be assigned to each category of use. The overall average value reflects the relative amounts of use of each type and their corresponding unit day values⁷. A spreadsheet is available to carry out these calculations.

Implementing the valuation procedures

Implementation of these procedures for a city park system requires a systematic examination of all park use data. Reliable use estimates should especially be made for the higher valued uses. Uses that are more difficult to measure should be estimated using some combination of the population-based, site-specific and capacity-based methods.

A panel of experts should be convened to develop a set of standard unit day values for the most common city park uses. Per unit values should be developed for a set of categories of activities and/or park types. A point system similar to that proposed by the WRC is recommended to capture differences in quality and value across parks and park systems. An example of a system for selecting unit day values for playground uses is included on the accompanying spreadsheet.

⁷ The average values for the subtotals and grand total (shaded cells in Table 3) are computed by summing the use and value columns within each category and then dividing the total value by the corresponding total amount of use.

Table 3: Park Use Value Estimator –Disaggregate Version by Type of Use/Activity

<u>Facility/Activity</u>	<u>Annual Use</u>	<u>Value unit of use</u>	<u>per Total Value (\$)</u>
<u>General Park Uses</u>	<u>Use (person visits)</u>	<u>Value per person visit</u>	<u>Total Value (\$)</u>
Playgrounds	180,000	\$3.50	\$630,000
Picnic Areas	80,000	\$3.00	\$240,000
Trail uses	200,000	\$4.00	\$800,000
Gardens	3,000	\$3.50	\$10,500
Other Passive uses of parks	500,000	\$2.50	\$1,250,000
General Park Use Subtotal	963,000	\$3.04	\$2,930,500
<u>Outdoor Sports facilities - individual use</u>	<u>Use (person visits)</u>	<u>Value per person visit</u>	<u>Total Value (\$)</u>
Tennis	52,000	\$4.00	\$208,000
Basketball	200,000	\$3.00	\$600,000
...			\$0
Other fields/courts	25,000	\$3.00	\$75,000
Sports Subtotal	277,000	\$3.19	\$883,000
<u>Facilities/Field rentals</u>	<u>Number of rentals</u>	<u>Rental value</u>	<u>Total Value</u>
Picnic Shelters	700	\$100.00	\$70,000
Baseball/softball -league	1,000	\$100.00	\$100,000
Baseball/softball -community	3,000	\$100.00	\$300,000
Outdoor Performing areas	50	\$500.00	\$25,000
Others			\$0
...			\$0
Rental Subtotal (per facility)	4,750	\$104.21	\$495,000
Rental Subtotal (per visit) ^a	118,750	\$ 4.17	
<u>Special Uses/Fee Areas</u>	<u>Volume of use</u>	<u>Per unit value</u>	<u>Total value</u>
Golf Courses	100,000	\$20.00	\$2,000,000
Nature centers	40,000	\$10.00	\$400,000
Zoo/arboreta	158,000	\$10.00	\$1,580,000
...			
Special Uses Subtotal	298,000		\$3,980,000
Grand Total	1,656,750	\$5.00	\$8,288,500

a. Per visit value for facility/field rentals is based on 25 users per rental.

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Exhibit A. Example of a unit day value table with ranges for individual activities or park types

Table A. Sample Suggested City Park Unit Day Use Values

General Park Uses	Value Range			Value indicators
	Min	Typical	Max	
Playgrounds	\$2.00	\$4.00	\$6.00	age, extent & variety of structures, maintenance
Picnic Areas	\$2.00	\$4.00	\$6.00	shelters, grills, grounds, shade,
Trails	\$2.00	\$4.00	\$6.00	surface, env quality, distance
Gardens	\$2.00	\$4.00	\$6.00	size, variety & quality
Passive uses	\$2.00	\$4.00	\$5.00	grounds, benches, shade, water
Beaches/lake swim areas	\$2.00	\$4.00	\$9.00	features, average length of stay
Outdoor Swim pools/aquatic centers	\$2.00	\$4.00	\$9.00	water quality, beach quality, grounds
Nature center	\$2.00	\$4.00	\$9.00	size, quality, special features
Ice Skating	\$2.00	\$4.00	\$9.00	size, quality, programs
Skateboard/inline	\$2.00	\$4.00	\$9.00	enclosed, artificial, rentals
Average/Other	\$2.00	\$4.00	\$9.00	size, quality, variety, amenities For use as an overall average or for other activities
Outdoor sport/court uses - individual use (per person)				
Tennis	\$2.00	\$4.00	\$7.00	surface, lights, ...
Basketball, soccer, other team sports	\$2.00	\$3.00	\$7.00	surface, lights, nets, ...
General court/field use	\$2.00	\$4.00	\$7.00	For an overall average or "other"
Special Facilities/uses				
Golf	\$10.00	\$20.00	\$40.00	course quality, holes
Zoo/arboreta	\$5.00	\$15.00	\$30.00	size, quality, programs
Camping (per site)	\$5.00	\$15.00	\$40.00	quality, amenities
Nature center/Env. Ed. program	\$5.00	\$15.00	\$40.00	size, quality, program extent
By Park Types				
Neighborhood park	\$2.00	\$4.00	\$7.00	size, facilities, quality
Natural area	\$3.00	\$4.00	\$9.00	size, access, quality
Sports fields	\$2.00	\$4.00	\$7.00	facilities, quality
City-wide park	\$4.00	\$6.00	\$9.00	size, facilities, quality
Rental facilities - group rental basis				
Picnic shelters	\$25.00	\$50.00	\$150.00	size, quality, amenities
Sports fields	\$25.00	\$50.00	\$150.00	quality, services

a. All values are dollars per person/individual use occasion except rental facilities, which are on a group rental basis.

Ranges and "typical values" are suggested. Further research is recommended to establish a set of recommended value ranges and guidelines for choosing a value from these ranges. Point systems based on ratings of the extent and quality of facilities and programs are one option that is illustrated in Exhibit B.

Exhibit B. Example of a point system for choosing unit day values for a particular park/use from a recommended range - Playgrounds.

Step 1. Establish a range of values for the activity. It is assumed that a range of values has been established for the activity. The point system is used to select a value from this range for a particular park or use.

Unit Day Value Range for Playgrounds

	Minimum	Typical	Maximum
Range	\$2.00	\$3.50	\$6.00
Quality Points	20	50	100

Step 2. Identify determinants of value for this activity and a rating system for each attribute. The example below identifies four value criteria for playground use and allocates 100 points across these four attributes. Levels for each attribute are identified across the columns with suggested point values/ranges for each level.

	Levels of the attribute		
Size (20 points)	Small 5-10	Medium 10-15	Large 15-20
Facility Quality (30 points)	Below Avg 5-10	Average 11-19	Above Average 20-30
Variety of Structures (30 points)	Minimal 5-10	Average 11-19	Extensive 20-30
Environment (20 points)	Below Avg 5-10	Average 10-15	Above Average 15-20

Step 3. Establish the relationship between quality points assigned and the unit day value range. A simple linear interpolation formula can be used to assign unit day values based on the number of points accumulated over the four attributes.

Points to Value Conversion

Total Quality Points	Unit Day Value
20	\$2.00
30	\$2.50
40	\$3.00
50	\$3.50
60	\$4.00
70	\$4.50
80	\$5.00
90	\$5.50
100	\$6.00

Step 4. Rate individual facilities or use occasions on each attribute. Sum the scores and determine the unit day value based on the point total. The examples below shows ratings and associated unit day values for four playgrounds that differ in size, quality, variety of structures and the surrounding environment.

Attribute	Examples			
	Playgd A	Playgd B	Playgd C	Playgd D
Size (20 points)	6	11	6	15
Facility Quality (30 points)	7	14	25	25
Variety of Structures (30 points)	7	14	10	25
Environment (20 points)	5	11	12	15
Total Points	25	50	53	80
Unit Value	\$2.25	\$3.50	\$3.65	\$5.00

Playground A represents an older, small playground
 Playground B represents an average playground
 Playground C represents a newer, small playground.
 Playground D represents a newer large, high-end playground.

Step 5. Estimate use of each facility and assign the corresponding value. Multiply the annual use of each facility by the unit day value and sum total values across all playgrounds to get an overall total value. The overall average unit day value (\$4.06) reflects the mix of uses of the higher and lower valued facilities.

Playground	Use	Per unit Value	Total Value	Characteristics
PlayGd A	5,000	\$2.25	\$11,250	Small, older structure
PlayGd B	10,000	\$3.50	\$35,000	Large, older structures
PlayGd C	10,000	\$3.65	\$36,500	New, small
PlayGd D	20,000	\$5.00	\$100,000	New, large
...				
Playground Total	45,000	\$4.06	\$182,750	

Appendix 5

A Tool for Quantifying the Economic Value of Human Health Associated With City Parks

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Introduction

During the past two decades, the rate of overweight and obesity among U.S. children and adults has been increasing rapidly. Based on the 1999 to 2000 National Health and Nutrition Examination survey, about 64% of U.S. adults are either overweight or obese.¹ Over the past decade, in adults, there has been a 12% increase in overweight and a 70% increase in obesity.² The age-adjusted prevalence of obesity ($\geq 95^{\text{th}}$ percentile of body mass index) for children between the ages of 6 and 17 has almost doubled from 1976-1980 to 1988-1994.³ This suggests that individuals have increased their caloric intake and decreased their caloric expenditure resulting in a state of "positive" energy balance. As technology has developed, most jobs have become less physically demanding, thus decreasing people's energy expenditure on the job. Consequently, in today's developed society, leisure time physical activity has become a critical component in meeting the recommended daily amount of physical activity level (30 minutes of moderate to vigorous activity on 5 or more days of the week).⁴

Many medical and epidemiological studies have documented the health benefits associated with physical activity.⁴ For example, inactivity is an independent risk factor for many chronic diseases such as type-2 diabetes, cardiovascular disease, osteoporosis, and depression. However, most Americans do not engage in a sufficient amount of physical activity to obtain health benefits. The prevalence of engaging in an insufficient amount of physical activity has remained around 30% for adults, with only 25% achieving the level of physical activity recommended by the American College of Sports Medicine and Centers for Disease Control and Prevention in the past decade.⁵ Current recommendations advise that people of all ages accumulate a minimum of 30 minutes of moderate intensity physical activity (brisk walking) on most, if not all, days of the week in order to obtain significant health benefits.⁴ Increasing physical activity is essential because it promotes good health, and as a result, health care costs are reduced. In fact, several studies have documented a large economic burden related to obesity and physical inactivity.⁶⁻¹¹ Clearly, reducing obesity and promoting physical activity has great potential for containing growing health care costs. In this paper, we will investigate how city parks increase physical activity, how those increases in physical activity can lead to improved health, and how improved health may contain specific types of health care costs.

City Parks and Physical Activity

Recent research suggests that a supportive environment is an important factor for increasing physical activity. City parks are a component of the built environment that influences people's daily lives in myriad ways. For instance, access to parks and other open spaces has been linked to increased physical activity¹²⁻¹⁸ For example, one study suggests that persons reporting a place to walk were significantly more likely to meet current recommendations for regular physical activity (41.5%) than were persons reporting no place to walk (27.4%).¹⁷ There are a

number of aspects of parks which can encourage or discourage their use as well as dictate what activities are engaged in at parks. An individual's decision to use a park can be influenced by aspects such as access to the park area, attractiveness of the park, and awareness of the parks existence. The accessibility of a park is influenced by factors such as travel time, quality of the route, and preference accommodation for mode (walking, biking, driving, etc). Several studies have shown a positive association between access to parks and physical activity levels, however most of these studies have relied upon self-reported data.^{14-15,17} Using self-report instead of an objective measure of access is a limitation since many individuals are not always aware of the parks around their homes nor may be aware of their physical activity level. However, these findings are supported by a couple of studies that have used an objective measure of park availability and found a positive association between park access and physical activity.^{16,18}

In addition to having access to the park, individuals must also view it as attractive. Some aspects of parks will have a more universal appeal such as being well maintained, while other aspects such as the availability of a playground for young children or a dog park may be viewed as attractive by some individuals but unattractive by others. Individuals may also be willing to travel farther to a park that offers unique facilities.¹⁶ Some studies have linked physical activity with access to trails and safety but these factors have not been specifically examined within parks.^{14-16, 19-23} While many variables have been suggested as important for influencing both park use and physical activity within parks (park size, lighting, safety, availability of drinking fountains, restrooms, availability of trails) there is little or no empirical data currently available to support these hypotheses.

Providing increased access to places where one can be physically active as well as increasing awareness of the facilities that are available is a strongly recommended strategy for promoting physical activity according to the *Community Guide for Preventive Services*.²⁴ Parks are also a popular place to engage in physical activity; 29.6% of physically active individuals from a national sample reported that they exercised in parks.¹⁴ Thus increasing access to and awareness of parks has potential for increasing physical activity.

Physical Activity and Health

The overall health and quality of life of Americans can be substantially improved by incorporating moderate amounts of physical activity into their daily lives.⁴ Amount of physical activity is a combination of frequency, duration and intensity. *The amount of physical activity a person must achieve in order to obtain health benefits may not have a lower threshold, which indicates that any activity is probably better than none.* However, it has been shown that **additional health benefits** can be gained through increasing amounts of physical activity. For example, people who can maintain a more regular regimen of activity or one that is of longer duration are likely to derive greater health benefits. The emerging consensus is that vigorous activity is not necessary to improve health and that it is not the intensity, but the *amount of physical activity* that appears to be proportional to health benefits.⁴ Physical activity leading to an increase in daily caloric expenditure of approximately 150 kilocalories/day (or 1,000 kcal/wk) is generally associated with substantial health benefits. This amount of caloric expenditure can be achieved (assuming a 70 kg adult) by raking leaves for 30 minutes, walking briskly (4 mph) for 30 minutes or jogging (5 mph) for 18 minutes.⁴ Emphasizing the amount versus the intensity of physical activity is more realistic and achievable for people and, thus, will hopefully encourage individuals to make physical activity a more regular part of their lives.

Physical activity has important positive effects on musculoskeletal, cardiovascular, respiratory and endocrine systems. Sufficient evidence exists that showing a causal relationship between physical activity and the prevention or reduced risk of developing the following diseases: coronary heart disease, type 2 diabetes, stroke, osteoporotic fractures, colon cancer and breast cancer. As well, the positive effects of physical activity are consistent with other health benefits like reduced risk of obesity, hypertension and premature mortality. Regular physical activity also appears to help reduce depression and anxiety, improve mood, and enhance ability to perform daily tasks throughout the lifespan.⁴

Physical Inactivity and Medical Conditions

The following section of this paper describes the relationship between physical inactivity and specific medical conditions.

Cardiovascular and Cerebrovascular Disease. Published research shows physical activity is strongly and inversely related to risk of cardiovascular heart disease (CHD).²⁵⁻⁴¹ Individuals who are physically active have a substantially lower overall risk for major coronary events. Studies have also demonstrated an inverse dose-response gradient between level of physical activity and risk of CHD. The greatest benefit seems to occur at *moderate* levels of physical activity.⁴² The numerous estimated measures of association for cardiovascular outcomes generally falls within the range of a 1.5 to 2.0-fold increase in risk of adverse health outcomes associated with inactivity.⁴

Hypertension. The reduction of elevated blood pressure is important for preventing stroke and CHD. Cohort studies have shown that physical inactivity is associated with an increased risk of developing hypertension among both men and women.⁴ A few studies have also demonstrated a dose-response gradient between amount of activity and degree of protection from hypertension.⁴³ Point estimates suggest that those least physically active have a 30% greater risk of developing hypertension than their most active counterparts.⁴⁴

Type-2 Diabetes. There is considerable evidence to suggest a relationship between physical inactivity and type-2 diabetes. One study found that women aged 55-69 years who had high levels of physical activity were half as likely to develop type-2 diabetes as were same-aged women with low levels of physical activity. Moderately active women had an intermediate risk between the high active and low active groups.⁴⁵ Another study in men found that each additional 500 kilocalories of leisure-time physical activity per week was associated with a 6% decrease in risk of developing type-2 diabetes. This study showed a more pronounced benefit from vigorous sports than from lower intensity activities like stair climbing or walking.⁴⁶

Colon Cancer. The research in this area strongly suggests that physical activity has a protective role against the risk of developing colon cancer. Studies have reported a statistically significant inverse relationship between physical activity and risk of colon cancer, with consistent results for both men and women. The majority of studies that used more than two categories of physical activity showed a statistically significant inverse dose-response gradient between level of physical activity or cardiorespiratory fitness and developing colon cancer.^{4,47}

Breast Cancer. Epidemiologic studies of leisure-time or total physical activity and breast cancer have yielded inconsistent results. Some studies report a significant inverse association, while some are non-significant and others show no relationship at all. Nonetheless, there are studies to support the hypothesis that physical activity during adolescence and young adulthood may

protect against later development of breast cancer.⁴⁸⁻⁵¹

Osteoporosis. Physical activity plays a substantial role in the development of bone mass during childhood and adolescence and in the maintenance of skeletal mass during young adulthood. Thus, physical activity may avert the development of osteoporosis by preventing: (a) an insufficient level of peak bone mass at physical maturity; (b) failure to maintain peak bone mass during the third and fourth decades of life and; (c) the bone loss that begins during the fourth or fifth decade of life.^{4, 52-53} In addition, physical inactivity may lower the risk of hip fracture, especially in post-menopausal women.⁵⁴

Musculo-skeletal: Osteoarthritis is the most common form of arthritis which is a leading cause of chronic pain and is associated with obesity, physical inactivity, and poor quality of life.⁵⁵ Moreover, physical inactivity associated with arthritis can have several negative health consequences such as loss of function, increased risk for cardiovascular disease and unnecessary disability.⁵⁶⁻⁵⁷ Research indicates that regular moderate exercise can relieve symptoms and improve function among people with both osteoarthritis and rheumatoid arthritis.⁴ Moreover, other research shows that after regular physical activity, persons with arthritis have a significant reduction in joint swelling.⁵⁸ Furthermore, increased levels of physical activity in persons with osteoarthritis are associated with improved psychosocial status, functional status, and physical fitness.⁵⁹⁻⁶⁰ Physical activity has been shown to reduce the prevalence and severity of various musculo-skeletal ailments including low back strain and various muscular strains and sprains.⁶¹⁻⁶⁴ There is also some evidence linking physical inactivity and obesity to increased risk for carpal tunnel syndrome.⁶⁵⁻⁶⁷

Obesity. Physical activity has been shown to be an important factor in maintaining a healthy weight. By expending energy and maintaining muscle mass, physical activity is useful and effective in avoiding weight gain as well as weight loss. Obesity plays a central role in the development of type-2 diabetes, increased risk for CHD, high blood pressure, various cancers and all-cause mortality. Cross-sectional studies show that higher levels of physical activity or fitness are related to lower weight, BMI and skinfold measures,⁶⁸⁻⁶⁹ as well as an inverse relationship between leisure-time physical activity (either walking or engaging in high-intensity activity) and risk of becoming obese.⁶⁹⁻⁷⁰

Mental Health (Depression and Anxiety) The World Health Organization has conceptualized health as a positive state of physical, mental, and social well-being.⁷¹ Therefore, the capacity to enjoy life and withstand challenges must also be acknowledged through psychological well-being, in addition to the reduced risk of developing diseases. Research suggests that people who are physically active or have higher levels of cardio-respiratory fitness have enhanced mood, higher self-esteem, greater confidence in their ability to perform tasks and better cognitive functioning than sedentary persons or those who are less physically fit.⁴ In addition, the literature shows a beneficial effect of physical activity on relieving symptoms of depression and anxiety.⁷²⁻

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Quality of life. Physical activity appears to improve health-related quality of life by enhancing psychological well-being and by improving physical functioning in persons compromised with poor health. The strength of this relationship is directly related to the length of time that an individual is involved in a physical activity program.⁷⁴ It is also important to note that the magnitude of improvement in both psychological well-being and physical function are highly dependent on the status of the patient's chronic disease. People with lower levels of mental or physical health may have the most to gain from physical activity since they have more room to

improve their health status than those who are already in good health. This fact suggests that city parks may play an important role in promoting physical activity for both healthy and unhealthy populations.

Health and Health Care Cost

National health expenditure (NHE) and the NHE as a percentage of gross domestic product in the United States has been increasing over the years. In 2003, the national health expenditure was \$1.7 trillion, accounting for approximately 15% of the gross domestic product.⁷⁵ Moreover, NHE is projected to reach \$3.1 trillion in 2012.⁷⁵ Recently, several studies have shown that costs associated with obesity and inactivity account for a large amount of these medical expenditures.^{6-8,10-11,76} For example, the direct medical costs of treating cardiovascular disease due to unhealthy weight was estimated at over \$22 billion, which was 17% of the total medical cost of treating CVD. For people with arthritis, over 12% of the direct medical cost (\$1,250 per person in 2000 dollars) may be associated with inactivity.⁷⁷ The total inactivity-associated medical expenditure was nearly \$12 billion in 1987 (\$38 billion in 2003 dollars) for people with mental disorders.⁷⁸

In the general population, a large cross-sectional stratified analysis of national medical care claims data showed that physical inactivity may cost the nation over \$76 billion in direct medical expenditures in 2000 dollars.¹¹ In particular, this analysis showed an annual difference of \$330 in direct medical care expenses between physically active and inactive persons. Interestingly, the level of physical activity measured in the study was even more modest than current federal guidelines of 30 minutes or more of moderate physical activity five or more days per week, suggesting that following current recommendations could yield even greater cost-savings.

Several other studies also show decisive cost differences between active and inactive adults. For example, one of the earliest studies published in this area showed an annual medical care cost-difference of \$391 (1992 dollars) between active and inactive workers in several large worksites.⁷⁹ Another study of auto assembly workers showed an annual cost difference of \$96 (1995 dollars) between active and inactive workers.⁸⁰ A third study involving 5,689 adults in Minnesota showed physically active persons had 49% lower medical care charges than inactive peers.⁸¹ And, most recently, a study of over 23,000 employees showed that physically active persons had annual medical care costs of approximately \$250 lower than sedentary individuals across all body weight levels.⁸²

Several studies have investigated the impact of the built environment on promoting health and preventing diseases.¹⁴⁻¹⁸ Wang and colleagues (2004) investigated the cost-effectiveness of bike/pedestrian trails in health promotion and found that the average annual cost for persons becoming more physically active was \$98 and \$142 for those who were already active at the recommended levels.⁸³ These low per person costs indicate that the addition of biking/pedestrian trails is a cost effective means of increasing physical activity and promoting health. Thus, it is important to examine other aspects of the environment, such as availability of parks, which can influence physical activity. These quantitative estimates provide much needed information for policy makers and community developers when making decisions about policies and funding with respect to a city's recreational facilities.

Overall, the economic value of human health associated with city parks from physical

activity include direct medical cost benefits and other indirect sociological and psychological benefits such as life enjoyment, family value, and enhanced productivity. Yet, due to limited data and methodological challenges, it is only feasible to focus on quantifying the direct medical costs, although this will certainly provide a very conservative estimate of economic value.

By and large, economic analysis of physical activity requires an understanding of the percentage of persons in a target population who are physically active. **Population-attributable risk percent (PAR%)** can be used to quantify the proportion of disease in a population that could have been prevented by improving physical activity. The PAR% measures the proportion of disease such as coronary heart disease and type-2 diabetes in the population that is attributable to a specific exposure such as physical inactivity. The PAR% is calculated as, $PAR\% = P(RR - 1) / [1 + P(RR - 1)]$, where P is the prevalence of physical inactivity in the study population, and RR is the relative risk for contracting the disease comparing the inactive with the active persons.

The prevalence of inactivity (P) can be estimated using survey information from residents around a park, i.e., categorizing individuals into active and inactive persons. Many medical and epidemiological studies have estimated the RR of several chronic diseases such as coronary heart disease, type-2 diabetes, osteoporosis, and some cancers for various population groups. For example, the RR of coronary heart disease for inactive persons is estimated to be 1.5.⁸⁴ This means that the risk of contracting coronary heart disease for inactive persons could be 50% higher than for active persons. To derive the medical cost attributable to inactivity, the risk of disease from both a baseline level of physical activity (no parks) and from the expected increased level of physical activity when parks are present are calculated. Since most of the chronic diseases occur in adults, the impact of physical activity on medical costs among children is insignificant and thus is not usually included in this type of analysis. In addition, there is not sufficient data to make good estimates of the relationship between physical activity and chronic diseases in children. Therefore, only the economic value of human health for adults was determined in this model. The steps to derive medical cost savings of physical activity in city parks are described in **Part II – General Methodology**.

Conclusions

Evidence suggests a positive association between park existence and level of physical activity.^{14-15,17} However, data on the actual degree of impact that parks have on physical activity as well as the aspects of parks that increase physical activity is lacking. This is one of the major challenges in assessing medical cost savings of physical activity associated with city parks.

Since medical cost saving estimates depend on accurate assessment of physical activity and park use, collecting data on physical activity performed in parks is critically important for an economic evaluation of human health. There is ample evidence showing the health benefits of physical activity. However, one potential problem in determining actual medical cost savings from physical activity and city parks is the overlapping of inactivity-related diseases (double counting). One way to address this issue would be to use the total medical cost of a specific disease by first diagnosis (first code listed on a medical claim).

Since conclusive research on the impact of city parks on physical activity is lacking, and the association between diseases and inactivity is complex, one economic method may not be sufficient to estimate the medical cost savings attributable to city parks through increasing physical activity. Therefore, caution should be taken when relying exclusively on any of the methods used in this analysis. Additionally, other types of economic analyses such as cost-

effectiveness analysis of city parks in health promotion often require not only more but also different data regarding parks.

Part II: General Methodology

The process used to develop the calculation tool includes several steps subject to the following associations/assumptions:

- City parks provide opportunities for persons to engage in various levels of physical activity
- Park users who engage in moderate physical activity gain various health benefits from such activity
- Park users who engage in moderate physical activity incur fewer and less severe medical care conditions than non-users
- Cost-differences used in calculating the financial value of specific health benefits from physical activity are probably underestimated because we don't know or have data on all medical conditions which may be associated with physical inactivity
- Costs related to injuries incurred during physical activity were not considered in this analysis due to a lack of data published in this area
- While there is some evidence that physical activity can enhance the quality of life, there was no attempt to financially quantify this association because the primary purpose of this analysis is solely to quantify **health benefits**.

Since *physical activity* is the **behavioral variable** that is measured in this tool, the initial step was to identify specific types of medical care cost conditions that are inversely related to physical activity. Upon conducting an extensive literature search, various medical care conditions inversely tied to physical activity were identified and are shown in Table 1. The vast majority of conditions listed in Table 1 are identified in the *1996 Surgeon General's Report on Physical Activity and Health* (SGR) as being directly associated with physical inactivity.⁴ A few conditions including **breast cancer, carpal tunnel syndrome, stroke, and hip fracture** were added to the original SGR listing, based on additional sources which show their link to physical inactivity.^{39-41,48-49,52-54,65-67}

Table 1: Medical Conditions Associated with Physical Inactivity 2⁵⁻⁶⁸

<u>DRG #</u>	<u>Condition</u>	<u>ICD Code</u>
MDC: Cancer (neoplasm)		
152,159,179	Colon cancer	230.3
274, 275	Breast cancer	174, 175
MDC: Endocrine & Metabolic		
294	Diabetes >35 years of age	250.0 250.9
296-297 300-301	Obesity	278
MDC: Circulatory		
134	Essential hypertension	401
134	Hypertensive heart disease	402.9
316 & 317	Hypertensive renal disease	403
	Hypertensive heart & renal disease	404
122	Acute myocardial infarction	410
	Acute & subacute ischemic heart disease	411
412	Old Myocardial infarction	412
140 & 143	Angina Pectoris	413
132 & 133	Coronary Atherosclerosis	414
127	Congestive Heart Failure	428.9
	Unspecified Heart Disease	429.9
014-017	Subarachnoid Hemorrhage	430
014-017	Intra-cerebral Hemorrhage	431
014-017	Unspecified Intracerebral Hemorrhage	432
014-017	Occlusion Precerebral arteries	433
014-017	Occlusion Cerebral Arteries	434
014-017	TransCerebral Ischemia	435
014-017	Acute Ill-defined cerebro vascular disease	436
014-017	Other cerebrovascular disease	437
014-017	Late Effects of Cerebrovascular Disease	438
132 & 133	Atherosclerosis	440
103	Heart transplant	
106 & 107	Coronary bypass	
MDC: Injury & Poisoning		
236	Hip Fracture	808 808.1
MDC: Musculo-skeletal		
241	Rheumatoid Arthritis	714
245	Osteoarthritis	715-715.9
	Pain in joint	719.4
	Stiffness joint	719.5
	Lumbago	724.2

243	Backache	724.5
	Polymyalgia Rheumatica	725
248	Synovitis & Tenosynovitis	727
	Rheumatism	729
	Osteoporosis	733
243	Strain/Sprain of back	847.9
MDC: Mental		
426	Neurotic Depression	300.4
426	Depressive Disorder	311
427	Anxiety states	300
MDC: Nervous system		
6	Carpal Tunnel Syndrome	354.0

The second procedure was to calculate *physical inactivity costs* among the targeted medical care conditions. In the past few years, physical inactivity cost analyses have been conducted on seven (7) states including California, Massachusetts, Michigan, New York, North Carolina, Texas, and Washington.⁸⁵⁻⁹¹ State-specific costs for physical inactivity averaged were based on a Proportionate Risk Factor Cost Appraisal™ technique which took into account the following factors:

- # and payments for inpatient and outpatient claims
- ratio of inpatient to outpatient claims and payments
- risk factors associated with each of the targeted conditions
- risk factor (epidemiological) weights for each risk factor
- percentage of adults with a specific risk factor (PAR)

Once physical inactivity costs were quantified for each of the seven states, calculations were done to compute an average annual cost-difference between physically active vs. physically inactive persons. Cost differences among the states averaged \$160 per adult (2004 \$) which consisted of (1) direct medical care services and (2) prescription medication costs associated with each of the targeted medical conditions. The 7-state cost-difference average is near the low-end of the range comprised of the previously-cited cost-differences:

<u>Source</u>	<u>Average Cost-difference</u>
Edington ⁷⁹	\$ 391
Pratt ¹¹	\$ 330
Pronk ⁸¹	\$ 294
Wang ⁸²	\$ 250
Seven states ⁸⁴⁻⁹⁰	\$ 160
Milliman & Robertson ⁸⁰	\$ 96
Unadjusted Average	\$ 253.50

The unadjusted average cost-difference of \$253.50 does **not** take sample size into account. Consequently, each of the preceding cost-differences were treated equally when, in fact, they represent populations of vastly different sizes.. For example, two of the six samples [7 states –and-Pratt] represent large *multi-state* adult populations whereas the remaining four samples represent large worksites or randomized samples of adults within a single state. Thus, in order for each of the five analyses to be properly represented, it is necessary to assign proportionate weights to each of the samples, based on their sample sizes. Therefore, the two multi-state samples are **each** assigned a percentage multiple of .40 (40%) with **each** of the remaining smaller samples assigned a multiple of .05 (5%). Consequently, a comparison of unadjusted vs. adjusted cost-differences for each group is as follows:

<u>Source</u>	<u>Unadjusted Average Cost-difference</u>	<u>Multiple*</u>	<u>Adjusted Cost-Difference</u>
Edington ⁷⁹	\$ 391	.05	\$ 19.55
Pratt ¹¹	\$ 330	.400	\$132.00
Pronk ⁸¹	\$ 294	.05	\$ 14.70
Wang ⁸²	\$ 250	.05	\$ 12.50
Seven states ⁸⁵⁻⁹¹	\$ 160	.400	\$ 64.0
Milliman & Robertson ⁸⁰	\$ 96	.05	\$ 4.80
Average	\$ 253.50	1.00	\$247.55

* Assigned percentage of total population

The adjusted cost-difference is slightly below the unadjusted cost difference. Thus, given the small difference between the two averages, a **median of \$250** will be used as the official cost-difference.

Physical Activity Benefits Calculation Tool

The physical activity cost-saving tool uses summarized cost-difference data from the previously-cited analyses. It is important to note the cost difference [\$250] listed in the attached spreadsheet should be viewed as an **approximate value** and not an exact or absolute value. Essentially, this cost-difference reflects the annual medical care cost-difference between a physically active vs. inactive adult.

A prerequisite for using the worksheet calculation is to factor in the number of park-using adults who can be classified as being physically active. For this particular equation, a *physically active* person is one who engages in *moderate* physical activity of some duration. Moreover, the *amount of physical activity a person must achieve in order to obtain health benefits may not have a lower threshold, which indicates that any activity is probably better than none.*⁴ However, it has been shown that **additional health benefits** can be gained through increasing amounts of physical

activity. For example, people who can maintain a more regular regimen of activity or one that is of longer duration are likely to derive greater health benefits. The emerging consensus is that *vigorous* activity is not necessary to improve health and that it is not the intensity, but the *amount of physical activity* that appears to be proportional to health benefits.⁴ Physical activity leading to an increase in daily caloric expenditure of approximately 150 kilocalories/day (or 1,000 kcal/wk) is generally associated with **substantial** health benefits. This level of caloric expenditure can be achieved (for a person weighing 154 lbs.) by raking leaves for 30 minutes, walking briskly (4 mph) for 30 minutes or jogging (5 mph) for 18 minutes.⁴

Overall, there is no universal agreement among researchers on the exact minimum number of minutes per day or per week that a person must engage in moderate physical activity to obtain various health benefits. However, virtually all researchers agree that moderate exercise must be *regular* and of *sufficient duration* to render some level of measurable health benefits (e.g., risk factor level reduction).⁹¹ Thus, persons who are responsible for computing the health benefits of physical activity in a park setting should consider the preceding examples in order to determine the quantity of park users who meet a minimum level of physical activity (e.g., walking briskly).

Since adults older than 65 tend to incur higher medical costs than younger adults, a multiplier of 2.0 has been inserted in the formula to account for this discrepancy. A baseline multiplier of 2.0 was chosen and is based on research showing adults ≥ 65 years of age typically incur two or more times more medical care services and costs than younger adults.⁹³

Finally, a regional multiplier is included in the equation to reflect regional differences in medical care inflation.⁹⁴

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Attachment 6

A Toll for Estimating the Spending of Visitors who use a Community's Park and Recreation Amenities

By John L. Crompton, Ph.D.

If leaders in most communities are asked to list the amenities that encourage people to visit and spend money in their community, the list is likely to be comprised of features such as cultural facilities, heritage places, parks, special events and festivals, sports facilities and tournaments, and arenas. Typically, these are operated by public agencies and nonprofit organizations. However, the general public frequently are unaware of the central role that parks, open space and recreation amenities play in the community's tourism effort.

To demonstrate their economic contribution to the community, an increasing number of agencies have undertaken studies of visitor spending. These studies measure the amount of new money coming into a community from outside that creates income and jobs for residents.

THE MEASUREMENT TEMPLATE

It is an unfortunate fact that urban park tourism is woefully under-measured. This is the case both from the perspective of tourists (what percentage of tourists come to a place because of its parks?) and from the perspective of the parks (what percentage of park users are out-of-town tourists?) A great deal of data is collected on tourism, but it is overwhelmingly oriented to the hotel, restaurant, airline, theme park, museum and retail sectors, not to public parks. The only methodical survey protocol for parks is conducted by the National Park Service, but the number of urban national parks is small and their usership are always numerically dominated by the much more highly visited municipally-operated parks in a city.

This data dearth makes it impossible to arrive at an accurate estimate of park-related tourism spending. Nevertheless, the number is an extremely important one, making it worthwhile to attempt a rough calculation. We have therefore designed a template to enable an estimate.

STAGE 1: Determine total tourist visits (i.e., visitation-days) to the city.

Most visitor and convention bureaus know the total annual visitation to a city. When getting that figure, however, it is important to seek a figure for the city itself rather than the more common one for the metropolitan area.

STAGE 2: Determine the breakdown between nearby visitors (less than 50 miles) and long-distance visitors (i.e., day-trippers and overnights).

This information should (hopefully) be available from the visitor and convention bureau.

STAGE 3: Determine the average expenditure per tourist per day.

Again, this information should be available from the visitor and convention bureau. In some cases the information may be in the form of "spending per party" or "spending per trip"; in

those cases, the results will need to be factored down to “per person per day.” In some cases, the data will distinguish between business travelers and non-business travelers, so the ratio may have to be determined and the numbers averaged. It will be seen that overnight trips generate much more spending than day trips because of lodging and extra meals.

STAGE 4: Estimate the percentage of tourists who visit a park while on their city trip.

This is difficult. It would vary tremendously by city (i.e., Washington, D.C. with its public park National Mall vs. Las Vegas with its private indoor casinos), so there is no “official” number across all cities. Ideally, in the future, visitor bureaus will add questions about park visitation to their surveys, but at present this will have to be estimated.

STAGE 5: Estimate the number of tourists who come to the city “significantly” because of a park or because of the park system.

It is not enough that a tourist happens to casually intersect with a park – he or she may have to walk through a small park simply to get to the hotel. We are seeking those persons who choose to visit a city *at least in part* because of a park – someone who says, “When we go to New York I want to go to the top of the Empire State Building, eat in Chinatown, see the Brooklyn Museum, take the Circle Line boat trip and, of course, go to Central Park.” Or someone who says, “I usually skip the annual convention, but this year it is in San Antonio and I’ve always wanted to see the River Walk.” Or, “Normally we bypass Chicago on the way to Lake Superior, but we heard so much about Millennium Park that we decided to stay over for a couple of days and see all the sights.”

Again, this is a difficult number to get and it will have to be estimated. In the future, it is hoped that visitor bureaus will routinely survey for this information.

Obviously, the combination of Stage 4 and Stage 5 will greatly diminish the total tourism spending number for the city, which is appropriate since most tourists don’t come to most cities because of the parks. (But presumably if a city park system continually improves so as to gain regional, national and international notice, the number of park-oriented tourists will increase, and their spending will be recognized.)

STAGE 6: Calculate the tax receipts on tourist spending. The tax charged on tourist spending constitutes income to the city. If it is not possible to determine the statistically accurate tax rate on tourists, an estimate can be obtained by averaging the city’s sales tax rate, hotel tax rate and auto rental tax rate.

The formula for determining spending is:

(Number of overnight person-visits) X (average spending per overnight person-visit) X (percentage of visitors who visit a park) X (percentage of those visitors who came to the city "significantly" because of a park or park system) X (the tax rate on tourist goods and services)

PLUS

(Number of day-trip person-visits) X (average spending per day-trip visit) X (percentage of day visitors who visit a park) X (percentage of those visitors who come to the city "significantly" because of a park, a park system or a park event) X (the tax rate on tourist goods and services)

OPTIONAL STAGE 7: Calculate the collective profit to the city economy from park-generated tourism. According to studies, about 65 percent of consumer spending covers expenses (such as the cost for restaurants of purchasing raw food) and 35 percent represents profit. Multiplying park-generated tourism dollars by 0.35 yields an estimate of the increase in the collective "wealth" of the community.

CAVEATS/COMMENTS

No attempt has been made to incorporate multiplier effects into this template. There is widespread recognition that these supposed effects are frequently abused when presenting economic impact data. If it is desired that they be used, then park and open space agencies should probably use those that are advocated by the community's tourism agency. These are likely to be exaggerated and inaccurate. However, if they are the accepted norms in the community, little is to be gained by developing accurate multipliers for park advocates because they will invariably be lower than those accepted norms.

Calculator #1 – Air Pollution



Air Pollution Removal Calculator

Northeastern Research Station, Syracuse, NY



Units

English

Metric

New Orleans, LA
 New York, NY
 Oklahoma City, OK
 Omaha, NE
 Pasadena, CA
 Philadelphia, PA
 Pittsburgh, PA
 Phoenix, AZ
 Portland, OR
 Providence, RI
 Roanoke, VA
 Sacramento, CA
 Salt Lake City, UT
 San Diego, CA
 San Francisco, CA
 San Jose, CA
 Santa Maria, CA
 Seattle, WA
 South Lake Tahoe
 St. Louis, MO
 Tampa, FL
 Tucson, AZ

Study Area Attributes

Area (Acres) Percent Cover

Externality Values Dollars per short ton

CO	NO2	O3	PM10	SO2
<input type="text" value="\$870"/>	<input type="text" value="\$6127"/>	<input type="text" value="\$6127"/>	<input type="text" value="\$4091"/>	<input type="text" value="\$1500"/>

Flux Values Pounds per square foot of tree canopy

CO	NO2	O3	PM10	SO2
<input type="text" value="0.00007471"/>	<input type="text" value="0.000287262"/>	<input type="text" value="0.000996118"/>	<input type="text" value="0.000788275"/>	<input type="text" value="0.000069317"/>

Results

Pounds Removed/Year	Pollutant					TOTAL
	CO	NO2	O3	PM10	SO2	
<input type="text" value="4759.0"/>	<input type="text" value="18298.7"/>	<input type="text" value="63452.9"/>	<input type="text" value="50213.3"/>	<input type="text" value="4415.5"/>	<input type="text" value="141139.4"/>	
U.S. Dollars/Year	<input type="text" value="\$2,070.18"/>	<input type="text" value="\$56,057.93"/>	<input type="text" value="\$194,388.10"/>	<input type="text" value="\$102,711.30"/>	<input type="text" value="\$3,311.63"/>	<input type="text" value="\$358,539.10"/>







Calculator #2 – Stormwater Runoff

Location		Sacramento, CA		Vegetation Coverage						
Climate/Region		Northern California		Open grown		Forest		Total		
				Vegetation Type	Acres	% of Total Parkland	Acres	% of Total Parkland	Acres	% of Total Parkland
Percent of City/Pervious (Omitting Parkland & Water)		50.9%		Forest/Trees	1,462.0	28.0	0	0	1,462.0	28.0
Acres of Parkland		Acres	% of Total							
With Pervious Soil		3,974.0	76.1%							
With Impervious Surface		1,022.0	19.6%							
Under Water		227.0	4.3%							
Total		5,223.0	100.0%	Grass	2,512.0	48.1	0	0	2,512.0	48.1
				Total	3,974.0	76.1	0	0	3,974.0	76.1
What Is a Park Worth? - Runoff Reduction				Results for a typical weather year	Inches	Cubic feet				
				Rainfall	17.52	332,170,266				
				Runoff with parks	2.51	47,631,251				
				Runoff without parks	4.69	88,911,384				
				Runoff reduction due to parks	2.18	41,280,132				
				Runoff/reduction rate	46%					
				Dollars	Cost of treating stormwater (\$ per cubic foot)		0.0204			
	Total savings due to park runoff reduction		\$842,115							

Calculator #3 – Property Value and Property Taxes

**The Hedonic (Property) Value of Parks --
Sacramento**

Total Value of Properties Within 500 Feet of a Park	\$ 1,438,394,037
<i>The Contributing Value of an Average Park</i>	5%
Portion of the Value of These Properties Attributed to Parks	\$ 71,919,702
Total	\$ 71,919,702
Effective Annual Residential Tax Rate (0.58%)	0.0058 \$ 417,134

Calculator #4 – Direct Use

Park Use Value Estimator, by Type of Use/Activity - Sacramento, CA

Facility/Activity	Use Measure	Value per unit of use	Total Value (\$)	Cost per person visit	Value per person visit minus cost	Total Adjusted Value
General Park Use						
	Use (person visits)	Value per person visit	Total Value (\$)			
Playgrounds or Tot Lots	11,446,703	\$3.04	\$34,808,912	\$0.00	\$3.04	\$34,808,912
Picnicking or Bench-Sitting	16,032,439	\$2.62	\$42,012,398	\$0.00	\$2.62	\$42,012,398
Walking on Trails	25,080,449	\$1.54	\$38,593,555	\$0.00	\$1.54	\$38,593,555
Visiting a Flower Garden	544,047	\$7.42	\$4,036,262	\$0.00	\$7.42	\$4,036,262
General Use SubTotal	53,103,638	\$2.25	\$119,451,127		\$2.25	\$119,451,127
Outdoor Sports facilities - individual use						
	Use (person visits)	Value per person visit	Total Value (\$)	Cost per person visit	Value per person visit minus cost	Total Adjusted Value
Tennis	2,733,804	\$3.73	\$10,200,088	\$0.00	\$3.73	\$10,200,088
Team Sports	10,723,568	\$2.37	\$25,415,561	\$0.44	\$1.93	\$20,697,191
Bicycling on Trails	14,621,443	\$3.11	\$45,474,276	\$0.00	\$3.11	\$45,474,276
Swimming	6,631,680	\$3.41	\$22,632,019	\$1.00	\$2.41	\$16,000,339
Running on Park Trails	13,422,097	\$3.15	\$42,287,895	\$0.00	\$3.15	\$42,287,895
Skateboarding	2,469,243	\$2.97	\$7,342,822	\$1.00	\$1.97	\$4,873,579
Sports Subtotal	50,601,834	\$3.03	\$153,352,660		\$2.76	\$139,533,368
Special Uses						
	Use (person visits)	Value per person visit	Total Value (\$)	Cost per person visit	Value per person visit minus cost	Total Adjusted Value
Golf Courses	3,245,290	\$18.30	\$59,402,920	\$10.92	\$7.38	\$23,964,352
Community Gardening	1,534,458	\$2.91	\$4,471,445	\$0.49	\$2.42	\$3,719,561
Festival or Cultural Performance	672,258	\$28.25	\$18,994,173	\$28.25	\$0.00	\$2,883
Birdwatching or Enjoying Nature	18,395,857	\$2.06	\$37,933,209	\$0.00	\$2.06	\$37,933,209
Zoo	0	\$0.00	\$0	\$0.00	\$0.00	\$0
Boating	3,968,426	\$4.75	\$18,860,868	\$2.32	\$2.43	\$9,654,121
Special Use Subtotal	27,816,288	\$5.02	\$139,662,617		\$3.11	\$86,612,599
Grand Total	159,338,050	\$2.59	\$412,466,404			\$345,597,094

Calculator #5 – Health

Parks Health Benefit Calculator

Date from Calendar Year 2007

	Cost Description	Amount
1	Average annual medical care cost difference between active and inactive persons, under 65 years of age	\$250
2	<i>The number of adults under 65 years of age who are physically active in a Sacramento park (Note a)</i>	71,563
3	Subtotal of health benefits for adults under 65 years of age [Line 1*Line 2]	\$17,890,735
4	Average annual medical care cost difference between active and inactive persons over 65 years of age	\$500
5	<i>The number of adults 65 and older who physically active in a Sacramento park (Note a)</i>	6,054
6	Subtotal of health benefits for adults 65 years of age and older [Line 4*Line 5]	\$3,026,923
7	Subtotals combined [Line 3+Line 6]	\$20,917,658
8	<i>Insert Regional Multiplier correlating to statewide medical costs</i>	0.95
9	Total annual value of health benefits from physical activity in the park [Line 7*Line 8]	\$19,871,775

Note a: Calculations based on persons engaging in moderate, vigorous or strenuous activity at least half-hour per day, 3 days per week; for detail, see "Health Data" worksheet

Telephone survey conducted January, 2007

Calculator #6 – Tourism
(continued on next page)

**Spending by Tourists Who Come to the
Parks of Sacramento**
*Partial**

I. Overnight Visitors

1	Annual number of day-trip and overnight leisure visitors to the greater Sacramento region		9,650,000
2	Of those in Line 1, the number coming from out-of-state (13%) -- all assumed to stay overnight	13% of Line 1	1,254,500
3	Of those in Line 1, the number coming from in-state (87%)	87% of Line 1	8,395,500
4	In-state leisure visitors to the region who stay overnight (48% of in-state visitors)	48% of Line 3	4,029,840
5	Total overnight leisure visitors to the region (in-state plus out-of-state)	Line 2 + Line 4	5,284,340
6	Proportion of regional visitors who stay in Sacramento City (58%)	58% of Line 5	3,064,917
7	Proportion of overnight city visitors who visit parks (24%)	24% of Line 6	735,580

II. Day Visitors

8	Annual number of day visitors to the region (52% of in-state visitors)	52% of Line 3	4,365,660
9	Proportion of regional day visitors who visit Sacramento City (58%)	58% of Line 13	2,532,083
10	Proportion of day-trip city visitors who visit parks (24%)	24% of Line 9	607,700

Combined Spending

11	Total number of day-trip and overnight visitors to Sacramento City who visit parks	Line 7 + Line 10	1,343,280
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12	Spending by those visitors (\$97.27 per person per day)	Spending * Line 11	\$130,660,846
13	Spending by those park visitors who came <i>because</i> of parks (20 percent of park visitors)	20% of Line 12	\$26,132,169
14	Average sales, meal and hotel taxes on park tourist spending (8.25%)	8.25% of Line 13	\$2,155,904
15	Net profit from tourist spending (35% of spending)	35% of Line 13	\$9,224,656

Blue numbers are taken from Greater Sacramento Convention and Visitors Bureau data

Red numbers are based on surveys, or best estimates

** Results are partial because there is insufficient data to analyze the spending of the 4.92 million annual business (non-leisure) visitors to the Sacramento region.*

Calculator #7 – Community Cohesion

Community Cohesion Value, Sacramento

Data from Fiscal Year 2006

Organization or Activity	Volunteer -Hours	Volunteer Value (\$20.36 per hour)*	Direct Financial Contributions	Total
Volunteers at City Park Sites	9,729	\$198,082		\$207,811
Volunteers in County Parks Within City	3,838	\$78,142		\$81,980
Fairytale Town	3,865	\$78,691		\$78,691
Old Sacramento (Living History Program)	2,365	\$48,151		\$48,151
Historic City Cemetery	12,686	\$258,287		\$258,287
Volunteers at Golf Course and Zoo	58,439	\$1,189,818		\$1,248,257
State Parks	165,000	\$3,359,400		\$3,359,400
Community Gardens (note a)			\$32,000	\$32,000
City Park Improvements (note a)			\$66,000	\$66,000
Donations to City Parks Dept.			\$12,424	\$12,424
Donations to City Parks for Equipment			\$18,326	\$18,326
Lowe's Donation			\$9,298	\$9,298
California Parks Foundation			\$2,500	\$2,500
Friends of Grant Park	240	\$4,886	\$37,500	\$42,386
Lawrence Park Neighborhood Assoc.	182	\$3,706		\$3,706
Natomas Community Assoc.	407	\$8,287		\$8,287
Oak Park Neighborhood Center	640	\$13,030		\$13,030
River Oaks Community Assoc.	940	\$19,138		\$19,138
Sierra Curtis Neighborhood Assoc.	395	\$8,042	\$2,500	\$10,542
Southside Park Neighborhood Assoc.	250	\$5,090		\$5,090
Totals		\$5,272,751	\$180,548	\$5,525,305

*Value of California volunteer as determined by Independent Sector, 2005

Note a: Donations through Gifts to Share

