THE ECONOMIC VALUE OF NEW JERSEY STATE PARKS AND FORESTS

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New Jersey Department of Environmental Protection
Division of Science, Research & Technology

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DIVISION OF SCIENCE, RESEARCH & TECHNOLOGY

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EXECUTIVE SUMMARY

Purpose and Scope

The purpose of this study is to develop a comprehensive analysis of the economic benefits of New Jersey's State parks, forests, and recreation areas. This revised report updates the original June 2004 report by adding new information and more extended explanations of key points and also addressing some analytic and data issues in the earlier report. The study covers the State parks and State forests under the jurisdiction of the Division of Parks and Forestry of the New Jersey Department of Environmental Protection (NJDEP).

This report excludes the extensive wildlife management areas (WMAs) and other sites administered by NJDEP's Division of Fish and Wildlife (DFW) and Office of Natural Lands Management (ONLM), as well as parks and forests owned by the Federal government, local government, and private parties. Because of these exclusions, this report provides a very conservative estimate of the economic benefits provided by New Jersey's total endowment of natural resources.

Overview of Approach

Parks and forests are extremely complex in both economic and ecological terms. The flows of park and forest-related goods and services involve visitors, businesses, the State Park Service, and society in general. To make sure that all sources of value are considered, this study uses the concept of Total Economic Value (TEV). TEV includes six main sources of value: recreational services; direct and secondary economic activity; ecosystem services; property enhancement; consumption goods; and non-use values. Some of these values involve cash payments, while others do not.

This report implements the TEV concept by quantifying the value of the annual "flow" of goods and services provided by the State parks and forests. Since those flows continue over an extended time period, their recurring values can be discounted to yield the estimated present value of the "natural assets" that provide these benefits. Because some of the goods and services are sold in organized markets while some are not, the study uses a variety of established valuation techniques. Throughout the study, 2004 is used as a base year wherever possible. Except as noted, all monetary figures in this report are stated in 2004 dollars.

This study is not a benefit-cost analysis. Such an analysis would include the costs involved in maintaining the State parks and forests, including the "opportunity" cost, i.e., the potential value foregone by preserving the parks and forests in their current undeveloped state. Estimating the full economic cost of preserving New Jersey's State parks and forests would require a major study in its own right, including extensive data collection and analysis. Such an undertaking is beyond the scope of the current project.

Recreational Value[1]

New Jersey's State parks and forests provide a wide range of recreational opportunities. For the five years 2000-2004, these facilities attracted an average of 14.2 million visitors annually. The admission charges paid by these visitors greatly understate the value they receive from their visits. While an original analysis of recreational value requires data which are not available, the economics literature supports values for a 4-hour visit ranging from $17 to $26, with a central estimate of $21. Based on these figures, the total recreational value of 14.2 million visits to the State parks and forests ranges from $240 million to $369 million annually, with a central estimate of $304 million.

Economic Activity

Public and private spending of $279 million/year related to State parks and forests contributes to New Jersey's economy by supporting business and employment opportunities that result in the production of cash income. Because of multiplier effects, the above spending supported $347 million/year in total sales; after deductions for sales of intermediate goods and services, those sales constitute $198 million of New Jersey's Gross State Product (GSP). After deductions for non-income items, this portion of the GSP translates into $126 million/year of personal income. The $347 million of sales supported about 7,000 jobs. (Note: the above dollar amounts are not additive.) Since most of the above benefits would probably continue to be generated by other economic sectors if the State parks and forests did not exist, these figures represent what economists call the gross economic "significance" of the State parks and forests rather than their net economic "impact".

Ecosystem Services

Healthy forests, wetlands, meadows, and their animal inhabitants provide a wide variety of ecosystem services to society, including protection of water quality and supply, sequestration and storage of greenhouse gases like carbon dioxide, removal of air pollutants, stormwater storage, soil formation and retention, pollination of plants, habitat and refuge for species of interest to human beings, and others. Based on a technique known as value transfer analysis, this study estimates the value of these ecosystem services at between $395 million and $605 million annually, with a central estimate of $498 million. These benefits do not currently represent cash transactions but could do so in the future.

Property Value Enhancement

A number of studies have documented the fact that proximity to *preserved* open space such as forests, wetlands, wildlife habitat, and natural areas enhances the value of residential property and thereby leads to higher home sale prices. The same studies show that the effect on property values of proximity to *unpreserved* open space tends to be smaller or even negative. Although the benefits are clear, the results from the studies that demonstrate these effects are not readily translatable into dollars per year of benefits.

[1] As used in this report, recreational value refers to the value of visits to State parks and forests to the visitors themselves; this a non-cash component of total economic value.

Consumption Goods

Assuming a sustainable management regime, the State parks and forests could in principle generate about $6 million annually in sales of commercial-grade timber. The U.S. Forest Service information on which these estimates are based dates from 1999, and there is therefore a significant degree of uncertainty in these estimates, especially since there are no comprehensive ecological models of New Jersey's forests. Development of such models could be a worthwhile future research task. The amount of commercial firewood harvested from the State parks and forests is minimal. This report did not attempt to quantify the value of fish and game animals taken in the State parks and forests.

Non-Use Values

The sources of value described above provide current benefits to individuals and/or to society as a whole, and economists would generally classify them as "use values". In contrast, some sources of value recognized by economists do not involve any current use of the resource being valued. These include existence, option, and bequest values. Non-use values are most difficult to quantify, and in the absence of relevant New Jersey-specific data, this report does not attempt to assign a dollar amount to these types of value.

Summary and Conclusions

New Jersey's State parks and forests provide total annual gross benefits estimated at between $953 million and $1.4 billion, with a central estimate of $1.2 billion (all figures in 2004 dollars). These annual benefit flows translate into present value amounts of between $31.8 billion and $45.4 billion of natural capital (central estimate $38.5 billion) based on discounting at a societal discount rate of 3%/year over an unrestricted time horizon. Since some benefits could not be quantified, these estimates are believed to be conservative.

The value of the goods and services provided by the State parks and forests may change in the future as a result of climate change, nearby land use conversion, and other natural and "anthropogenic" causes. The State parks and forests represent economically productive "assets" which are in many cases irreplaceable. Their preservation and enhancement therefore makes good economic sense and good public policy.

THE ECONOMIC VALUE OF NEW JERSEY STATE PARKS AND FORESTS

Section I: Purpose and Scope of Study

The purpose of this study is to develop a comprehensive analysis of the economic and financial benefits of New Jersey's State parks and forests.[2] In addition to assembling the results of prior relevant studies, the present report offers new analyses of a number of park and forest-related impacts not previously considered in New Jersey.

This study covers the State parks and State forests under the jurisdiction of the Division of Parks and Forestry of the New Jersey Department of Environmental Protection (NJDEP). The Department is a cabinet-level agency which seeks to serve as a national leader in the stewardship of natural resources, preserve the ecological integrity of the Garden State, and maintain and transform places in the state into healthy sustainable communities. (Source: NJDEP Draft Vision Statement, June 2006.) As a key part of this overall mission, the Department is responsible for the protection, conservation and management of New Jersey's natural resources.[3]

DEP's Division of Parks and Forestry (DPF) is responsible for managing New Jersey's State parks and forests. As set forth in its mission statement, the Division is "dedicated to excellence in the stewardship of the State's rich and diverse historic, cultural, recreational and natural resources for the benefit of present and future generations." The Division includes the State Park Service, State Forest Service, Forest Fire Service, and Office of Natural Lands Management.

The State Park Service (SPS) administers 42 state parks, 11 state forests[4], 3 state recreational areas, 43 natural areas, 57 historic sites and districts, 5 state marinas, 1 public golf course, 4 reservoir sites, and 22 miscellaneous areas (including 2 cemeteries and a Civil War monument located in Maryland). These units cover a total area of over 400,000 acres[5] and are visited by more than 15 million people annually. SPS facilities located in these areas include nearly 1,700 buildings, over 1,500 miles of trails, 326 bridges, 48 dams, 21 fire towers, a major interpretive center, and an airstrip.

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[2] The study also includes State recreation areas; for simplicity, the phrase "State parks and forests" will be used throughout to refer to all three types of facility.

[3] Unlike many states, New Jersey combines in a single agency the responsibilities for environmental protection and natural resource management. In effect, NJDEP is the state-level equivalent of both the US Environmental Protection Agency *and* the US Department of the Interior.

[4] As the text notes, State parks and State forests are both managed by the State Park Service. The State Forest Service also plays an important role with respect to New Jersey's forests; its mission is to "practice and promote sound stewardship and conservation of public, private and community forest lands, to monitor and nurture forest health, to assist municipalities with the development of their tree resources and to achieve forest-related economic, environmental and social benefits for current and future generations." In terms of agencies, the focus of this report on *State* parks and forests is the State Park Service.

[5] Most of this land is owned outright by the State of New Jersey; however, the total also includes over 37,000 acres of land subject to State-held conservation easements.

The Division of Parks and Forestry is part of DEP's Natural and Historic Resources Group. Related units in that group include the Division of Fish and Wildlife (DFW), which has the mission of protecting and managing the state's fish and wildlife to maximize their long-term biological, recreational and economic values for all New Jersey residents. The group also includes the Green Acres Program and the Historic Preservation Office. Currently, there are well over 100 wildlife management areas (WMAs) located throughout the state totaling roughly 300,000 acres.

This report excludes wildlife management areas and other sites administered by DFW and ONLM. The report also excludes certain specialized sites administered by DPF, including historic sites (which are treated in a separate report), nature preserves, recreation areas other than parks and forests, and various miscellaneous areas. The value of the physical infrastructure in parks and forests such as buildings, roads, bridges is also not covered in this analysis.

The exclusions just listed are based on various factors, including data availability and comparability, analytic consistency, simplicity, etc. Exclusion in no way implies that a given type of area or site is less important than those discussed in this report. Indeed, based on the findings presented here, it is clear that the excluded areas have substantial economic value of their own and deserve their own separate studies.

Because this report focuses on the State parks and forests managed by SPS, it *greatly understates* the benefits provided by New Jersey's total endowment of natural and historic resources. For example, as of 1995/1997, New Jersey had 2.1 million acres of forested land, including 500,000 acres of forested wetlands.[6] The 338,000 acres of State-owned parks and forests managed by the State Park Service represent about 16% of that total.[7] A separate study (currently in process) is examining the economic value of all of New Jersey's ecosystems and "natural capital" without regard to ownership or administrative status; that report is expected to be released in the fall of 2006.

[6] Land use and land cover data updated through 2002 are expected to be available in early 2007; those data are expected to show a reduction in forested land cover.

[7] This comparison is a rough one, since some State parks are not forested, e.g., Island Beach State Park. However, the unforested parks tend to be smaller in size, and the comparison does serve to place the size of the State parks and forests in a reasonable perspective.

Section II: Overview of the Approach

Parks and forests are as complex in economic terms as they are in terms of ecology. In order to understand the various components of economic value, it is essential to first understand the flows of park and forest-related goods and services and the payments for them. Figure 1 (next page) presents the most important components and flows relevant to the current study. These factors can be summarized as follows:

- Visitors to New Jersey's parks and forests pay for admission and parking and spend money in connection with their visit on food, transportation, gifts, souvenirs, clothing, supplies, equipment, entertainment, and overnight lodging or camping. All of these transactions involve cash payments from visitors to providers of goods and services. In addition, visitors derive enjoyment from their visit that is *not* reflected in their payments for specific goods and services, and they spend time traveling to and from the site, which represents a non-cash cost incurred to obtain the anticipated economic benefits (e.g., personal satisfaction) associated with the visit.

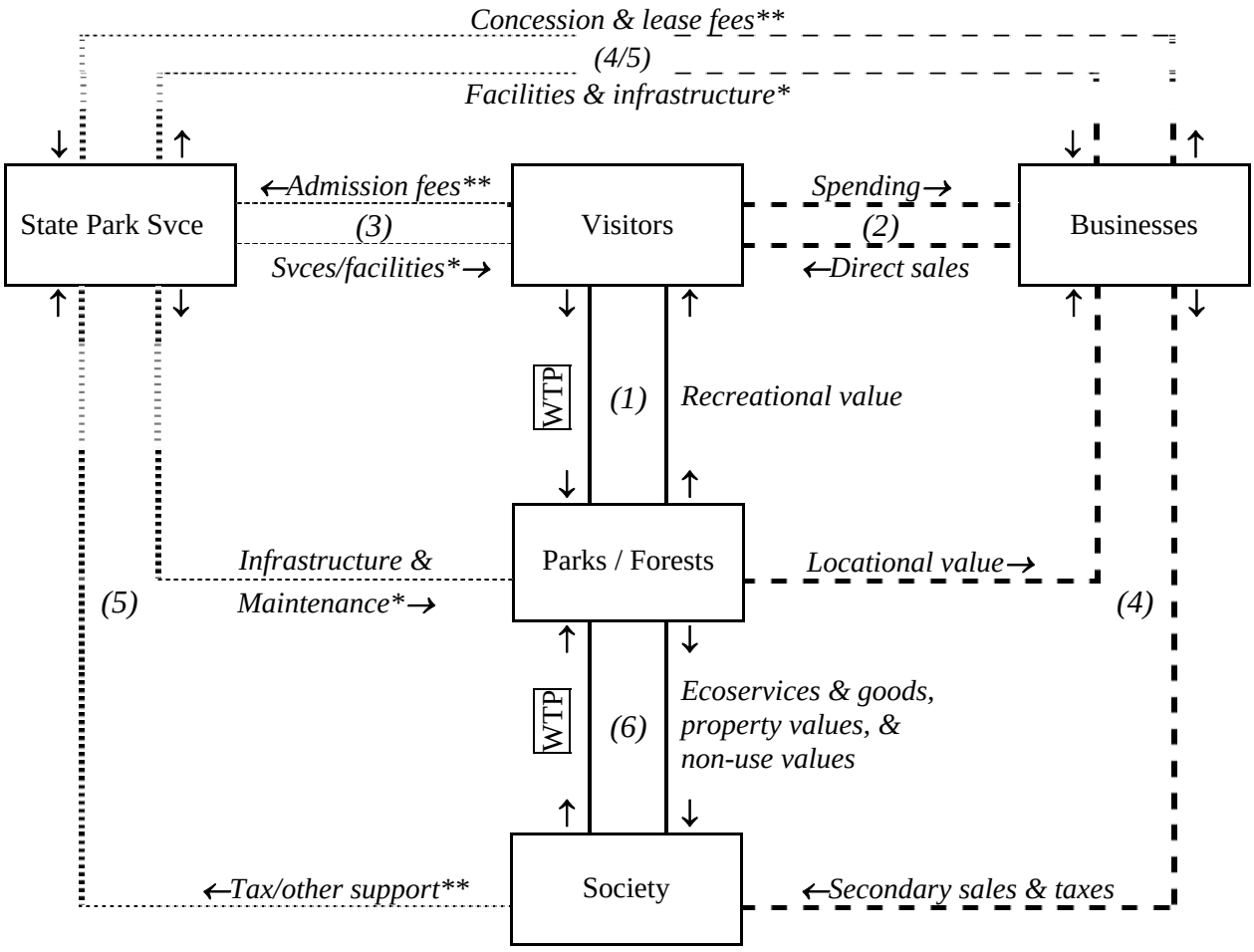
- Parks and forests provide society in general (including non-visitors) with a variety of economically valuable services, including storage of carbon dioxide (a major greenhouse gas), soil retention, provision of habitat for plant and animal species, and numerous others. While society does not explicitly pay for those services, it would presumably be willing to do so if necessary to preserve the benefits. Parks and forests also serve to enhance the value of near-by properties and provide some consumption goods.

- Businesses located in or near the State parks and forests sell goods and services directly to visitors. Such businesses must pay their suppliers, and those payments account for part of the demand for the output of those suppliers. The businesses also pay their employees, and they presumably generate profits for their owners. As wages, profits, and payments to suppliers are spent by their recipients, secondary economic activity is generated in various economic sectors.

- Finally, the State Park Service receives revenues from several sources (including entry fees) to provide services and infrastructure (and a limited range of goods) to visitors and related businesses and to maintain the parks and forests. Those missions account for a significant payroll and purchases of goods and services in their own right, and the re-spending of the related wages, profits, and payments to suppliers generate further secondary economic activity.

(text continues after Fig. 1)

FIGURE 1: BENEFIT FLOWS FOR STATE PARKS AND FORESTS



* State Park Service expenditures

** State Park Service revenues

WTP = willingness to pay

private sector economic activity (#2 & 4)

public sector economic activity (#3 & 5)

other sources of economic value (#1& 6)

A. Sources of Economic Value

The standard economic definition of the "value" of a resource such as a park or forest is the maximum amount that society or an individual would be "willing to pay" (WTP) to preserve the resource or the minimum amount that society or an individual would be "willing to accept" (WTA) to allow the destruction of the resource.[8] Equivalently, the value of a resource can be defined as the amount, usually expressed in monetary terms, by which society or an individual would be worse off if the natural resource were no longer available. The emphasis here is on the purely economic value of a resource, although as will become clear, "economic value" includes some things that are often thought of as "non-economic" in nature.

Complex systems such as the one depicted in Fig. 1 include multiple sources of value, and in analyzing such systems, economists therefore use a concept called total economic value (TEV) or total willingness to way (TWP)[9], of which TEV is the more widely used term. Economists have developed a variety of schemes for classifying the components of TEV; some of the most widely-used categories distinguish between use and non-use values, active and passive use, direct and indirect use, consumptive and non-consumptive use, etc. Different economists sometimes use these terms to refer to different sources of value, and as Freeman (2003) and others have observed, arguments over what to call something often serve little purpose.

For these reasons, this report adopts a different classification scheme based on the various flows of value shown in Figure 1; the first two elements of that scheme are as follows:

- **Recreational value**. Recreation is perhaps the most obvious sources of value we derive from visits to our State parks and forests. As used here, "recreational value" refers to the satisfaction or "utility" *to the visitors themselves* and not to the economic activity that their spending generates (see Fig. 1, flow #1). As such, this source of value does not involve cash benefits to society, although economists consider it a completely legitimate component of TEV.

- **Economic activity**. In addition to the recreational value they derive from their use of State parks and forests, visitors spend money in connection with their visits (Fig. 1, flows 2 and 3); and as private firms (flow #4) and public agencies (flow #5) re-spend that money, New Jersey realizes secondary economic benefits. There is a well-established method for estimating the cash value of this economic activity. In contrast to recreational value, this component of TEV involves actual transfers of cash in market activities and therefore brings cash benefits both to the participants and to society as a whole.

[8] While they are closely related, in practice WTP and WTA are not equivalent. For one thing, the amount an individual (or society) is willing to pay depends on income, where the amount the same person (or society) is willing to accept does not. In practice, WTP is used far more than WTA because for various technical reasons it is easier to estimate.

[9] The term "total willingness to pay" is not in general use; it appears in Tietenberg (2000).

In addition to these fairly straightforward sources of economic value, there are several other components of TEV that are perhaps less obvious but no less important as follows(see Fig. 1, flow #6):

- **Ecosystem services**. As noted above, healthy forest ecosystems provide a variety of economically valuable services, such as watershed protection, climate regulation, and many others. While those services are not currently bought and sold to any significant extent, economists have developed techniques for assigning monetary values to them. Although these services currently provide mainly non-cash benefits to society, their value is quite large. Under different institutional and arrangements and legal rules, the beneficiaries of these ecoservices could be required to pay for them, e.g., through user fees.

- **Property enhancement**. Proximity to parks and forests can increase property values by providing nearby open space, barriers to unwanted future development, and scenic "amenities". Some economists classify all of these as "amenity values" and include them under ecosystem services; however, the methods used to estimate their magnitude are very different from those used to evaluate ecosystem services, and they are treated separately in this report.

- **Consumption goods**. A final source of "use value" derives from products such as fuelwood, timber, medicinal plants, fruits, etc. that can be extracted or harvested from a given park or forest (if legally permitted). While harvesting of park and forest resources can lead to depletion if the harvest rate exceeds the sustainable yield, the fact that these resources are biologically renewable means that, if sustainably managed, they can potentially yield this type of benefit indefinitely. Such ecosystem goods can be harvested for the personal use of the harvester or for commercial purposes, with the latter involving cash transactions.

- **Non-use values**. In the terminology of most economists, all of the above sources of economic value involve the "use" (or "active use") of the park or forest, whether a particular use involves the consumption of ecosystem goods or not and whether or not cash benefits result from the use. In contrast, so-called "non-use" (or "passive use") values relate to the value that many people experience from the mere fact that parks and forests exist, even if they do not personally visit those areas or derive other tangible benefits from them. Related to such "existence" values are the categories of "option" and "bequest" values.

These six sources of value will be discussed in detail in Sections III-VIII of this report. The order of discussion bears no necessary relationship to the relative "importance" or magnitude of the six types of value.

B. Methods of Estimating Value

The six types of economic value differ considerably in terms of how easy they are to quantify in monetary terms, the most common measure of economic value. For goods and services for which commercial markets exist, the market prices of the goods and services are usually taken as reasonable estimates of the value that consumers assign to those goods and services. Economists usually begin a valuation project with market prices if available.

In contrast, many of the goods and services provided by parks and forests are not sold in regular commercial markets and therefore have no market prices. Many ecosystem services fall into this category, such as soil retention, carbon sequestration, and water regulation. The difficulties are compounded when we consider the aesthetic appeal of forests, the potential benefits of forest research, and non-use values such as existence value. Economists have developed a number of methods to quantify at least some of these sources of value, and Appendix A describes the most important of these techniques.

The valuation methods used in this report estimate the value of natural assets such as parks and forests by quantifying the value of the annual "flow" of benefits which the assets provide, e.g., recreational value. Since those flows usually continue over an extended time period, their monetary equivalents can be discounted to yield the estimated present value of the assets. In real estate appraisal, this approach is called the cash flow method. Other valuation methods used by real estate appraisers focus on the "stock value" of the assets; these methods include book value (for land, the historical acquisition cost), replacement cost (for physical assets other than land), and comparable sales. In terms of financial accounting, the cash flow method can be thought of as pertaining to the income and cash flow statements, while the other methods pertain to the balance sheet.

Since the asset sale rubric does not apply to the State parks and forests, the present report is not intended as a real estate appraisal and thus does not examine the value of the State parks and forests considered purely as theoretically saleable assets. Any such examination would face various hurdles. First, the book value of an asset such as land that does not depreciate and that was acquired many years ago is a purely historical figure with little if any current relevance. Second, since the undeveloped portions of parks and forests would be difficult or impossible to replace, replacement cost is not relevant. Third, in terms of comparable sales, the prices paid by the Garden State Preservation Trust, Green Acres Program, Natural Lands Trust, and others to acquire land to add to the system of State parks and forests are far lower than the present value of the flows of goods and services provided by those parks and forests and thus seem inappropriate to use as measures of their economic value. For these reasons, this report uses only the cash flow method.

In principle, valuation analyses should be carried out at the level of the individual facility, since every site is unique, considered both by itself and in terms of its local economic and ecological context. However, such an analysis would require resources far beyond those available for the current project and could require several years to complete without necessarily resulting in a significantly higher degree of accuracy. Therefore, the analyses presented in this report were performed largely at the state level, albeit using aggregates of facility-specific data.

This choice represents a compromise between theoretical precision and practicality, but in the authors' judgment the compromise is a reasonable one.

C. Cash and Non-Cash Values

In addition to the classification scheme outlined above, the flows of value portrayed in Fig. 1 can also be classified in two broad categories in terms of their *financial* impacts:

- Some flows result in the exchange of cash for goods or services, as for example when a visitor pays for food sold by a park concession stand, and when the concession stand's owners, employees and suppliers spend their share of the revenues received from such sales. Such flows have financial impacts on the private parties involved and on the State economy as a whole.

- Other flows do *not* result in the exchange of cash for goods or services. For example, the root systems of trees hold soil in place, thereby reducing the amount of sediment in streams that flow through forests. The residents of a town that takes its drinking water from such a stream do not pay explicitly for the sediment control service that the forest provides. However, those residents would probably be willing to pay something for that service if they had to, since building and operating a sediment filtration plant would probably cost them considerably more. By reducing the cost of sediment control, the forest provides a service with a clear economic value for the State, a value that can be estimated using various techniques.

This report analyzes both types of impacts to present the fullest possible picture of the economic benefits provided by New Jersey's State parks and forests. For further discussion of the distinction between cash and non-cash impacts, see Stynes et al. (A) and (B) and Wells (1997).

It should be noted that a complete economic analysis would also include the costs involved in maintaining the State parks and forests, including the "opportunity" cost, i.e., the potential value foregone by preserving the parks and forests in their current undeveloped state. Estimating the full economic cost of preserving New Jersey's State parks and forests would require a major study in its own right, including extensive data collection and analysis. Such an undertaking is beyond the scope of the current project, although the analysis of income generation value does provide information on certain types of public sector spending, which is one major type of cost. Even there, however, the emphasis will be on the benefits stemming from the expenditures in question.

The following six sections of this report analyze in detail the sources of economic value which New Jersey derives from its State parks and forests, using data for fiscal years 2000-2004 as a baseline. Section IX summarizes the report's findings, discusses the uncertainties in the estimates, and offers some concluding observations.

Section III: Recreational Value

The most obvious economic benefits provided by New Jersey's State parks and forests are the recreational services they offer to visitors. The basic measure of these benefits is the value of these services *to the visitors themselves*. For the five years 2000-2004, New Jersey's State parks and forests attracted an average of 14.2 million visitors annually. These facilities provide a wide range of recreational opportunities:

- One group of recreational activities comprises what economists call "non-consumptive use", including swimming, hiking, camping, canoeing, wildlife viewing,[10] etc. Leaving aside congestion effects, these activities leave the recreational resource intact for future users, i.e., they do not "consume" the resource. For example, multiple visitors can view a rare bird or swim in a river without using up the bird or the river, again assuming that congestion is properly managed.

- Parks and forests also provide habitat for game animals and fish, thereby affording opportunities for "consumptive use", including hunting and fishing. These activities consume the individual animal or fish, although if the rate of consumption or "harvesting" does not exceed a sustainable level, future users can enjoy the same activity. Hunting and fishing take place in lands that are privately owned, administered by DEP's Division of Fish and Wildlife, and Division of Parks and Forestry. According to a 2004/2005 Hunting Report, 282,000 acres of park and forest lands were open to hunting. However, hunting and fishing data limited to SPS sites is not readily available. Therefore, this source of value is not addressed in the present study.

Economists treat all of these sources of value under the umbrella of "direct use value".

The generally accepted measure of direct use value is the willingness of actual or prospective users to pay for the opportunity to enjoy a site's recreational "services", i.e., the maximum amount that they would be willing to pay (WTP) for the opportunity to enjoy the services (Freeman 2003). Except in hypothetical circumstances, this will usually exceed the amount that users actually pay. For example, a user might be willing to pay up to $10 if required for the right to visit a particular park, but the actual admission charge might only be $6. Economists call the difference "consumer surplus". Whether consumer surplus is important for New Jersey and how it might be measured for State parks and forests will be discussed below.

The most obvious way to quantify WTP for our State parks and forests would appear at first to be the revenues from admission charges for those sites. Nineteen of the 56 State parks, forests, and recreation areas managed by SPS have fees of some kind for day visitors. Of the sixteen, eight charge fees for weekday and weekend visitors who drive into the facility, but nothing for visitors who walk in. Five facilities charge fees for both drive-ins and walk-ins, while another five charge a fee for weekend drive-in visitors only. One site (Parvin State Park) charges a fee for walk-ins over the age of 3, and one (Island Beach State Park) charges fees for in-season and off-season drive-ins. Where charged, fees are generally $5 per vehicle for

[10] Wildlife viewing and certain other activities are sometimes treated separately as "ecotourism".

weekday drive-ins, $10 per vehicle for weekend drive-ins, and $2 per person for walk-ins.[11] If allowed, overnight campers incur an average fee of $2.50 per person per night.

For the five years 2000-2004, revenues from these fees and from the fees for visitors to State historic sites averaged $2.9 million annually[12]. With an average of 15.1 million visitors annually to all SPS facilities (14.2 million to State parks and forests and 900,000 to historic sites and miscellaneous facilities), SPS visitor revenues averaged 19 cents per visit. Given that most State parks and forests have *no* admission fees, it is clear that SPS revenues from visitors do *not* represent the total WTP of visitors to State parks and forests. Leaving aside issues of collection and enforcement, if every visitor (both drive-in and walk-in) paid $1 per visit, revenues from entry fees for State parks and forests alone would average $14.2 million annually; even at 50 cents/visit, such revenues would average $7.5 million, as compared to the actual 5-year average of $2.9 million for visitors to *all* SPS facilities.[13] It seems implausible that very many visitors would be unwilling to pay these extremely modest amounts.

By understating users' total WTP, entry fees thus understate the total direct use or recreational value of the State parks and forests, and the understatement appears to be quite large. Put another way, users of the State parks and forests in the aggregate are realizing a very substantial but unquantified consumer surplus given the low level of actual cash payments.

Under these circumstances, one conventional way of estimating that consumer surplus or, equivalently, of estimating total WTP, would be a "revealed preference" method such as contingent valuation (see Appendix A). The contingent value method or CVM essentially involves use of a carefully constructed survey to elicit expressions of WTP under various hypothetical circumstances from actual or potential consumer, in this case visitors of State parks and forests. For example, actual and potential visitors might be asked whether they would be willing to visit a given State park or forest if the entry fee were increased to a given hypothetical level. The technique may sound simple, but well-designed CV surveys contain numerous safeguards that attempt to detect responses that do not in fact represent users' true WTP.

While the results of a CV survey could be considered hypothetical, economists who design and conduct such surveys defend them as having as much validity as market or consumer research and public opinion polling, each of which is widely used in business, advertising, and electoral politics by firms and candidates who presumably think the results are worth something

[11] For State parks and forests with fees, the difference between the regular drive-in rates and the walk-in rate arguably represents mainly payment for parking rather than for the visit per se.

[12] This figure basically includes only Day-Use Parking/Walk-in Fees, Overnight Use Camping, and State Park Passes. SPS reported revenues, which average $5 million annually for the 2000-2004 period, include other items such as restaurant, concessions, and golf course revenues. These other items are not relevant to this particular context.

[13] Strictly speaking, estimates such as these should be based on *marginal* willingness to pay (MWTP); however, any estimates of MWTP would need to be based on a complete demand curve for each SPS facility. Since that data is not available, this report uses *average* WTP. The authors believe that the very low level of WTP assumed in the illustration is unlikely to exceed MWTP for any significant class of visitors and are therefore conservative.

since they are willing to pay large sums to the survey firms. Nonetheless, skeptics continue to criticize CVM as offering only expressions of opinion not backed by actual economic behavior. Moreover, a good CV survey takes time and skill to design and conduct and carries a substantial price tag. As far as is known, no CV study has ever been conducted for the State parks and forests, although such studies have been conducted for other parks and forests in other areas of the country.

Travel Cost Method

Another frequently used method for estimating the total WTP of visitors to recreational facilities is the "travel cost" (TC) method.[14] In economic theory, the value of recreational services *to a visitor* is the visitor's willingness to pay (WTP) for the services; the aggregate value for all visitors is then the sum of the individual WTPs. WTP in turn is based on the demand for recreational services (at the individual or aggregate level). Models for estimating recreational demand are based on the fact that visiting a recreational site involves an implicit transaction in which the visitor incurs various costs (see below) in return for the value or "utility" he or she experiences during the visit. Assuming that the value of the visit to the visitor is at least equal to the costs incurred, the total cost represents the implicit price of the visit to the visitor and hence provides at least a "lower bound" for the value of the visit.[15]

A full study using the Travel Cost Method (TCM) requires that information be available on the amount of time that visitors spend traveling to specific parks and forests, the amount of time they spend at those facilities, and several other factors; such information is often collected through a visitor survey. While the information needed for a complete TCM analysis of recreational value is not available for the State parks and forests,[16] it is possible to perform a simplified analysis to obtain rough estimates of the value to visitors of their trips to the State parks and forests. Exhibit A presents such an analysis.

The costs incurred in visiting recreational sites include the value of the time spent traveling to the site and back, the value of the time spent at the site, the admission fee (if any), and any cash travel costs, e.g., tolls and gas. Admission fees and cash travel costs are considered in Section IV on economic activity.[17] Travel and visit times are normally the largest components of

[14] The following discussion draws heavily on Freeman (2003), perhaps the leading text on environmental valuation theory and methods. The issues involved are much more complex than indicated here, and readers interested in a more complete treatment should consult Freeman (2003), chapter 13, and the many sources cited there.

[15] The value could be higher if the visitor is willing to incur even higher costs, e.g., if he or she is willing to make the visit even if the price of gasoline increases from the level in effect at the time of the visit.

[16] According to SPS staff, 70% of the visitors to State parks and forests live less than 30 miles from the facility visited and 30% live more than 30 miles away. However, application of the TCM requires more precise information on distances and travel times.

[17] Both the visitor spending estimates and the sales multipliers used in the Economic Activity analysis in the next section include entry fees; and since there is no clear-cut way to remove those fees from the spending figures, the fees are necessarily included in that analysis. Therefore, they are excluded from the estimates of recreational value in this section to avoid double-counting.

the visitor's total cost. Since no one has unlimited time, time has an implicit "scarcity value". Traveling to and from a recreational site and visiting it takes time away from other potential activities, i.e., it reduces the visitor's opportunities to engage in other activities. Travel and visit times therefore represent "opportunity costs" to the visitor. Since spending time on travel and visiting involves no explicit cash outlay, the question is how to assign a value (in economic terms a "shadow price") to that time.

Most empirical models of recreational demand take the relevant wage rate (or a percentage thereof) as the basis for measuring the opportunity cost of travel and visit time. In the simplest case, if a visitor has the opportunity of working additional hours at his or her usual wages, the value of his or her time equals 100% of the wage rate, since visiting a recreational site entails giving up an opportunity to earn additional income. The assumption is that the value of the visit to the visitor must at least equal the wage rate, or else the visitor would forego the visit to engage in additional hours of paid work.

Since not everyone has the opportunity to work additional hours for pay, for a large number of individuals the average value of recreational time will usually be less than 100% of the wage rate.[18] Economists have developed a variety of techniques for obtaining empirical estimates of this parameter; the techniques involve complex analytic procedures and survey data, and developing an estimate specific to visitors to New Jersey State parks and forests is well beyond the scope of the present study. A value of one-third of the wage rate was most commonly obtained (or assumed) in studies of recreational value performed in the 1970s and 1980s; some of the more recent studies have used higher values, e.g. 40%, and there is no a priori reason that the "true" value might not be even higher (cf. footnote 14 above).

One could therefore develop estimates of recreational value for visitors to the State parks and forests using 33% and 40% of the relevant wage rate. To help test whether these parameter values are plausible, we examined the results of a large-scale secondary study of the value of outdoor recreation by Rosenberger and Loomis (2001) conducted for the U.S. Forest Service. As part of the study, Rosenberger and Loomis reviewed five original studies of general recreational value in the Northeastern U.S. published between 1979 and 1996. Each of the original studies reported one or more "point" estimates of the value of general outdoor recreation to users of outdoor recreational facilities.[19] In addition, in what economists refer to as a meta-analysis, Rosenberger and Loomis analyzed those point estimates statistically to derive a new valuation function which they then used to generate further estimates.

In their final report, Rosenberger and Loomis converted all results to a common metric, namely *consumer surplus per person per activity day*. An activity day is the typical amount of time spent pursuing an activity within a 24-hour period. For example, if the typical time spent on a hiking trip in a 24-hour period is 10 hours, then an activity day for hiking equals 10 hours. As discussed above, consumer surplus (sometimes called net willingness to pay or net WTP)

[18] In some circumstances the percentage could exceed 100%. See Freeman (2003), p. 439.

[19] Rosenberger and Loomis also reviewed prior studies of specific activities such as hiking, boating, hunting, etc. Since we do not have a breakdown of visits to New Jersey's State parks and forests by activity, we have used the figures for general recreation for the present analysis.

represents the total amount that a consumer (here a park or forest visitor) would be willing to pay for the good or service in question, net of any costs that the consumer actually has to bear. (In the studies reviewed by Rosenberger and Loomis, visitor costs included the cost of gasoline, tolls, food, etc. and the value of the visitor's time in getting to the site, visiting it, and returning home.)

From the five prior studies they reviewed, Rosenberger and Loomis obtained an average consumer surplus per person per activity day of $16.76 for "general recreation" activities in the Northeastern U.S.; from their meta-analysis, they also obtained a new point estimate of $35.70.[20] If we assume that an average "activity day" for general recreation lasts four hours (including travel time), these figures translate into hourly consumer surplus estimates of $4.19 and $8.93, respectively. These in turn represent 26% and 55%, respectively of New Jersey's 2004 median hourly wage rate of $16.24. For purposes of the present analysis, we dropped the higher value in order to be conservative but used the other to provide a low-end estimate.

As Exhibit A shows, we therefore multiplied New Jersey's 2004 median wage rate of $16.24/hour by three different values—26%, 33%, and 40%—to obtain estimates of the hourly value to visitors of leisure time used for general outdoor recreation. We then multiplied the three estimates of leisure time value per visit by 14,200,000 annual visits to obtain estimates of total annual recreational value. As Exhibit A shows, those estimates range from $240 million/yr to $369 million/yr, with a central estimate of $304 million/yr.[21]

The above approach assumes that a linear relationship holds between length of visit and value per hour, i.e., each hour of visit time is assumed to have the same dollar value. An alternative assumption would be that each added hour has either a lower or a higher value than the earlier hours, i.e., the marginal utility of visit time decreases or increases as the total visit length increases. While such a non-linear relationship may be more realistic, quantifying it would require a complex econometric analysis based on either data on visitors to SPS facilities that is not available or on arbitrarily selected parameter values. For these reasons, we treat the per-activity-day and per-hour dollar amounts as *average* values and do not attempt to analyze the marginal recreational value of time spent visiting the State parks and forests.

The figures shown in Exhibit A indicate that the best estimate of total consumer surplus for the value visitors obtain from visiting State parks and forests is about $304 million, which greatly exceeds the actual entry fees they pay. In other words, the direct use value to visitors is much greater than their actual out-of-pocket payments for entry fees.

[20] The Rosenberger and Loomis (2001) values have been converted from fourth quarter of 1996 to 2004 dollars using the All-Items Urban Consumer Price Index published by the U.S. Bureau of Labor Statistics.

[21] Because a breakdown of visitors to State parks and forests by age group is not available, this analysis uses the same per-hour value of leisure time for both adults and children and therefore probably overstates actual recreational value.

Section IV: Economic Activity

In addition to the personal value or "utility" experienced by visitors to State parks and forests and discussed above under the heading of recreation value, spending related to State parks and forests contributes to New Jersey's economy by supporting business and employment opportunities that result in the production of cash income. These effects and the methods used to quantify them apply to both the private and public sectors. This report section presents the basic concepts involved and then applies them to private and public economic activities involving State parks and forests.

In estimating the cash income generated by New Jersey's State parks and forests, several basic caveats must be kept in mind:

1. Where labor, materials, and other resources in the area around an SPS facility are fully employed, any increase in economic activity associated with visitor spending will likely make use of resources previously employed elsewhere in the outdoor recreation sector or in a completely different economic sector, and as a result there will be *no net gain* in total economic activity but merely a reallocation of economic activity within or among sectors.

2. To the extent that visitors to State parks and forests come from elsewhere in New Jersey, the benefits for the locality where the park or forest is located may be offset by reduced spending elsewhere in the state, e.g., on visits to the Jersey Shore or to local movie theaters. The question is what part of the amount spent represents money that would not be spent in New Jersey without the presence of the State parks and forests.

To highlight these facts, economists distinguish between economic "impacts" and economic "significance". If all of the resources available to provide goods and services in State parks and forests would be fully employed elsewhere in New Jersey but for the existence of the State parks and forests, and if all of the visitors to these sites were New Jersey residents, the net impact of parks and forests on the state economy might be nil, but the parks and forests would still represent a significant share of the New Jersey economy. In a significance analysis such as the one presented below, the jobs, business opportunities, and income associated with the State parks and forests are not considered to be "new" to New Jersey, but they are nonetheless important and would need to be replaced if they did not exist. For further discussion of the difference between economic significance and economic impact, see Stynes et al. (A) and (B) and Wells (1997).

A. Basic Concepts

The standard method used to estimate the income generated by visitor spending to a park or forest is somewhat involved; a detailed explanation is provided in Appendix B. The Total Effects of spending related to parks and forests are divided into Direct Effects and Secondary Effects. The steps used to estimate the Direct Effects can be summarized as follows (capitalized terms are standard in this field):

1. The number of visits[22] is multiplied by spending per visitor to obtain *Total Spending*. Ideally, visitor spending is obtained from site-specific surveys and is broken down into major categories such as lodging, food, transportation, etc. Where such data is not available on a site-specific basis, total spending per visit from other sources is used instead.

2. Total Spending is multiplied by the Capture percentage to obtain *Direct Sales*. The capture percentage is less than 100%, reflecting the fact that visitor spending on some goods and services is paid to out-of-state suppliers and generates no economic benefits in New Jersey; this phenomenon is called Leakage. For example, a restaurant near a State park may purchase food from out-of-state distributors; the restaurant receives only its "retail margin" .

3. Direct Sales is multiplied by a value-added percentage (less than 100%) to obtain *Value Added*, which constitutes the net contribution to Gross State Product (GSP). The retail vendors who provide goods and services to visitors purchase inputs from in-state suppliers, e.g., food, utilities, etc. The cost of such inputs is reflected in the retail price to visitors and is therefore implicitly part of the retailer's revenue, but it is also revenue for the suppliers. The use of the value-added percentage avoids double-counting of these revenues.

4. Value Added is multiplied by an income percentage (less than 100%) to obtain *Direct Income*. This adjustment reflects the fact that in addition to Income, Value Added also includes amounts relating to inventory and "capital consumption" (depreciation), sales and excise taxes, and other components that do not constitute personal or household income.

5. Direct Sales is also multiplied by the number of jobs supported per million dollars of sales to obtain *Direct Employment* or *Direct Jobs*. Like the various percentages mentioned above, this factor is taken from the related economics literature and prior economic impact studies. The salaries for such jobs are not additional benefits but rather are included in Direct Sales and the other quantities described above.

Once the Direct Effects have been determined, the steps used to estimate the Secondary and Total Effects are as follows:

6. As the dollars that make up Direct Sales are re-spent in New Jersey, they support further economic activity, which in turn supports still further activity, and so on. For example, employees of motels that serve park visitors spend their wages on food and clothing, creating Secondary Sales for those retailers. The economic "stimulus" decreases at each "round" of spending, eventually reaching a *de minimis* level.

[22] Best practice in this type of analysis calls for estimating visitor spending, Direct Sales, etc. on the basis of party-days or party-nights, since a group of people (such as a family) traveling together will have aggregate spending levels that reflect common costs such as motel rooms and gasoline. Because SPS data are not sufficiently detailed to support party size estimates for New Jersey, all calculations in this report are carried out in terms of visits (i.e., visitor-days).

7. To quantify this *Multiplier Effect*, Direct Sales is multiplied by a *Sales Multiplier* (derived from the economics literature or prior studies) to obtain *Total Sales*; Secondary Sales are the difference between Total and Direct Sales. For parks and forests, the multiplier is usually between 1 and 2. A multiplier of 1.5 means that for each dollar of Direct Sales, 50 cents of Secondary Sales are generated for Total Sales of $1.50.

8. Once Total Sales have been estimated, Total Value Added, Total Income, and Total Employment are calculated in the same fashion as their Direct counterparts, except that the various percentages differ from their Direct equivalents. The percentages are again obtained from the relevant economics literature and prior economic significance studies.

While the above methodology may seem fairly straightforward, its actual application to the State parks and forests is challenging for a number of reasons.

1. Detailed data on visitors to State parks and forests is lacking, including data on hometown, method of travel, types and amounts of expenditures, etc. Given this, estimates of Total Spending, Leakage, Direct Sales, Value Added, and Direct Income must rely on estimates drawn from non-New Jersey sources, which introduces an element of uncertainty.

2. The level of Secondary Sales also depends on the levels and types of visitor spending. For example, spending on meals in restaurants near a park or forest will create demand for raw food of various sorts, restaurant furniture and equipment, electricity and cooking fuels, menus, tablecloths, silverware, etc., while spending for motel lodging will create demand for an entirely different set of inputs. Since the strength of the Multiplier Effect is industry-specific, the absence of detailed visitor spending data necessitates use of generic Sales Multipliers.

3. Similarly, the effects of that portion of Secondary Sales driven by the spending of income by employees and business proprietors depend on the proportion of Value Added that represents Income, the average salaries of employees, etc. These factors vary by industry as well, but the data available for State parks and forests is not sufficiently detailed to support industry-specific calculations.

Given these limitations, this study uses input assumptions derived from non-New Jersey sources believed to be relevant; this necessarily introduces an element of uncertainty into the estimates presented below. However, even when precise site-specific data are available, there is an element of imprecision in estimated economic impacts.[23] The authors believe that the results presented below are comparable to those that would be obtained if more detailed information were available.

[23] As noted earlier, the present analysis is a significance analysis; however, the more familiar term impact analysis is used for convenience.

B. New Jersey Data

As described above, the following pieces of information are needed to estimate the income generation value of the State parks and forests:

- numbers and types of visitors
- average spending per visit
- capture or leakage percentage
- sales multiplier
- value added percentage (direct and total)
- income percentage (direct and total)
- employment multipliers (direct and total)

These factors are discussed in the following paragraphs.

Number and types of visits. For the five years 2000-2004, total visits to State parks and forests averaged 14.2 million, of which 3% represented overnight visits.[24] SPS estimates that 70% of its day visitors are local (they live closer than 30 miles) and 30% non-local. In contrast, the local and non-local shares of daytime visits were 40% and 60% respectively for a sample of National Park Service (NPS) facilities in the Northeastern United States, and overnight visits accounted for 23% of total visits. The NPS facilities thus have a very different visitor mix; however, given New Jersey's high population density, it is plausible that local residents would generate a higher share of total visits.

Average spending per visit. The authors have found only three sources for estimates of spending by visitors to New Jersey's State parks and forests. The first is contained in a 2003 analysis on "Trends 2001" prepared by the Division of Parks and Forestry[25]. That analysis stated that visitors to State parks and forests spend about $165 million annually (in 2003 dollars) on goods and services directly related to park and forest visits, excluding admission fees. The $165 million represented about $11.62 per visit on average (in 2003 dollars).

The $165 million estimate was based on data from a 1994 National Park Service survey of expenditures by visitors to selected parks in NPS's North Atlantic Region. Review of the original source document[26] reveals that the parks surveyed were limited to two or three facilities: Minuteman National Historic Park in Lexington/Concord, Massachusetts and the Statue of Liberty/Ellis Island (with the New Jersey and New York portions considered as two separate

[24] A number of SPS facilities are so small that they lack on-site staff to collect visit data; therefore, the figures here do not include those sites.

[25] The full title is Economic Impact of Visitors to Division of Parks and Forestry Sites, Statewide Money Generation Model – 2000, National Park Service Methodology – 1995, Trends 2001", Division of Parks and Forestry, November 18, 2003.

[26] Economic Impacts of Visitors to National Park Service Units, North Atlantic Region, Draft Report for National Park Service, North Atlantic Region, prepared by Douglas Rae, independent economist, April 1995, Exhibit 1.

parks). In the judgment of the authors of the current report, the 1994 survey is not an adequate basis for the present study.

Two New Jersey-specific estimates of visitor spending are available from the website of economist Daniel Stynes at Michigan State University[27]; Stynes was the lead author for the 2001 update of the Money Generation Model (MGM2) used by the National Park Service (NPS). Those estimates pertain to Morristown National Historic Park and Edison National Historic Site; the figures for the latter reflect a total of just 3,359 visits. While these estimates are New Jersey-specific, they relate to just two specific historic sites. It is therefore questionable whether they provide an adequate basis for estimating visitor expenditures for State parks *and forests* that are not explicitly designated as historic sites and that are not located in highly urbanized areas such as Morristown and Edison.

A 2001 study by the US Fish and Wildlife Service (USFWS) provides data on estimated spending by wildlife watchers, hunters, and fishers in New Jersey. This study is often cited as support for the statement that these groups spent a total of $2.2 billion in New Jersey in 2001. However, there are several problems with this conclusion:

- Of the $2.2 billion, only $0.2 billion came from non-residents; the other $2.0 billion came from New Jersey residents. Therefore, it is likely that substantially less than the $2.0 billion represents new dollars for the New Jersey economy; the $2.0 could still have economic *significance* for New Jersey but not economic *impacts* as defined earlier.

- Of the $2.0 billion spent by New Jersey residents, $1.2 billion was spent by wildlife watchers (including bird watchers) and the other $0.8 million by hunters and fishers. As discussed earlier, because many of the sites where hunting and fishing take place are privately owned or administered by DEP's Division of Fish and Wildlife or Office of Natural Lands Management, data limited to SPS sites is not readily available, and therefore, these sources of value are not addressed in the present study.

- The $1.2 billion spent in New Jersey by wildlife watchers includes $0.2 billion in equipment and $0.2 billion for items such as food, lodging, and transportation; the uses of the other $0.8 billion—which represents two-thirds of the $1.2 billion—were not identified. It seems risky to accept the $1.2 billion as a basis for the current study without having some idea of what the $0.8 billion was spent on.

- The $1.2 billion of in-state spending was reportedly generated by 1,895,000 participants in wildlife watching. This comes to over $650 per participant, a figure far in excess of the estimated per visit spending for any category of visitor to any park or forest in the US for which spending data are available. This amount is therefore suspect.

- It seems likely that a significant portion of the $0.2 billion of equipment was produced outside New Jersey, meaning that most of those dollars would be subject to leakage.

[27] See http://www.prr.msu.edu/mgm2/default.htm.

The authors conclude that the USFWS study is not a suitable basis for the present study.

In the absence of reliable New Jersey-specific visitor expenditure data, we could use national averages for facilities that have been studied or generic averages for broad classes of such facilities, e.g., those located in metropolitan, small town, or rural areas, those with "average" or higher or lower than average spending, etc. Each of these approaches would likely bias our results to an unknown extent. Instead of taking that risk, this study uses expenditure estimates based on two samples of National Park Service facilities located in the Northeastern United States. The following paragraphs describe the samples in detail[28].

State parks. New Jersey's State park system includes a variety of sites, such as Revolutionary War battlefields (Princeton and Monmouth), beaches (Island Beach State Park), early industrial era sites (Long Pond Ironworks), forested parks (Swartswood State Park), and major national monuments (Liberty State Park). Because of this variety, it can be argued that any estimates of per-visit spending should be based on a sample of comparable facilities rather than a random sample of national parks from across the country. Visitors to New Jersey's parks and forests are unlikely to have the same spending and travel patterns as visitors to, say, Yosemite, Yellowstone, or the Grand Canyon.

Therefore, we collected data on Total Spending, Direct Sales, and other factors for a group of national parks in the Northeastern United States; Exhibit B presents this comparison group and shows its relationship to New Jersey's State parks and forests. While some facility classifications could be challenged, the range of NPS facilities available for constructing a comparison group is not unlimited, and the mix of NPS facilities at least parallels the mix of SPS facilities in broad terms. Exhibit C presents selected spending data for the NPS sites.

Visitor spending patterns vary between local and non-local visitors, day and overnight visitors, and (within the "overnight" category) between visitors camping vs. those staying in hotels, motels, or B&Bs. Therefore, we calculated a weighted average per-visit spending level of $16.32 based on weights provided by SPS (if available) or on an assumed 50/50 split.

State forests. National data compiled for the National Park Service and US Forest Service show that park and forest visitors have somewhat different spending patterns and levels. For example, visitors to national forests are likely to travel different distances, are more likely to camp out, and will likely spend more on groceries than on prepared meals. It could therefore be risky to generalize from park visitors to forest visitors or vice versa. Both NPS and SPS operate facilities that can be described as forests, but such sites represent a larger share of the SPS portfolio than they do of NPS's overall Northeastern US portfolio.

To address this issue, we constructed a separate comparison group of NPS forest sites; this group and the related spending data are shown in Exhibit D. As with State parks, we calculated a weighted average per-visit spending level of $18.90 based on weights provided by SPS (if available) or on an assumed 50/50 split. The difference in spending levels between visitors to

[28] The analytical separation of State parks and State forests is for purposes of comparison with national/federal land examples in the northeast: national parks administered by the National Park Service and federal forest lands administered by the U.S. Forest Service.

parks and forests comes to $2.58 or 16% per visit. While it may appear small in isolation, such a difference becomes more important when applied to a total of 14.2 million visits a year.

Other required inputs. The other inputs required for the income generation analysis were also obtained from the two NPS comparison groups, i.e., capture rates, sales multipliers, income and value added percentages, and employment multipliers (see Exhibits E and F).

C. Private Sector Spending

Based on the methodology and input assumptions discussed above, Table 1 below shows the estimated economic activity associated with private sector expenditures related to State parks and forests. The estimates are based on an average volume of 14.2 million visits a year (11.9 million to State parks and 2.3 million to State forests). Details may not add to totals due to rounding. Exhibit G provides the detailed back-up.

Table 1: Summary of Economic Activity Analysis for State Park and Forest Visitor Expenditures (millions of 2004 dollars per year)

	Direct	Secondary	Total
Visitor spending	$238	N/a	$238
Sales*	194	94	289
Value Added**	107	59	166
Personal Income	71	34	106
Jobs supported	4,706	1,267	5,973

**Sales=Spending–Leakage **=increase in GSP*

As noted earlier, State parks and forests constitute about one-sixth of the forested land in New Jersey. The above figures therefore greatly understate the economic contribution of the State's total endowment of forested land. Also, the figures in Table 1 are all annual amounts; on a present value basis, these annual benefits are worth billions of dollars, as will be discussed in Section IX of this report. These contexts are essential to appreciating the important role that State parks and forests play in New Jersey's economy.

D. Public Sector Spending

As suggested earlier, expenditures by government agencies such as SPS have the same economic impacts as expenditures by private parties, all other things being equal. State agencies purchase products from suppliers and support payrolls, and the re-spending of money by suppliers and employees generates secondary activity in the same fashion as private expenditures. Only the category of proprietors' income does not apply in the public sector, although agencies could in principle generate operating surpluses in any given year.

In addition to general appropriations, State Park Service revenues include entry fees from visitors, concession and lease payments from businesses, withdrawals from certain revolving funds, and others. Excluding appropriations, total SPS revenues averaged $7.8 million for the five years 2000-2004, although FY 2005 non-appropriation revenues were substantially higher.

However, revenues are not a suitable basis for estimating economic impacts, because economic activity is generated when money is *spent*, not when it is received. The relevant quantities are therefore SPS's operating and capital expenditures.

For the 5 years 2000-2004, the NJ State Park Service spent an average of $34.2 million (in 2004 dollars) for day-to-day management of the State parks and forests, including salaries, equipment, supplies and services. For the same period, SPS spent an average of $7.3 million annually (in 2004 dollars) on capital projects. In the same way as private sector spending, the purchases of supplies and equipment, the spending of income by SPS employees. and SPS's capital expenditures generate secondary effects as described earlier in this section. While the spending here come from a public agency, private sector businesses are the most likely to benefit from these multiplier effects.

To estimate the magnitude of the secondary effects, one could attempt to use the same multipliers as were used earlier to estimate the impacts of private sector spending. However, since SPS employs a different occupational skill mix from private firms (e.g., park rangers rather than hotel and restaurant staff) and purchases a different mix of supplies and equipment (e.g., maintenance equipment and office supplies rather than food and lodging), merely using the multipliers for private sector spending could lead to inaccurate results.

To address this issue, the authors first broke SPS's operating expenditures into personal services (salaries, wages and employee benefits) and other expenditures, using the breakdown of Direct State Services (DSS) in the 2002-2004 annual State budgets for Natural Resources Management (which includes SPS).[29] Including benefits, personal services averaged 70% of total DSS for those years, and we assumed that the same percentage applies to SPS.

Spending by SPS employees who live in New Jersey generates economic activity in the state; spending by SPS staff who reside in other states also generates economic activity in New Jersey, but at a lower rate. Since the latter rate is not known, we assumed that 100% of the compensation of non-resident staff is spent outside New Jersey. Based on SPS data, non-residents represent 6.7% of SPS staff, so we used 93.3% as the capture rate for employee compensation. For other operating expenditures, we assumed a capture rate of 82% based on a sample of previous studies of public agency spending, as described in Appendix C.

As to the remaining parameters, we made the following assumptions:

- We assumed the ratio of Value Added to Direct Sales to be 55%, the value for the US economy as a whole in 2004 (BEA 2006). Unfortunately, this type of information is not available at the state level.

- We assumed that the ratio of Direct Income to Value Added is 64%, the ratio of total earnings to the New Jersey GSP in 2004 (BEA SA04).

[29] Before 2002, employee benefits were included in the budget for the Department of Treasury, making pre-2002 figures non-comparable.

- To estimate the Direct Jobs multiplier, we divided Direct Sales by New Jersey's average earnings per job in 2004 (see BEA SA30) to obtain an estimate of the number of jobs supported and then worked backwards from that to obtain the multiplier.

- In the absence of better information, we assumed that these three parameters remain constant at the Total Effects level.

- Again in the absence of better information, we assumed that the values for all parameters are the same for capital expenditures as for total operating expenditures.

Based on these assumptions, Table 2 shows the estimated financial impacts of SPS expenditures; Exhibit H presents the details.

Table 2: Summary of Economic Activity Analysis for State Park Service Expenditures (millions of 2004 dollars per year)

	Direct	Secondary	Total
Agency spending	$42	N/a	$42
Sales*	37	21	58
Value Added**	21	11	32
Personal Income	13	7	20
Jobs supported	688	378	1,066

**Sales=Spending–Leakage **=increase in GSP*

In addition, it should be noted that SPS itself currently employs 463 full-time employees. However, these employees and their compensation are not counted here as economic benefits because doing so would have the paradoxical effect of automatically converting a cost into a benefit. Instead, on the salary side we count only the effects that occur when SPS employees spend their earnings. This treatment is in keeping with the literature, e.g., Stynes (A) and (B) and with other studies, e.g., NJCEGC (2000).

5. Fiscal Impacts

Most of the economic activity estimated above generates taxable income, resulting in tax revenues for the levels of government that impose and collect the taxes in question. However, in most cases, tax revenues are not considered to be an economic benefit. This is because taxation in essence transfers money from one party (the taxpayer) to another (the government), and the increase in resources available to the government is counterbalanced by the decrease in resources of the taxpayer.[30] Given this, and for the sake of simplicity, this study does not attempt to estimate the various tax revenues, although such revenues may be important from a purely *fiscal* perspective, i.e., from the standpoint of government finance.

[30] This is not intended in any way as an argument for or against particular levels of taxation or specific taxes; in fact, this report concludes that New Jersey's tax-funded expenditures on State Parks and Forests are clearly beneficial to the State as a whole.

Section V: Ecosystem Services

The Millennium Ecosystem Assessment (MEA)[31] defines an ecosystem as "a dynamic complex of plant, animal, and microorganism communities and the nonliving environment, interacting as a functional unit… Human beings are an integral part of ecosystems". MEA's basic premise is that the concept of an ecosystem provides a useful framework for analyzing and acting on the linkages between people and their environment.

Any region of Earth produces a set of services that influence human well-being. The two most widely-cited definitions of ecosystem services are as follows:

> "Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life. They maintain biodiversity and the production of ecosystem goods, such as seafood, forage timber, biomass fuels, natural fiber, and many pharmaceuticals, industrial products, and their precursors." (Daily 1997)
>
> Put more simply, "[e]cosystem goods (such as food) and services (such as waste assimilation) represent the benefits human populations derive, directly or indirectly, from ecosystem functions." (Costanza et al. 1997)

Ecosystem services (or ecoservices for short) have been classified in a number of ways, and ecosystem services are sometimes defined to include ecosystem goods. The MEA groups ecosystem services into four main categories as follows:

- Provisioning "services": the products obtained from ecosystems, such as food and fuel.
- Regulating services: the benefits obtained from the regulation of ecosystem and abiotic processes, e.g., Earth's climate system.
- Cultural services: the non-material benefits that people obtain from ecosystems, such as aesthetic experiences.
- Supporting services: those that are necessary for the production of all other ecosystem services. These services differ from provisioning, regulating, and cultural services in that their impacts on people are either indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people.

When managed sustainably, natural forests provide multiple ecosystem services; Box 1 (next page) lists and defines the most important of these, grouped into the four MEA categories. Some services bridge two categories, e.g. waste assimilation could fit under regulating or provisioning services.

[31] The Millennium Ecosystem Assessment is an international effort to provide decision makers and the public with scientific information concerning the consequences of ecosystem change for human well-being and options for responding to those changes. The Assessment was launched by U. N. Secretary-General Kofi Annan in June 2001 and was completed in March 2005.

BOX 1: ECOSYSTEM SERVICES PROVIDED BY FORESTS

Provisioning Services:

1. ***Hydrological services****:* fresh and clean water is essential to life and is one of humanity's most valuable natural assets. When water supplies fail, water must be imported at great expense, more extensively treated, or produced using more expensive means (such as desalinization). Forests and their underlying soil help ensure that rainwater is stored and released gradually rather than allowed to immediately flow downstream as runoff. Forests provide a natural buffer between human activities and water supplies, filtering out pathogens, nutrients, metals, and sediments. This service benefits humans by providing cleaner drinking water and plants and animals by reducing harmful algae blooms, increasing dissolved oxygen, and reducing excessive sediment in water.
2. ***Biodiversity/genetic data:*** every species contains unique genetic information and contributes in often unknown ways to the ecosystems where it lives. Scientists increasingly view biodiversity as insurance against ecosystem fragility and as sources of new medicines and food products.

Regulating Services:

3. ***Climate/gas regulation****:* life on earth exists within a narrow band of chemical balance in the atmosphere and oceans, and alterations in that balance can have positive or negative impacts on climate processes and air quality. Ecosystems influence this chemical balance in many ways. For example, trees sequester carbon (a major greenhouse gas) and also improve air quality by filtering out particulates and toxic compounds.
4. ***Disturbance mitigation****:* many natural and semi-natural landscapes provide a 'buffering' function that protects humans from destructive perturbations. For example, forests help mitigate the effects of floods by trapping and containing stormwater.
5. ***Biological control:*** dynamic regulation of species populations, including control of invasive and unwanted species, e.g., pests, predators, weeds, disease vectors, etc.

Cultural Services:

6. ***Aesthetic/recreational****:* intact ecosystems that attract people who fish, hunt, hike, canoe, watch wildlife, etc. bring direct "utility" to people for which they are willing to pay. People are also often willing to pay to preserve the integrity of a natural site to protect the beauty and quality of that site.
7. ***Cultural/spiritual:*** some ecosystems, habitats, or landscapes have special meaning for human beings, even those who do not live nearby. That meaning can be cultural, historical, spiritual, or even religious, depending on the circumstances.

Supporting Services:

8. ***Wildlife habitat/refugia***: Contiguous landscape 'patches' large enough for natural ecosystem functioning support many plant and animal species. As patches decrease in size and become isolated, population sizes can decrease below the levels needed to maintain genetic variation, withstand events such as storms, droughts, and population oscillations, and meet breeding and migration needs. Intact forests serve as critical population sources for species that human beings value for aesthetic and functional reasons.
9. ***Soil formation/retention****:* soils provide many of the services mentioned here, including water storage and filtering, waste assimilation, and a medium for plant growth. Natural systems create and enrich soil through weathering and decomposition and retain soil by preventing its being washed away by precipitation.
10. ***Pollination:*** like other ecosystems, forests provide pollinators essential to the reproduction of plant populations.

It should be noted that the above definitions of ecosystem services and the categories of such services are not universally accepted. For example, Boyd and Banzhaf (2006) criticize the definitions quoted above as too vague and all-encompassing, in part because they include ecosystem functions and processes which are components of true ecosystem services; in standard economic terminology, the functions and processes are "intermediate goods", while the services are (or at least may be) "final goods".

As one example, Boyd and Banzhaf cite the MEA's category of supporting services (see above), which by definition are "necessary for the production of all other ecosystem services." Counting both the value of the supporting services and the value of the services that are supported amounts to double-counting, in the same way that including in economic output both the value of steel production and the value of steel-containing buildings and vehicles counts the value of the steel twice. The critique by Boyd and Banzhaf is too recent to have affected ecoservice valuation practice but could well affect future valuations.

A growing number of studies have found the ecosystem services provided by forests, wetlands, and other ecosystems to be of great economic value, e.g. Constanza *et al.* (1997), Pearce & Pearce (2001), and Pearce & Moran (2001). In perhaps the most comprehensive recent effort, Anielski and Wilson (2005) have assessed the value of the ecosystem services provided by Canada's boreal forests. In fact, in terms of globally critical issues such as climate stabilization and protection of biodiversity, forests often provide higher-value ecosystem services than many other terrestrial ecosystems.

The value of a given ecosystem service for a defined geographic area can be thought of as follows: Value of Ecoservice = Acres of land or water providing service x Service level per acre x Value per service unit. While acreage is relatively simple to determine, the level of ecosystem services provided by a given ecosystem depends on local climatic, biological, geological, and economic circumstances, as well as on the management regime (e.g., natural forest, agroforestry estate, forest plantation, intensive logging, ecotourism, etc.). Given the limitations on knowledge, time, and resources, analyzing the variations in such factors over a geographic area as large as New Jersey is currently not feasible. However, sophisticated models have been constructed for smaller-scale areas, and increases in computing power should enable future researchers to continue expanding the geographic reach of such models.

Because of these constraints, the ecoservice value of a given ecosystem is generally estimated using a simplified approach: Value of Ecoservice = Acres of ecosystem providing a given ecoservice x Value per acre, which tacitly assumes that each acre of the ecosystem provides a comparable level of each ecosystem service. In the absence of contrary information, this is an unavoidable default assumption. The valuation task then reduces to determining a value per acre for each ecoservice of interest and the area of the ecosystems involved. In this study, the per-acre values were obtained using a method known as "value transfer".

The Value Transfer Method

Value transfer is the adaptation of existing valuation information to new geographic or policy contexts. The transfer method involves two steps:

- obtaining one or more estimates for the value of a given non-marketed ecoservice from one or more prior studies carried out in a different geographic area or under a different policy regime.

- applying those values from the original 'study site(s)' to a new 'policy site', in this case New Jersey's State parks and forests.

The critical underlying assumption of the transfer method is that the economic value of ecosystem services at the study site can be inferred with sufficient accuracy from the analysis of existing valuation studies at other sites (Desvouges et al., 1998; Loomis, 1992; Smith, 1992). For a convenient summary of the value transfer method, see Rosenberger and Loomis (2001).

With the increasing sophistication and volume of empirical studies in the peer-reviewed literature, value transfer has become an increasingly practical way to inform decisions when primary data collection is not feasible due to budget and time constraints, or when expected payoffs are small (Kreuter et al., 2001; Moran, 1999). As such, the transfer method is a very important tool for policy makers since it can be used to reliably estimate the economic values associated with a particular landscape, based on existing research, for considerably less time and expense than a new primary study. As the richness, extent and detail of information increases within the source literature, the accuracy of the value transfer technique will likewise improve.

The value transfer method is increasingly being used to inform landscape management decisions by public agencies (Downing & Ozuna, 1996; Eade & Moran, 1996; Kirchoff et al., 1997; Smith, 1992). Despite acknowledged limitations such as the sensitivity of value estimates to contexts, existing studies can and do provide a credible basis for policy decisions involving sites other than the study site for which the values were originally estimated. This is particularly true when existing ecosystem service valuations are either negligible or (implicitly) zero because they have simply been ignored.

While primary valuation research will always be a "first-best" strategy for gathering information about the value of ecosystem goods and services (Smith 1992; Downing and Ozuna 1996; Kirchhoff et al. 1997), value transfer has become an increasingly practical way to inform policy decisions when primary data collection is not feasible due to budget and time constraints, or when expected payoffs are small (USEPA 2000; National Research Council 2004). In such cases, the "second-best" strategy of value transfer can be a source of meaningful valuations. The usual alternative is to treat the economic value of ecosystem services as zero, a "solution" that, based on the weight of the empirical evidence, will often be much more error prone than value transfer results themselves.

Valuation of Specific Ecosystem Services

Preservation of parks and forests can yield substantial economic benefits in the form of ecosystem services. In fact, ecoservices such as watershed protection and carbon storage can be more valuable than forest products such as wood pulp and timber. The following subsections discuss the principal ecosystem services provided by the State parks and forests. The value of

each ecosystem service is first estimated on a per-acre per-year basis, in keeping with the approach taken in much of the ecoservice valuation literature; those values are then multiplied by the relevant acreage from the State park and forest system to obtain ecoservice values expressed in terms of dollars per year. The emphasis is on ecosystem services provided by forested land, including the forested portion of the State parks. This is a conservative approach since wetlands, which make up a significant part of many State parks and forests, have been consistently shown to generate much higher ecoservice values per acre than forests. (See, e.g., Costanza et al. 1997 and Costanza et al. 2006 and the numerous sources cited in each of these studies.)

A. Hydrological Services

The water-related benefits provided by forest ecosystems include maintenance or improvement of water quality, regulation of flow, and provision of water supply. Except for highly polluted areas, water quality is likely to be higher in forested watersheds due to the natural water holding and filtration capacities of forest ecosystems. While a full review of the literature is beyond the scope of this project, this section reviews several studies of the economic value of the types of "hydrological" services provided by forests and develops an estimate of the value of those services for State parks and forests.

A 1997 study in the highly-regarded peer-reviewed journal Nature estimated the value of forest hydrological services at $92/hectare/year in 1994 dollars, including $87 for waste treatment, $3 for water supply, and $2 for flow regulation Costanza et al. (1997). Converting this to U.S. measurement units and 2004 dollars, we obtain a value of $47/acre/year. The 1997 estimate was based on the damage costs incurred when deforestation leads to reduction in water quality or fisheries production, the market value of water lost to reduced quality created by deforestation, and the replacement cost for natural decomposition of wastes.

A second estimate involves New York City, which obtains its drinking water from reservoirs located in watersheds with an aggregate area of about 2,000 square miles (1.26 million acres). By 1989, as a result of residential and commercial development in those watersheds, the City's drinking water no longer met federal drinking water standards. As a result, the City was faced with the prospect of being forced to meet the standards by installing a water filtration plant estimated to cost $6 billion to build and $300 million/year to operate. In a ground-breaking application of the concept of ecosystem services, the City instead obtained USEPA approval in January of 1997 to meet the federal standards by implementing a variety of measures to better protect the watersheds from which its drinking water comes.

The protective measures had an estimated up-front cost of about $1.5 billion for an up-front savings of around $4.5 billion.[32] The $4.5 billion of up-front savings is in effect the net replacement cost for the watershed's ecosystem services, i.e., the net cost of replacing the watershed's natural ecoservices with physical infrastructure to provide the same services. In economic terms, the net savings are therefore a measure of the value to society of the hydrological services provided by properly managed and preserved watersheds. Dividing $4.5

[32] The on-going costs of the watershed protection measures are not clear, so a comparison with the on-going costs of the filtration plant is not attempted here.

billion of savings by 1.26 million acres gives an up-front amount of $3,568/acre in 1997 dollars or $4,200/acre in 2004 dollars. This up-front amount is equivalent to $126/acre/year based on an annual discount rate of 3% in perpetuity.

The final estimate discussed here relates to the national forests. According to the Chief of the U.S. Forest Service, the two main purposes for creating the National Forest System were to maintain abundant forest reserves and to supply abundant water; as of 1999, over 3,400 communities with over 60 million residents relied on National Forest lands located in 33 states for their drinking water (Dombeck 1999). The same source assessed the marginal value of water on National Forest Lands nationwide at more than $3.7 billion per year (Dombeck, 1999); this value mainly relates to the value of raw water supplied from the forests. Assuming the estimate is in 1999 dollars, the value in 2004 would be $4.2 billion. Since the National Forest system comprises about 191 million acres, the implied annual value per acre is $22 annually.

Based on these studies, we have obtained estimates of $22, $47, and $126 per acre per year for the types of hydrological or watershed services provided by forests. The average of these is $65/acre/year. While the high and low estimates are clear, the appropriate figure for a middle estimate is less certain. The $47/ac/yr figure is based on an older study, and the $74 midpoint between the high and low estimates is higher than both the mean and the median. In the authors' judgment, the average of $65/ac/yr is the most appropriate basis for the middle estimate of the value of the hydrological services provided by State parks and forests.

B. Carbon Sequestration and Storage

Carbon dioxide is the most important of the greenhouse gases involved in anthropogenic global climate change. Several studies have suggested that carbon sequestration and storage can potentially have a large impact in this area (Brown & Pearce, 1994; Dixon *et al.*, 1994; IPCC, 2000). Functioning as carbon "sinks", forests can help mitigate climate change in two ways:

- In photosynthesis, growing trees absorb carbon dioxide and convert it to biomass, thus "sequestering" [33] carbon on an on-going basis.

- Trees "store" carbon in their leaves, stems, branches, boles, and roots; the biomass of a tree is about 50% carbon by weight (NSFA 2002). Forests also store carbon in other plants (the "understory"); in the organic litter or dead plant material on the forest floor; and in organic matter in forest soil.

In other words, trees can provide both a "flow" value by sequestering additional carbon and a "stock" value by storing carbon previously sequestered. Through the action of soil bacteria, stored carbon is eventually released as trees and other organic matter die and decay; but if the trees that die are replaced by new growing stock, the storage and sequestration values are in principle indefinitely renewable, barring events such as conversion of land to non-forest uses.

[33] The terminology in this field is not fully standardized; as used here, "storage" and "sequestration" have the meanings set by the Intergovernmental Panel on Climate Change (IPCC).

Conceptually, the value of these two ecoservices equals the following: Number of forested acres x Carbon stored or sequestered/acre x Value (in $) per unit of carbon. The following paragraphs review information on the latter two factors and then combine values for each to arrive at an estimated value per acre for the carbon storage and sequestration services provided by SPS-administered forested lands.

Carbon storage and sequestration per acre

The amount of carbon in forests is conventionally measured in metric tonnes per hectare (MT/ha); one MT/ha equals about 0.446 US or "short" tons per acre (ST/ac). The amount of carbon stored or sequestered depends on many factors, including the mix of tree species (deciduous vs. conifer), the average tree age (older trees are generally larger), and the species-specific growth rates under prevailing climate conditions. The amount also depends on exactly which parts of a forest are included, since carbon is sequestered and stored not only in the visible portions of live trees and standing dead trees but also in root systems, the forest floor (including fallen dead trees), coarse woody debris, the forest understory (e.g., shrubs), and soil organic carbon; the last can account for half of the total carbon. If all of these forest components are included, closed primary forests can store 250 MT/ha (112 ST/ac) or more (Nasi et al. 2002). [34]

Three publicly available sources provide New Jersey-specific figures for the amount of carbon stored or sequestered per acre:

- A 2003 study performed for the U.S. Forest Service (USFS) by Far Horizons Corporation estimated the potential carbon content of New Jersey's public forests at 238.3 MT/ha (106.3 ST/ac); annual sequestration was not estimated. The purpose of the study was to identify options for carbon sequestration in New Jersey's forests, and the study paid special attention to urban forests. Since urban forests generally consist of deciduous trees, and because such trees hold substantially more carbon than conifers, the study may have somewhat of an upward bias in terms of carbon storage capacity (Nowak et al. 2002).

- Using data from its Forest Inventory & Analysis and Forest Health Monitoring programs and other sources, USFS has created a Carbon On-Line Estimator (COLE); the model can be found at http://ncasi.uml.edu/COLE. Using USFS data on a sample of all New Jersey forests, COLE produces an estimate of 191.3 MT/ha (85.4 ST/ac) for carbon storage and 1.28 MT/ha/yr (0.571 ST/ac/yr) for annual carbon sequestration.

- A study by the U.S. Forest Service Northeastern Research Station using the UFORE (Urban Forestry) model estimated *urban* forest carbon storage in New Jersey at about 38.3 MT/ha (17.1 ST/ac) and gross carbon sequestration at 1.242 MT/ha/yr (0.554 ST/ac/yr). The storage figure is far below the other two estimates and probably

[34] A "primary" forest is one that has not been logged previously. The adjective "closed" describes canopy at the main level of forests formed by a more or less continuous cover of branches and foliage of adjacent trees; the canopy is closed because light cannot reach the forest floor directly. About 83% of New Jersey's forests and an unknown portion of its forested wetlands have crown closures above 50%.

represents only the above-ground portion of younger live trees of species deemed suitable for urban forestry.

The figures from these three sources can be summarized as follows:

Table 3: Per-Acre Carbon Storage and Sequestration in New Jersey		
Source	**Storage (ST/ac)**	**Sequestration (ST/ac/yr)**
Far Horizons (2003)	106.3	not quantified
COLE (USFS)	85.3	0.571
UFORE (USFS)	*17.1*	0.554

These figures are not as inconsistent as they may appear at first. As noted above, the UFORE study focused on urban forests, which in New Jersey tend to be weighted towards recently planted, i.e., younger and therefore smaller trees. Such trees obviously contain less carbon than older, larger trees, and urban forests also tend to contain less understory, brush, and soil carbon than non-urban forests (Nowak and Crane 2002). On the other hand, younger trees in general grow faster than older ones, i.e., they add more carbon per year. For these reasons, the present study will not use the UFORE storage figure, which is a clear outlier; the other four figures, however, represent plausible and comparable values suitable for the analyses to follow.

Value per unit of carbon

To the extent that the carbon stored in forests could be released into the atmosphere, it has a high economic value from the standpoint of climate change mitigation. The question is how to estimate that value. As described below, two main approaches are currently available.

The first approach uses the prices at which carbon "credits" are actually bought and sold on the world's carbon markets. In this market, one carbon credit or sequestration unit (CSU) equals the amount of organic carbon sequestered in wood or soil that is equivalent to the removal of one metric tonne (1.1023 short tons) of *carbon dioxide* from the atmosphere (National Carbon Offset Coalition). This source of valuation data has the advantage of being market-based, i.e., CSU values represent the actual prices at which buyers and sellers are willing to trade carbon for money and therefore presumably represent their real valuation of carbon sequestration. Moreover, in economic theory, these "marginal" prices should reflect the marginal cost of carbon abatement (since otherwise buyers would have no incentive to purchase credits), which in turn should equal the marginal benefit to society of sequestering a ton of carbon.

While carbon credit prices thus have a number of advantages as a source of valuation data, they have the disadvantage of potentially changing every time a block of credits is bought and sold. Moreover, those potential price changes are in the main not driven by easy-to-model factors such as inflation, for which a future inflation rate can be assumed. Rather, they are driven by the climate policies and regulations of the nations of the world and by developments in the technology of carbon abatement; therefore, the prices cannot be predicted with any confidence. Faced with this issue, the present study uses the most recent price data available on the theory that such data at least reflects all policies and regulations and all technological developments in place as of the sale date.

As of June 2006, the European Union Emissions Trading Scheme (EU ETS) accounted for about 85% of the global volume of carbon credit transfers; the other 15% included projects under the Kyoto clean development mechanism (CDM), carbon trades on the Chicago Climate Exchange (CCX), and non-exchange transactions. The most recently available price and volume data are summarized below. Since the dollar values are as of different dates, they were deflated back to 2004 dollars before per-ton prices were calculated.

Table 4: Recent Pricing of Carbon Credits

Price Source	**EU ETS**	**Non-Kyoto**	**Kyoto**	**Total or Avg.**
Metric tons CO2	250,000,000	31,978,062	13,077,132	295,055,194
Conversion factor	0.2727	0.2727	0.2727	0.2727
Metric tons C	68,181,818	8,721,290	3,566,491	80,469,598
Conversion factor	1.1023	1.1023	1.1023	1.1023
Short tons C	75,156,818	9,613,478	3,931,343	88,701,638
Valuation date	06/27/06	04/29/05	03/02/06	2004
Value in current $	$5,075,000,000	$84,714,390	$7,630,000	$5,167,344,390
All-Items CPI-U	202.9	194.6	199.8	188.9
CPI deflator	0.931	0.971	0.945	1.000
Total value in 2004 $	$4,724,827,501	$82,233,033	$7,213,749	$4,814,274,283
2004 $/short ton C	**$62.866**	**$8.554**	**$1.835**	**$54.275**

EU ETS = European Union Emissions Trading Scheme (prices converted from euros to US dollars).
Kyoto market includes Clean Development Mechanism & Joint Implementation CO2 credit sales.
Non-Kyoto market includes Chicago Climate Exchange, voluntary/retail, & other CO2 credit sales.
CPI-U = Urban Consumer Price Index; CPI deflator = 2004 CPI-U / current CPI-U.
1 metric ton = 2,204.6 lb. = 1.1023 short tons of 2,000 lb.
1 ton C = 3.6667 tons CO2, and 1 ton CO2 = 0.2727 tons C.

As can be seen, the weighted average price is about $54 per short ton of carbon.

The second main approach to assigning a value to carbon storage and sequestration services is economic modeling, and by far the most common type of modeling uses various types of economic models to estimate the change in Gross World Product (GWP) of reducing carbon dioxide emissions by one ton. (GWP is the global equivalent of Gross Domestic Product.) The models themselves are extremely complex and will not be described here; fortunately, the results can be easily summarized. Costanza et al. (2006) reviewed 16 different peer-reviewed studies of this type; the results are presented in Exhibit I. The total number of estimates is 38, since some of the studies analyzed multiple scenarios and therefore presented multiple estimates. It should be emphasized that these studies relate solely to carbon sequestration and not to carbon storage.

As with the other ecosystems discussed in the present report, the ecoservice values in Exhibit I are expressed in 2004 dollars per acre per year. For each study, minimum, mean, and maximum values are shown; however, where a study provided a single estimate for a scenario, the three are equal. The bottom of Exhibit I presents selected summary statistics for the ecoservice values and the carbon prices in $/ST C implied by those values. As can be seen, the

central price estimates are $77/ST C based on the average of the 38 study/scenario means and $29/ST C based on the median of the 38 study/scenario means.[35]

Together with the value of $54/ST C derived above from carbon market price data, these values from the peer-reviewed literature define a plausible range of carbon sequestration values:

Table 5: Value of Carbon Sequestration Services		
Estimate	**Basis**	**Value**
High	economic modeling	$77 per ST C
Middle	carbon market data	$54 per ST C
Low	economic modeling	$28 per ST C

The value based on actual market data is close to the midpoint between the theoretical estimates.

Value per acre for carbon storage and sequestration

The last step in this part of the value transfer analysis is to combine the estimates of storage and sequestration with the estimates of the value of those services; the result is the value of the storage services per acre and the sequestration services per acre per year.

TABLE 6: VALUE OF CARBON STORAGE AND SEQUESTRATION SERVICES				
Ecoservice and Source of Rates	**Sequestration and Storage Rates**	**Low Value $29/ST C**	**Middle Value $54/ST C**	**High Value $77/ST C**
Storage:				
Far Horizons	106.3 ST/ac	$3,083/acre	$5,740/acre	$8,185/acre
	annual equivalent*	$92/acre/yr	$172/acre/yr	$246/acre/yr
COLE	85.3 ST/ac	$2,474/acre	$4,606/acre	$6,568/acre
	annual equivalent*	$74/acre/yr	$138/acre/yr	$197/acre/yr
Average	*Annual equivalent*	*$83/acre/yr*	*$155/acre/yr*	*$222/acre/yr*
Sequestration:				
COLE	0.571 ST/ac/year	$17/acre/yr	$31/acre/yr	$44/acre/yr
UFORE	0.554 ST/ac/year	$16/acre/yr	$30/acre/yr	$43/acre/yr

The storage values can be thought of in financial terms as present values; the annual or "annuity" equivalents shown above "amortize" the present values at 3% per year in perpetuity. This conversion makes it possible to compare the storage and sequestration values. Since storage implies a more permanent benefit than sequestration, it makes sense that the annual equivalent values for storage would exceed those for annual sequestration.

[35] The calculations are as follows: $56/ac/yr divided by 0.723 ST C/ac/yr = $77/ST C, and $21/ac/yr divided by 0.723 ST C/ac/yr = $29/ST C. Costanza et al. (2006) used a sequestration rate of 0.723 ST C/ac/yr, based on a USFS national study (Birdsey 1992). While this differs from the New Jersey-specific sequestration rates discussed above, the difference does not affect our own calculations, since the carbon prices (unlike the ecoservice values) are not determined by the sequestration rates but by the economic modeling in the 16 studies that Costanza et al. analyzed. We can therefore use the carbon prices from Costanza et al. (2006) with the New Jersey-specific sequestration rates discussed above.

C. Air Quality Maintenance

It is well-recognized that forests (including urban forests) improve air quality by removing various air pollutants, including nitrogen dioxide (NO_2), sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), and particulate matter 10 microns or less in size (PM10). As documented by USEPA in several major studies, the main economic benefit to society of such "pollution abatement" services is the resulting improvement in human health and life expectancy. Conversely, a reduction in air quality leads to increased human morbidity and mortality, each of which has well-documented economic costs, e.g., increased healthcare costs and the imputed value of lost years of life due to pollution-related illness.

The value of the air quality services provided by forests depends on three things: the physical amount of each air pollutant removed annually by a given amount of forested land, the dollar value per unit (e.g., per pound or per ton), and the number of acres of land providing this ecosystem service. A 2003 study by American Forests found that an acre of forest in the Delaware Valley removes between 76 and 85 pounds of air pollutants annually, with a midpoint of 81 lb/ac/yr. The study area included only four counties in New Jersey (Burlington, Camden, Gloucester, and Mercer. However, analysis of data generated using the USDA Carbon On-Line Estimator indicates that the carbon sequestration capacity of forests in the other 17 New Jersey counties was 13% higher (198.5 vs. 176 metric tonnes per hectare). If the ability to remove carbon from the air is proportional to the ability to remove other air pollutants, forests in the four counties studied may not be unrepresentative of the state as a whole in terms of the latter ability.

American Forests (2003) estimated the value of the air quality service at about $2.29/lb, which would equal $2.35/lb in 2004 dollars. At that figure, the three pollutant removal rates cited above would have dollar values of $179/ac/yr, $190/ac/yr, and $200/ac/yr.

D. Stormwater Control

Forested land slows storm runoff, thereby reducing peak stream flows and reducing the amount of stormwater storage capacity needed by downstream parties. The amount of stormwater temporarily stored per acre of forest depends on several factors, including the amount of tree canopy, the slope of the land, and others. American Forests (2003) estimated that an acre of South Jersey forest could store between 2,659 and 3,011 cubic feet, with a midpoint value of 2,835 cu ft/ac.

The value to society of this stormwater storage capacity can be estimated using the "avoided cost" method, i.e., by quantifying the cost that society would need to incur if forested lands did not store these amounts of water. American Forests (2003) estimated this cost at $2 per cu ft of storage or $2.05 in 2004 dollars. At that value, the stormwater storage services provided by 280,000 acres of New Jersey forest land would be worth $5,451/ac, $5,812/ac, or $6,173/ac for the low, middle, and high estimates of storage capacity per acre. These up-front savings translate into $164, $174, and $185 per acre per year based on amortization at 3% annually in perpetuity.

E. Wildlife Habitat and Species Refugia

Contiguous landscape "patches" large enough for natural ecosystem functioning support many plant and animal species. As patches decrease in size and become more isolated from each other, population sizes can decrease below the threshold levels needed to maintain genetic variation, withstand events such as storms, droughts, and population oscillations, and meet breeding and migration needs. Intact forests serve as critical population sources for species that human beings value for aesthetic and functional reasons.

Forests also provide refuges ("refugia") for rare, threatened, and endangered species. Of the rare species found in New Jersey, 36.24% have been documented on lands managed by the Division of Parks and Forestry. An unpublished DEP economic impact study of the proposed regulation governing modification of endangered and threatened species habitats in New Jersey indicated that the total benefits to society from species protection (as measured in WTP) amount to hundreds of millions or possibly even billions of dollars in present value terms.

Estimating the value of rare, threatened, or endangered species is complicated by a number of factors, including the following:

- There is a threshold issue as to whether one is valuing the species or its habitat. A species cannot survive without suitable habitat, but any habitat (e.g., a forest) will provide values in addition to protecting the species in question. If one is attempting to value the species "by itself", then the habitat becomes an "intermediate" rather than a "final" good, and the predominant source of "final" value is likely to become the recreational value from wildlife watching associated with that species.[36] Since recreational value was discussed earlier in this report, including it again here would amount to double-counting.

- It is well known that most people are willing to pay more to protect so-called "charismatic" species (e.g., whales) or "totemic" species (e.g., salmon in the Pacific Northwest) than species which do not meet these somewhat subjective criteria. However, the value of an acre of forest should in principle include its provision of habitat for *all* species of interest living there. Unfortunately, estimating this total value for habitat provision services is difficult.

- Since rare, threatened and endangered species cannot legally be bought and sold in commercial markets, valuation efforts usually rely on "contingent value" surveys. If survey respondents indicate a willingness to pay a given amount (whether one-time or annually) to protect the habitat for a given species, this does not mean that they would be willing to pay the same amount to protect a second species or a third. It is entirely plausible that the marginal willingness to pay would decline sharply after the first species and reach zero fairly quickly. If this is true, then the order in which species are presented to respondents for consideration will affect the valuation results.

[36] Some would argue that there every species also has an intrinsic value that does not depend on whether or not it provides benefits to humanity. Whether or not one accepts this argument in principle, it is very difficult to define the concept of intrinsic value in such a way that it can be quantified.

- Some species of special interest, e.g., bald eagles, are found in some parts of New Jersey's forests but not others, and it would clearly be incorrect to assume a bald eagle protection value for the entire system of State parks and forests.

For these reasons, this report does not attempt to value individual species themselves. Instead, we rely on the results of a detailed survey of the published literature performed for the Department as part of a study of New Jersey's natural capital (Costanza et al. 2006). That survey identified five high-quality peer-reviewed contingent valuation studies that as a group yielded eight separate estimates of the value per forest acre of habitat/refugium services, as summarized in Table 7 below.

Table 7: Estimated Value of Habitat/Refugium Services

		2004 $ / acre / year		
Author(s)	**Year**	**Minimum**	**Mean**	**Maximum**
Garrod, G. D. and Willis. K. G.	1997	$3,101	$3,242	$3,383
Garrod, G. D. and Willis. K. G.	1997	$1,817	$1,910	$2,003
Amigues, J. P., et. al.	2002	$1,140	$1,649	$2,158
Kenyon, W. and Nevin, C.	2001	$426	$426	$426
Amigues, J. P., et. al.	2002	$55	$132	$208
Garrod, G. D. and Willis. K. G.	1997	$15	$15	$15
Haener, M. K. and Adamowicz, W. L.	2000	$1	$4	$7
Shafer, E. L. et. al.	1993	$3	$3	$3
Average		**$820**	**$923**	**$1,025**

Given the strict criteria used by the outside investigators in screening studies for inclusion, we feel justified in using the above averages for purposes of the present study.

F. Soil Formation and Retention

Soil is essential for plant growth, and forests provide both soil formation and soil retention services. As to soil formation, Costanza et al. (1997) cited an earlier estimate by Pimentel et al. (1995) that soil organisms help produce 1 ton of topsoil per hectare per year on agricultural soils and about half that amount on natural soils. According to Costanza et al. (1997), Pimentel et al. (1995) estimated the cost of topsoil at $12/ton in 1994 dollars, yielding an estimate for soil formation services of $6/hectare/yr for both grassland and forests. This translates into $2.4/acre/year in 1994 dollars or $3/acre/year in 2004 dollars. Costanza et al. (1997) also provide an estimate of $10/ha/yr in 1994 dollars or $5/ac/yr in 2004 dollars.

In terms of soil retention, much of the peer-reviewed literature (e.g. Costanza et al. 1997) focuses on tropical areas, probably out of a concern over the fate of tropical rain forests. However, New Jersey participates in the USDA-supported Conservation Reserve Enhancement Program (CREP) which provides an implicit measure of the value of soil erosion control in

temperate zone climates[37]. The program seeks to maintain the ecological functions of streams, reduce non-point source pollution from farm runoff, and maintain a high level of water quality by providing economic incentives to farmers under 10 to 15-year contracts.

The economic incentives under CREP include two components:

- a one-time payment from $100 to $150 per acre for enrollment in the program,[38] plus
- an annual payment consisting of the USDA "basic soil rental rate" ($47.50/acre for New Jersey in 2004) plus an incentive of 100% or 150% depending on the specific conservation practices adopted plus an annual "maintenance payment".

The annual incentive is 150% for creating riparian buffers by planting trees, and since this is the conservation practice most relevant here, this figure will be used in the analysis below.

The economic incentives offered under CREP can be used as a proxy measure for the soil retention value of State parks and forests because they perform the same function as farmland enrolled in CREP. The one-time incentive amounts imply the following per-acre values:

TABLE 8: ESTIMATED UP-FRONT SOIL EROSION CONTROL VALUE (2004 $)

Incentive Level	One-Time Incentive	Equivalent/yr in Perpetuity
Minimum	$100/acre	$30.00/ac/yr
Middle	$125/acre	$37.50/ac/yr
Maximum	$150/acre	$45.00/ac/yr

The annual equivalents are based on an amortization rate of 3% per year in perpetuity. The annual equivalents of the one-time incentive should not be confused with the annual incentive amounts (see below); the annual equivalents were calculated solely for comparison purposes and do not represent actual incentive payments under CREP.

The value of the annual incentive depends on the percentage add-on. With an add-on of 150% over and above the 2004 New Jersey basic soil rental rate of $47.50/ac/yr, the total annual incentive would be $47.50 x 250% = $118.75. As noted above, the 150% add-on seems most applicable where tree planting is involved.

Since these annual incentive amounts would only continue over the 10 to 15-year contract term, they cannot be compared directly with either the one-time incentive amounts or their annual equivalents in perpetuity. To make a comparison possible, the annual incentives were first converted to present value amounts based on 10 or 15-year time horizons, and those present values were then converted to *their* annual equivalents in perpetuity.

[37] The State and Federal governments fund CREP payments, which are therefore only surrogate measures of erosion control value. That value would not be zero even if CREP ceased to exist because uncontrolled soil erosion has economic consequences.

[38] The one-time payment amounts do not appear to be adjusted for inflation.

TABLE 9: ESTIMATED ON-GOING SOIL EROSION CONTROL VALUE (2004 $)			
Contract Duration	**Incentive at 150%**	**Present Value over Contract**	**Equivalent in Perpetuity**
10.0 yr	$118.75/ac/yr	$1,013/ac	$30.39/ac/yr
12.5 yr	$118.75/ac/yr	$1,165/ac	$34.94/ac/yr
15.0 yr	$118.75/ac/yr	$1,418/ac	$42.53/ac/yr

Since farmers are eligible for both the up-front and the on-going incentives, the results from Tables 8 and 9 should be combined to produce more complete estimates of the value assigned to soil retention or erosion control under CREP. While in theory the three estimates from Table 8 and the three from Table 9 can be combined to yield nine different valuations, we have chosen, for simplicity, to present only the lowest, highest, and most central of the nine:

TABLE 10: ESTIMATED CREP SOIL EROSION CONTROL VALUE (2004 $)			
Scenario	**Up-Front**	**On-Going**	**Total**
Low	$30/ac/yr	$30/ac/yr	$60/ac/yr
Middle	$38/ac/yr	$35/ac/yr	$73/ac/yr
High	$45/ac/yr	$43/ac/yr	$88/ac/yr

As with the other estimates of value per acre per year, these will be combined below with an estimate of the relevant acreage to estimate annual ecoservice benefits in dollars.

G. Other Services

Costanza et al. (2006) identified a high-quality peer-reviewed study for each of three other ecosystem services: biological control, cultural/spiritual values, and pollination services (see Box 1 above for definitions). The studies and the valuations are as follows:

TABLE 11: MISCELLANEOUS ECOSERVICE VALUES				
		2004 $ / acre / year		
Ecosystem Service	**Author(s)**	**Minimum**	**Mean**	**Maximum**
Pollination	Hougner, C.-to be published	$59	$162	$265
Biological Control	Costanza, R. et. al.-1997	$2	$2	$2
Cultural & Spiritual	Costanza, R. et. al.-1997	$1	$1	$1
Totals		**$62**	**$165**	**$268**

Values could not be estimated for several other ecosystem services; those services and the difficulties in estimating their values are described in Appendix D.

Summary of Ecoservice Valuation Results

Table 12 summarizes the results obtained thus far.

TABLE 12 : FOREST ECOSERVICE UNIT VALUES (2004 $ PER ACRE PER YEAR)			
Ecosystem Service	**Minimum**	**Middle***	**Maximum**
Waste removal-air	$179	$190	$200
Stormwater control	164	174	185
Pollination	59	162	265
Carbon sequestration	83	155	222
Soil retention	60	73	88
Hydrological services	22	65	126
Carbon storage	16	30	43
Soil formation	3	4	5
Biological control	2	2	2
Cultural / spiritual	1	1	1
Biodiversity/genetic data	?	?	?
Urban form definition	?	?	?
Public service functions	?	?	?
Subtotal	**589**	**856**	**1,137**
Habitat / refugia	820	923	1,025
Total	**1,409**	**1,779**	**2,162**
Note: excludes recreational services.			
*May represent mean, midpoint, or other central estimate.			

Table 12 excludes studies of recreational value because this source of value was treated in Section III above. The table also excludes ecoservices with no usable value estimates.

To convert these dollars per acre per year values into dollars per year, it is necessary to quantify the amount of land that provides these ecoservices. New Jersey's State parks and forests include a variety of land cover types, e.g., wetlands (Double Trouble and Cheesequake State Parks), beaches and dunes (Island Beach State Park), open surface water (Hopatcong and Swartswood State Parks), forests, and others. Moreover, most SPS facilities combine multiple land cover types, making categorization more difficult.

To address these issues, and in the absence of detailed land cover data for State parks and forests, the authors allocated the total acreage of the State parks and forests between forest and non-forest land cover based on the following assumptions (see Exhibit J):

- State forests were assumed to be 90% forested; the other 10% was assumed to comprise roads, parking lots, buildings, and other non-forested areas such as rocky areas.

- State parks with substantial forest (e.g., Swartswood) were assumed to be 50% forested.

- Beaches, estuaries (Corson's Inlet), and sites consisting predominantly of built structures (e.g., Barnegat Lighthouse) were treated as 0% forested.

- All other State parks and State recreation areas were assumed to be 15% forested.

Exhibit J shows that based on these assumptions, about 280,000 acres of the State parks and forests would be able to provide the types of ecosystem services discussed above.

Based on this estimated area of 280,000, Table 13 presents the annual dollar value of the ecoservices listed in Table 12 above.

TABLE 13: FOREST ECOSERVICE ANNUAL VALUES
(MM 2004 $ PER YEAR)

Ecosystem Service	Minimum	Middle*	Maximum
Waste removal-air	$50.1	$53.2	$56.0
Stormwater control	$45.9	$48.7	$51.8
Pollination	$16.5	$45.4	$74.2
Carbon sequestration	$23.2	$43.4	$62.2
Soil retention	$16.8	$20.4	$24.6
Hydrological services	$6.2	$18.2	$35.3
Carbon storage	$4.5	$8.4	$12.0
Soil formation	$0.8	$1.1	$1.4
Biological control	$0.6	$0.6	$0.6
Cultural / spiritual	$0.3	$0.3	$0.3
Biodiversity/genetic data	?	?	?
Urban form definition	?	?	?
Public service functions	?	?	?
Subtotal	**$164.9**	**$239.7**	**$318.4**
Habitat / refugia	$229.6	$258.4	$287.0
Total	**$394.5**	**$498.1**	**$605.4**
Note: excludes recreational services.			
*May represent mean, midpoint, or other central estimate.			
Based on 280,000 acres of State parks and forests estimated to provide the indicated ecosystem services.			

As noted above, these figures exclude the recreational services treated in Section III of this report. They also exclude ecoservices for which there are no usable value estimates.

In assessing the differences between the low, middle, and high estimates, it is important to bear in mind that ecosystem valuation is not (and probably never will be) an exact science; estimating the value of the ecoservices provided by a forest is inherently a more imprecise task than estimating the market value of a piece of commercial real estate, precisely because the forest's services are not marketed and their value must therefore be estimated using indirect techniques, as described above. It is not particularly surprising to see variations of 25% or more in ecoservice values; this variability is consistent with previous findings in the empirical ecosystem services literature (National Research Council 2004).

Limitations of Ecoservice Valuation

Some ecosystem services have been studied much more extensively than others, especially in terms of the peer-reviewed literature. For example, Costanza et al. (2006) identified 16 high quality peer-reviewed studies on carbon sequestration but only two on hydrological services; the dearth of such studies led the present authors to use some non-peer-reviewed analyses in estimating the value of hydrological services for New Jersey. Such disparities probably reflect in large part the preferences of funding agencies, which are presumably motivated to a significant extent by factors other than the desire to ensure equal coverage of all ecosystem services.

Notwithstanding this, valuation of ecosystem services is an evolving field of study, and as the field continues to develop, these gaps in the literature will hopefully be filled in. The addition of new studies of previously uncovered or under-covered services should result in *higher* estimated ecoservice values for many land cover types (including forests), because some ecosystem services that can reasonably be expected to be delivered by healthy, functioning forests and other ecosystems are currently not well addressed or not addressed at all in the literature. As the under-represented ecoservices and ecosystems receive more attention, the total estimated value associated with each land cover type will likely increase.

Given the gaps in the ecoservice valuation literature, the results presented in this report should therefore be treated as conservative or "lower bound" estimates of the value of the ecosystem services provided by New Jersey's State parks and forests. In other words, the results presented here are likely to underestimate the true value of those. However, even with these limitations, the results confirm that a broad range of ecosystem services with a total value in the hundreds of millions of dollars annually is being delivered to New Jersey's residents every year by their State forests and by substantial portions of their State parks as well.

Section VI: Property Enhancement

There is a substantial body of independent peer-reviewed research which supports the conclusion that proximity to open space (i.e., undeveloped land) and in particular, legally preserved open space, increases the value of privately-owned residential property (see Table 14).[39] For example, the presence of a forest or woodland near housing estates can increase house prices (see, e.g., Powe *et al.* 1997; Tyrvainen and Miettinen, 2000). Some analysts classify this effect as an ecosystem service, but because of the difference in methods and the difficulty in comparing results, it is treated separately in this report.

The research in question uses a technique called "hedonic price analysis" to estimate the value that people assign to open space and other environmental "amenities" (e.g., scenic views).[40] The basic concept is that a piece of residential property consists of a "bundle of "attributes", e.g., lot size, number of rooms, school quality, scenic views, etc.; these attributes are sold as a package rather than separately, but each attribute contributes something to the total value of the property. The hedonic approach applies statistical techniques to information on actual real estate transactions (usually sales of privately-owned homes) to isolate the value that homebuyers assign to the home's environmental features.

As an example of the hedonic method consider two otherwise identical homes that differ only in their proximity to an area of legally protected open space. If the home closer to the open space commands a higher price in an arm's length sale, then economists will attribute the difference in price to the value which home-buyers assign to being closer to the open space. Since few, if any, houses are identical in all respects save their environmental attributes, a large sample of home sales must be analyzed using statistical techniques to correct for the many other differences among homes. While hedonic price analysis is complex, it is an accepted economic technique; more detailed discussions can be found in Freeman (2003) and other sources.

Many of the early studies using this approach focused on how much more people have paid for homes located in areas with better air quality, greater distances from landfills, etc. The studies considered to be relevant here are mainly studies performed from 2000 to 2003 in the United States that focus on proximity to open space; studies that emphasize greenbelts and golf courses are not included. All of the studies considered here have been published in peer-reviewed journals and were therefore conducted mainly by independent, university-based investigators. The research findings relevant to the present analysis can be summarized as follows (see Table 14 for further details):

- In general, the closer a home is to open space, the higher its sale price. The increase in price is usually greater for open space which is legally protected by public ownership, a conservation easement, or another enforceable mechanism, as compared to potentially developable open space.

[39] While the concepts discussed in this section could in theory apply to commercial and other non-residential property, the empirical work to date has focused on residential property.

[40] The term "hedonic" derives from the Greek word for pleasure, the idea being that homeowners and others derive pleasure from proximity to features the provide natural beauty or other benefits.

- A positive effect on home prices has been found for proximity to preserved forest land, with a similar negative effect from closeness to developable forest land (see Table 14). The increase in prices approaches 7% in some studies. The impact is highly location-specific.[41]
- Proximity to wetlands also has a positive impact on homes prices of as much as 2.80%, although lower impacts were obtained in some cases (Table 14).
- Finally, proximity to natural areas and designated wildlife habitat also increases a home's value in some cases, although the effects are much smaller in absolute value and probably cannot be separated from the underlying increase in value resulting from proximity to the underlying land type, e.g. forest, wetland, etc.

It should be emphasized that within each of the above categories, it is the legally protected status of the open space that appears to be critical to enhanced property values. That is, proximity to a *legally protected* forest, wetland, etc. increases a home's value more than proximity to a *developable* forest, wetland, etc., and in fact closeness to developable open space can *reduce* the selling price. Homebuyers clearly take into account the risk of future development in deciding how much to pay for a given home.

As noted above, hedonic analysis examines the effect of proximity to parks, forests, and other natural "amenities" on the value of residential real estate; the results are usually expressed in terms of the change in home sale prices (in dollars or percent) as a function of the distance between the amenity and the real estate. In other words, hedonic analysis does not directly measure the value of the environmental feature itself but rather the feature's effect on the value of something else. In theory it is possible to translate the latter into the former; however, in practice the translation is extremely complex, and very few hedonic studies attempt it. For this reason, the present study does not offer estimates of the value for the property enhancement services provided by State parks and forests. Hopefully future studies can perform these translations to yield valuations comparable to those reported here for the other sources of value.

In addition to the effects on residential real estate prices, a study by the National Park Service found that when companies choose to set up business or relocate, the availability of properly managed recreation, parks and open space is high on the list of criteria for site selection. This "business attraction value" is however difficult to quantify and was not estimated in the current study.

[41] For example, Garrod and Willis (1992) found that proximity to broadleaf forest increases the price of nearby homes whereas proximity to Sitka Spruce stands reduces it.

Table 14: Summary of Selected Studies of the Effect on Home Prices of Proximity to Open Space					
STUDY	**REAL ESTATE MARKET**	**TYPE OF OPEN SPACE**	**PROXIMITY MEASURE**	**PRICE EFFECT**	**% AVG. PRICE**
OPEN SPACE-GENERAL					
Acharya and Bennett (2001)	New Haven CT 1995-97	Open space-general	add 1% OS in < 1-mi.	+ $75	+ 0.06%
USFS (1999)	Lake Tahoe Basin NV	Open space-public	public/total land up 10%	$20,000	n/a
Riddel (2001)	Boulder CO 1981-1995	Open space-public	15,000 acres purchased	n/a	+ 3.75%
Irwin (2002)	4 MD co. 1995-99	Open space-public	within 300 ft.	+ $994	+ 0.57%
Smith et al. (2000)	Wake Co. NC 1995-98	Open space-public	move 650 ft. closer	*- $553*	*- 0.33%*
Irwin (2002)	4 MD co. 1995-99	OS--preserved-private	within 300 ft.	+ $3,307	+ 1.87%
PARKS					
Lutzenhiser & Netusil (2000)	Portland OR 1990-92	Park-specialty	within 1,500 ft.	+ $5,657	+ 8.50%
Lutzenhiser & Netusil (2000)	Portland OR 1990-92	Park-urban	within 1,500 ft.	+ $1,214	+ 1.80%
Geoghegan et al. (2003)	4 MD co. 1993-1996	Park-public	+1% OS <1-mi / <300 ft	$0 / +$1,306	0% / +0.71%
Anderson and West (2003)	Minn.-St. Paul MN 1997	Park-special	move 650 ft. closer	$0 / +$600	0% / +0.58%
Anderson and West (2003)	Minn.-St. Paul MN 1997	Park-developed	move 650 ft. closer	$0 / +$458	0% / +0.44%
Shultz and King (2001)	Tucson AZ 1990	Park-regional/district	650 ft. closer	*- $98*	*- 0.09%*
Shultz and King (2001)	Tucson AZ 1990	Park-undeveloped	move 650 ft. closer	*- $206*	*- 0.18%*
Shultz and King (2001)	Tucson AZ 1990	Park-neighborhood	move 650 ft. closer	*- $568*	*- 0.49%*
FORESTED LAND					
Thorsnes (2002)	Grand Rapids MI '70-'00	Forest-preserved	directly adjacent	$5,800 / 8,400	+ 2.90% / 6.80%
Geoghegan et al. (2003)	4 MD co. 1993-1996	Forest-preserved-pvt.	+1% OS <1-mi / <300 ft	$0 / +$1,306	0% / +0.71%
Geoghegan et al. (2003)	4 MD co. 1993-1996	Forest-developable-pvt.	+1% OS <1-mi / <300 ft	*$0 / - $768*	*0% / - 0.51%*
Irwin (2002)	4 MD co. 1995-99	Forest-general	within 300 ft.	*- $1,424*	*- 0.82%*
WETLANDS					
Doss and Taff (1996)	Suburban St. Paul MN	Wetland-scrub-shrub	move 650 ft. closer	+ $2,900	+ 2.80%
Doss and Taff (1996)	Suburban St. Paul MN	Wetland-emergent	move 650 ft. closer	+ $2,720	+ 2.60%
Doss and Taff (1996)	Suburban St. Paul MN	Wetland-open-water	move 650 ft. closer	+ $1,980	+ 1.90%
Mahan et al. (2000)	Portland OR 1992-94	Wetland-general	1,000 ft. closer	+ $436	+ 0.36%
Mahan et al. (2000)	Portland OR 1992-94	Wetland-general	move 650 ft. closer	+ $286	+ 0.23%
Mahan et al. (2000)	Portland OR 1992-94	Wetland-general	wetland 1 acre larger	+ $24	+ 0.02%
Doss and Taff (1996)	Suburban St. Paul MN	Wetland-forested	move 650 ft. closer	*- $960*	*- 0.91%*

SECTION VII. CONSUMPTION GOODS

All of the uses of State parks and forests discussed thus far are considered by economists to be "non-consumptive" in nature. That is, economists assume that barring congestion, these uses (whether "direct" or "indirect") do not diminish the quantity or quality of the parks or forests and therefore do not reduce their capacity to continue supporting the same uses indefinitely. In contrast, the uses discussed in this section are explicitly "consumptive", that is, by their very nature they involve consuming a portion of the park or forest. It should be noted that as used in this context, consumption is not the same as *total* consumption; indeed, *sustainable* consumption (also called sustainable use, extraction, harvesting, yield, etc.) is the express goal of most current park and forest management regimes.

The potentially consumable "ecosystem goods" produced by any park or forest include timber, fuelwood, game animals, fish, and some plant species.[42] As noted earlier, hunting and fishing are not included in this report due to lack of adequate data specific to State parks and forests. Harvesting of timber, fuelwood, and other plants on forested public lands that are reserved (e.g., parks, wildlife preserves, and wetlands) is also administratively restricted. However, in principle, timber and fuelwood harvests limited to a sustainable level under a multiple-use management regime would by definition be compatible with continued non-consumptive uses of those lands, and this analysis will focus on the potential economic value of such sustainable harvests.

Timber

While New Jersey is not considered a major timber-producing state, about 1.9 million acres or 90% of the state's 2.2 million acres of forested land are classified by the United States Forest Service as "timberland", i.e., forested land containing resources suitable for commercial timber harvesting under a regime of sustainable timber or forest management.[43] As noted in the first section of this report, the State Park Service has 338,000 acres of parks and forests[44] under its jurisdiction, comprised of 240,000 acres of State forests and 98,000 acres of State parks. For reasons of data availability, this analysis is limited to the 280,000 acres of State forests and forested parks (see Sec. VI and Exhibit J).

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[42] In this context, the emphasis is on the game animals and fish themselves rather than the satisfaction that hunters and anglers derive from their respective activities, which would count as a recreational value.

[43] The literature distinguishes three types of forestry. Sustainable timber management refers to forest management systems that aim for sustained timber yields; sustainable forest management refers to systems that aim for sustained yields of multiple products from the forest and not just timber. Both of these can be distinguished from conventional logging, which is more short-term in focus, less concerned with forest regeneration through management, and often lacking in government regulation.

[44] The figure is as of 2003/2004. The latest reported DPF acreage is 400,508, as of August 2006, which includes all areas under the jurisdiction of the Division (i.e., including not only State parks and forests but also such areas as historic sites, marinas, reservoir sites, golf course, natural, and miscellaneous areas). The 2003/2004 acreage is used as the reference area since most of the available data required for the analyses relate to that point or up to that point in time.

Forests contain a wide variety of trees, including live trees of various species, ages, and sizes, standing and fallen dead trees, etc. Commercial interest focuses on live trees ("growing stock") that meet certain standards of size and wood quality ("sawtimber")[45]. At its simplest, the monetary value of the timber contained in State forests equals the volume of merchantable (commercially valuable) sawtimber times the price per unit volume. Sawtimber volume is conventionally measured in board-feet; a sawtimber log measuring 1 foot x 1 foot x 1 inch contains 1 board-foot. Since timber prices vary by tree species, the volume data must reflect the mix of tree species or forest types in the State forests. (A "forest type" contains multiple species found growing in close proximity; a "forest type group" include several forest types.)

The principal sources of detailed information on New Jersey's forest resources are the periodic inventories conducted by the U.S. Forest Service; the most recent such inventory took place in 1999 and will be referred to herein as USFS 1999. Based on the data from that source, we have estimated the monetary value of the timber in the State forests as follows (row names refer to Exhibit K):

1. Rows A-C: USFS 1999 reported acreage (but not volume) by forest type group (FTG) for public and private timberlands.[46] Assuming that the FTG mix for public timberland in general applies to State parks and forests in particular and that the 2004 mix was the same as the 1999 mix, we allocated the 280,000 acres of State forest and forested parks in 2004 to the six FTG's used in USFS 1999.

2. Rows D-G: not all timberland is sawtimber land, and only the latter is relevant for commercial purposes. For 1999, USFS reported both total timberland and sawtimber land by FTG. Using that data, we calculated the sawtimber fraction for each FTG and applied those fractions to the timberland in State forests to obtain State forest sawtimber land by FTG.

3. Rows H-K: we next estimated the 2004 sawtimber volume per sawtimber acre for each FTG and multiplied those factors by the number of State forest sawtimber acres in each FTG to obtain total board-feet of sawtimber estimated to be contained in the State forests in 2004. We then developed average 2004 stumpage prices[47] for each FTG and multiplied by the sawtimber volumes to obtain an estimated one-time dollar value of $231 million for the stock of sawtimber in the State forests in 2004. The calculations in Rows H and J involved translating data by tree species into data by FTG; the details are available from the authors.

4. Rows L-O: in the same way, we estimated the 1999 sawtimber volume per acre by FTG and multiplied by the same FTG acreages to obtain an estimate of 1999 sawtimber

[45] In addition to growing stock, topwood (wood and bark of above merchantable height), cull (rotten or rough trees) and non-growing stock may also have commercial value. Due to lack of data, this value is not estimated here.

[46] Public timberland includes State forests, other timberland managed by SPS, timberland managed by other State agencies, and municipal, county, and federal timberland.

[47] Stumpage or the stumpage price is the amount that a logger would have to pay a landowner for the right to harvest a given area of forest.

volume. We divided the difference between the 1999 and 2004 estimates to obtain an estimate of the annual change in sawtimber volume by FTG and multiplied those figures by the prices used above to obtain an estimated value of $6.2 million per year for the annual change in State forest sawtimber.

The estimate just presented is based on rough estimates of sawtimber volumes for 1999 and 2004 and a straight-line interpolation of the difference between those estimates over a 5-year period. It may be worth noting that according to the New Jersey Forest Service, 4.7 million board-feet were harvested on privately-owned timberland during the period from July 2003 to June 2004, based on reports submitted by certified consulting foresters. In contrast, the annual harvest implied in Exhibit K is 23.7 million board-feet, despite the fact that in 1999, 31% of New Jersey's timberland was publicly-owned (the 2004 figure is not readily available). (Note: whether or not harvesting should be countenanced in the State parks or forests and, if so, at what level, is a policy issue that this report does not address.)

It should be emphasized that the estimate of $6.2 million/yr cannot necessarily be taken as the value of the sustainable yield from the State forests. An accurate estimate of sustainable yield would require more detailed modeling by tree species of such factors as growth of previously established trees, colonization of new acreage, deliberate tree plantings and removals, tree diseases, normal tree mortality, and other factors. Those variables are in turn affected by such things as climate change, populations of disease vectors, crowding-induced limitations on the number and size of trees per acre, etc. Models incorporating these factors are not available for New Jersey and would require substantial amounts of time and resources to develop. Such an effort is much more an ecological analysis than an economic one and in any case is far beyond the scope of the current project.

The estimates of monetary values presented above are thus subject to certain uncertainties caused by the limitations in the available data and the need to make assumptions about the missing values. The most important of these gaps are the actual 1999 and 2004 values for State forest timberland and sawtimber land by FTG and the total 1999 State forest acreage. However, despite these uncertainties, we believe that the estimates are reasonable ones that are not likely to be improved on without further extensive research and that they are sufficient given the limited purposes of the current project. It is worth noting that as Exhibit K shows, the total estimated value of the sawtimber in the State parks and forests in 2004 was $270 million, which means that the benefits provided by intact parks and forests far exceed their value as a source of raw materials.

Fuelwood

The other main ecosystem good produced by and potentially obtainable from the State parks and forests is fuelwood. Whereas sawtimber is timber intended for use in furniture, home-building, etc., fuelwood is wood intended to be burned for energy. Given this, fuelwood represents a distinct use of forest resources.

Fuelwood consists mostly of wood wastes, including logging residues; rough rotten, and salvageable deadwood; excess saplings; and small pole trees (Walsh et al. 1999). Wood wastes also include those generated by processing of wood into fiber and other products (industrial

wood waste). A final category that relevant to New Jersey is "urban wood wastes", which include yard trimmings and other woody materials that are generally disposed of as part of the municipal solid waste (MSW) stream and in construction/demolition (C/D) landfills.

From the fragmentary statistics available, the amount of firewood allowed to be harvested from State parks and forests and sold commercially is quite small and possibly declining; from 1991 to 1996 the volume dropped from 1,090 to 198 cords (NJFS). A small amount is also allowed to be harvested from state lands and sold as "cordwood", probably for pulp and paper production use. Thus, consumption of fuelwood or firewood obtained from State parks and forests appears to be a minor forest use and as such will not be discussed further in this report.

Section VIII: Non-Use Values

All of the sources of value considered thus far provide current benefits to individuals and/or to society as a whole, and economists would generally classify them as "use values". In contrast, some sources of value recognized by economists do not involve any current use of the resource being valued. These include "pure" *existence value* (the satisfaction many individuals feel from merely knowing that a natural asset such as a rare species exists, even if the valuer has no intention of ever "using" it), *bequest value* (the willingness of many people to pay to conserve the benefits of a resource for the use of future generations), and *option* value (the benefit derived from retaining the option of using a resource in the future by protecting or preserving it today[48]).

That State parks and forests have such additional non-use values is suggested (although not proven) by New Jersey voters' consistent approval of open space bond issues and by residents' pledges to private conservation funds. Non-use values are the most difficult to quantify, and such values are usually estimated based on the results of costly surveys akin to public opinion polls or market research surveys. In the absence of studies that deal directly with the State parks and forests (or with parks and forests in New Jersey generally), this report does not attempt to assign a value to the mere existence of those parks and forests, the options which their continued existence preserves for New Jerseyans, and their value as a bequest to future generations.

[48] In the context of future decisions with irreversible consequences, some economists also distinguish *quasi-option value* as the improvement in the expected outcomes of those decisions obtained by preserving the information value inherent in natural resources. Freeman (2003), however, argues that this "value" is in fact the benefit of improved decision-making rather than of the natural asset in question.

Section IX: Summary and Conclusions

Table 15 summarizes the estimated economic benefits that New Jersey derives from the State parks and forests under the jurisdiction of NJDEP's Division of Parks and Forestry. As can be seen, the benefits total between $953 million and $1.36 billion annually and have a present value of between $32.8 billion and $45.4 billion (based on a annual discount rate of 3% in perpetuity).[49] In addition to the monetary benefits, these State facilities support an estimated 7,039 jobs (excluding temporary construction jobs and part-time or seasonal park and forest jobs and jobs related to timber harvesting, hunting, fishing, etc.).

As noted in earlier sections of this report, some of the benefits involve actual transfers of cash and some do not. Some benefits involve consumption of natural resources and some do not, and some involve direct use while others represent indirect uses. The authors have cast as wide a net as possible to capture as much of the total economic value of these sites as the data and current state of valuation theory permit.

Discounting theory and methods are the subjects of considerable research and discussion in economics. Besides the obvious question of which discount rate(s) to use, economists have developed a number of discounting techniques, including several in which the marginal discount rate declines the further out one carries the calculations. Some economists favor eliminating discounting entirely unless the amounts being discounted represent actual flows of investable cash. Rather than complicating the report with these complexities, we have limited our analysis to conventional discounting, in which a single discount rate is used for all future periods. In keeping with a common practice in valuing benefits to society, we use a "social" discount rate of 3% rather than the much higher rates used in valuing private projects. See, e.g., OMB (2003).

The appropriate time horizon for valuing natural assets such as parks and forests is also open to discussion. In principle, renewable assets such as forests have a potentially infinite life if sustainably managed and if external forces do not intervene. Therefore, any shorter time horizon is essentially arbitrary, and using such a horizon results in potentially understating the benefits of assets such as parks and forests that have no definite "useful life".

For natural assets with an indefinite or potentially unlimited life, it can be shown mathematically that the present value is equal to the recurring annual flow of benefits (expressed in monetary terms and assumed to be constant) divided by the constant discount rate. This method has the effect of assuming an indefinitely long time horizon and thus avoids the problem of selecting an arbitrary cut-off date for present value calculations. Table 16 (following Table 15) shows how present values derived using regular discounting with a fixed time horizon compare with the present value of a perpetual "annuity", in each case based on a hypothetical payment of $100/year.

[49] As noted elsewhere in this report, the *economic activity portions* of these figures do not represent the types of incremental impacts on the New Jersey economy that might be expected, for example, from the creation of a completely new business that was staffed by previously unemployed or underemployed New Jersey residents, that used no imported raw materials or out-of-state financial capital, and that sold all of its output to residents of other states or countries. Rather, the economic activity figures are estimates of the overall significance of the State parks and forests considered as part of the New Jersey economy.

TABLE 15: Annual Benefits from New Jersey State Parks and Forests (2004 $MM/yr.)					
Benefit	**Notes**	**Jobs[8]**	**Low**	**Middle**	**High**
CASH BENEFITS					
Economic activity value[1]	From private sector spending	5,973	260	289	318
Economic activity value[1]	From public sector spending	1,066	52	58	64
Consumption goods	Timber only[7]	--[9]	6	6	6
Subtotal		**7,039**	**318**	**353**	**388**
NON-CASH BENEFITS					
Recreational value	Value to visitors		240	304	369
Ecosystem services:					
Habitat/refugia			230	258	287
Other quantified services[2]			165	240	318
Non-use values[3]	Not quantified		--	--	--
Subtotal			**635**	**802**	**974**
OTHER BENEFITS					
Property enhancement[4]	Not quantified		--	--	--
Total (MM 2004 $/year) *Present value (MM 2004 $)[5]*		**7,039**	**953** *31,767*	**1,155** *38,500*	**1,362** *45,393*
Total (MM 2005 $/year)[6] *Present value (MM 2005 $)[5]*			**985** *32,847*	**1,194** *39,809*	**1,408** *46,944*

Note: columns may not add to totals due to rounding.

1. figures represent total sales or total jobs supported and are not incremental impacts. Low and high estimates = middle value +/- 10% based on Stynes (A) and (B).
2. values of some ecosystem services were not quantified.
3. non-use values, including existence, bequest, and option values, were not quantified.
4. benefit is in $ per foot closer to a park or forest; not readily convertible to pure $.
5. present values are based on a discount rate of 3% per year in perpetuity.
6. based on US Bureau of Labor Statistics, All-Items Urban Consumer Price Index.
7. excludes fuelwood, fish, game animals, minerals, medicinal or decorative plants, etc.
8. jobs supported are based on the "middle" values.
9. jobs supported by timber extraction and processing not quantified.

(see next page for Table 16)

Table 16: Effect of Time Horizon on Present Value		
Years	**Present Value**	**% of Present Value of Perpetual Annuity**
25	$1,741	52%
50	$2,573	77%
75	$2,970	89%
100	$3,160	95%
Perpetual Annuity	$3,333	100%
Annual payment	$100	
Discount rate	3%	

Because of this advantage, the perpetual annuity approach has been used throughout this report.

The values cited in this report are all expressed in 2004 dollars and all reflect the area of the State parks, forests, and recreation areas in that year. From time to time SPS is able to acquire new sites or expand existing ones through purchase or donation, and such changes will affect the total economic value of these State facilities considered in the aggregate. On the other hand, changes in land cover or land use associated with development can affect the health of parks and forests located nearby and their value as providers of economically important goods and services, even if the State facilities themselves suffer no obvious encroachment.

In a related vein, the estimates in this report assume the continuation of the climate regime existing in New Jersey as of 2004. As the reality and extent of global climate change become more and more evident, this assumption becomes increasingly untenable. State parks and forests are not immune to such changes, which may include increased temperatures, increased and/or decreased precipitation, more frequent and intense storms, shifts in the ranges for pests and disease organisms, and so forth. It is beyond the scope of this report to examine the possible effects of such changes on the State parks and forests, but those effects may well be substantial.

The figures cited above most likely *understate* the true economic value of the State parks and forests, since values have not been estimated for a number of benefits due to methodological or data limitations. Even with these omissions, we can confidently state that New Jersey derives very substantial economic benefits from its State parks, forests, and recreation areas, and on economic grounds alone these sites deserve to be preserved and protected. The extent of that preservation and protection depends on many things, some of which are not under human control. However, as a primary actor in the on-going effort to protect and enhance these valuable natural assets, NJDEP has a major responsibility and impact, and the resources it deploys clearly earn a substantial return on society's investment. The State parks, forests, and recreation areas are not assets that New Jersey can afford to lose; they are in most cases irreplaceable, and their protection merits the constant attention and stewardship of the public officials and residents of New Jersey.

APPENDIX A: METHODS FOR ESTIMATING NON-MARKET VALUES

The economic values of marketed goods and services are generally assumed to equal their market prices. Where market prices are not available, economists have developed various techniques for estimating "shadow" prices. These methods can be generally divided into two categories: stated preference and revealed preference methods. The methods in the first category try to determine people's preferences by directly questioning them. Methods in the second category try to discern consumer preferences from peoples' actual behavior.

Among the stated preference methods, the contingent valuation method (CVM) is accepted by most economists as a reasonable method to estimate the monetary value of goods and services for which no markets exist. CVM is essentially a survey approach that asks people what they are willing to pay (WTP) for a benefit, or what they are willing to accept (WTA) by way of compensation for loss of the benefit[50]. There are four common techniques to carry out CVM: contingent referendum, payment card method, open ended question method, and the bidding game.

Among the revealed preference methods, the travel cost method (TCM) is the most widely used and is commonly applied to estimate the monetary value of recreational benefits. The assumption behind the method is that the value of a location (such as a recreational site) is reflected in the cost that visitors incur to travel to it, including the imputed value of their time. Other examples of revealed preference methods include hedonic pricing, change in productivity, and replacement cost, and these are described briefly below.

The concept behind the hedonic pricing approach is that when making a decision to buy or rent a house, households will consider the value of the available services (water, clean air, scenic views, etc.) associated with the housing unit. This approach estimates the value of the specific attribute of a good that is sold only as a bundle of these attributes.

Change in productivity is usually applied to estimate the watershed values of forests and parks. The watershed values can affect the agriculture production or outputs of development projects in and around the forests or parks. It is then possible to quantify the economic value of these non-market benefits by analyzing changes in productivity.

The replacement cost approach is based on the expenditure incurred to replace or restore the non-market service that has been damaged or has declined.

Another method of valuation is to estimate the cost of *not* proceeding with a development project in forest or park area in the interest of conservation. This cost is referred to by economists as opportunity cost. The opportunity costs of conservation include the development benefits foregone. In this method, the costs of conservation represent a minimum value against which the benefits can be judged.

[50] WTP is typically easier to estimate than WTA. Further, one's WTP is bounded by one's income; one's WTA is not. Thus, most valuation studies estimate WTP.

A technique for valuing non-marketed goods and services that has been used to measure the value of biodiversity is demand analysis. This involves the application of a general demand model using a constant set of assumptions. An example would be a model of the demand by pharmaceutical researchers for marginal species on the basis of their incremental contribution to the probability of making a commercial discovery.

Detailed data collection to establish economic values using the above techniques can be costly and time-consuming. For this reason, the benefits transfer method is sometimes employed instead. This approach involves taking an estimate of the economic value of a resource or service from an existing study done elsewhere (the "study site") and applying ("transferring") it to a new context (the "policy site"), assuming in effect that the values obtained from existing studies can be used as reasonable approximations of the values that would have been obtained if fresh studies were at other locations. A correction factor is sometimes employed to adjust the unit values (e.g., value per acre) to consider conditions at the policy site.

There are three main approaches to benefit transfer: a) transferring mean unit values; b) transferring adjusted unit values; and c) transferring demand or benefit functions. Value transfers (i.e., *a* and *b*) encompass the transfer of a single (point) benefit estimate from a study site, or a measure of central tendency for several benefit estimates from a study site or sites (e.g., the means). Function transfers encompass the transfer of a benefit or demand function from a study site, or a function derived from a meta-analysis of the results from several study sites. Function transfers then seek to adapt the function to fit the specific situation of the policy site.

APPENDIX B: CALCULATION OF ECONOMIC ACTIVITY VALUE

As noted in the main text, the Total Effects of spending related to parks and forests consists of Direct Effects and Secondary Effects. This appendix begins with the Direct Effects.

A. Direct Effects

The direct economic effects associated with State parks and forests are best described in terms of five basic measures of economic activity: total spending, direct sales, value added, personal income, and employment. As used in this branch of economics, some of these terms have specialized meanings that are explained below.

- **Total Spending**. Total spending by visitors of State parks and forests is simply the number of visitors multiplied by the average spending per visitor. Different types of visitors have been found to have different spending patterns and levels depending on whether they are local or non-local, whether their visit is daytime or overnight, and, if overnight, whether they are staying in area lodgings or camping. Ideally, information on the number and type of visitors and their actual spending are obtained through site-specific visitor surveys; in the absence of such data, economists use previously developed regional or national estimates for these factors.

- **Direct Sales**. Some of the goods and most of the services that visitors spend money on are produced near the park or forest in question or at least within the state. However, some goods are produced outside New Jersey, e.g., bed linens for motels, food for restaurants, souvenirs, etc. Except for the retail margin (and perhaps the wholesaler margin and payments to shippers), most of the price for such goods accrues to suppliers outside the state. The portion of the sales dollar lost to out-of-state suppliers is termed "leakage". Spending that remains in the state constitutes "direct sales", and the fraction of the sales dollar that remains in the state is called the "capture" percentage. Leakage and capture factors vary by type of good or service; where such a breakdown is not available, generic averages must be used.

- **Value Added**. Direct sales are not counted at 100% in estimating the contribution of State parks and forests to New Jersey's Gross State Product (GSP), the generally accepted measure of aggregate economic activity in a state. This is a consequence of the fact that businesses purchase inputs (e.g., raw materials) from each other. For example, a restaurant located near a State park may purchase raw food from a New Jersey wholesale distributor which in turn bought the food from a New Jersey farmer; at each transfer, one or more New Jersey trucking companies may also be involved. Including in GSP the direct sales of the restaurant, the wholesaler, the farmer, and the truckers would entail substantial double-counting. Therefore, GSP only includes the value that each business adds to the inputs it purchases, i.e., sales receipts minus input costs. This is the most accurate measure of an industry's contribution to a state's economic output.

- **Direct Income**. Value added includes three main components: compensation to proprietors and employees (including employee benefits), gross operating surplus, and taxes on production and imports. Gross operating surplus includes profits, economic rents, net interest, allowances for capital consumption (related to depreciation), changes in inventory levels, and certain other items. Taxes on production and imports include state and local property, gross receipts, and sales taxes, Federal excise taxes, customs duties, and certain other levies. Given the complex makeup of value added, it is clear that only employee (and proprietor) compensation represents personal income to New Jerseyans. The ratio of such income to total value added varies depending on how labor-intensive a given sector (lodging, restaurants, etc.) is and on the wage and benefit structure for that sector.

- **Direct Employment**. Economic activity obviously generates and supports jobs. Job estimates for an industry are based on the number of jobs per million dollars of direct sales, value added, or personal income as determined through prior detailed analyses of production "functions" or patterns in the industry. Once again, the specific quantities vary from industry to industry (retail clothing, gasoline stations, etc.), although averages are available where detailed information on the mix of industries for a given analysis is not available. It should be noted that employee income is *not* an added economic benefit, since employee compensation is already reflected in direct sales, value added, and personal income.

B. Secondary and Total Effects

The flows of cash payments involved in direct sales generate two types of "secondary" economic activity for each dollar spent: the purchases of goods and services by businesses generate "indirect" effects, and the spending of employee compensation (excluding benefits) creates "induced" effects. Examples of these are as follows:

- A motel that derives its business from overnight visitors to a nearby park or forest must purchase bed linens, electricity, and other inputs, thereby contributing to the demand for the output of producers of linen goods, electric utilities, etc. Such impacts are known as Indirect Sales. (As noted above, only the value added by each such firm is included in GSP.)

- Similarly, as the employees and proprietor of the motel spend the income *they* receive, a separate stream of economic activity is generated, referred to as Induced Sales. Purchases of food and clothing by motel employees are a good example of such sales.

The initial "rounds" of both indirect and induced sales are followed by subsequent rounds, although the economic stimulus decreases at each round. The sum of the direct and secondary sales is termed Total Sales.

The Total Sales resulting from a dollar of Direct Sales of a particular type (lodging, food, etc.) are estimated by multiplying the amount of Direct Sales of that type by an appropriate local or regional sales multiplier. For example, if the appropriate multiplier for a given type of good

or service has been estimated at 2.0, then $1 of direct sales of that type will generate an additional $1 of indirect and induced sales, resulting in total sales of $2 for that type of good or service. A variety of economic studies have been performed to estimate sales multipliers for a large number of industry sectors and sub-sectors. Total Sales can in turn can be used to estimate Total Value Added, Total Personal Income, and Total Employment. The multiplier effect decreases at each round of spending, since at each round some of the dollars spent will go to out-of-state suppliers and some will go for the non-income components of Value Added.

It should be noted that Income is often expressed as a function of Sales, i.e., Income = Sales x Income Multiplier. This is mathematically equivalent to the approach used in this report:

if	Direct Sales x Value Added % = Value Added	(1)
and	Value Added x Income % = Income	(2)
then	Direct Sales x (Value Added % x Income %) = Income	(3)
or	Direct Sales x Income Multiplier = Income	(4)

where the Income Multiplier in Eq. 4 is equal to the Value Added % x the Income %. Similarly, some studies express Jobs as a function of Income; again, this is equivalent to the approach used in the present study. Finally, multiplying Sales in $MM by Jobs per $MM of Sales is equivalent to dividing Sales in $ by Average $ per Job.

C. Limitations

The standard method for estimating economic activity value, which is the method used in this study, is acknowledged to have a number of inherent limitations. First, as noted in the main text and in Tietenberg (2000), secondary benefits should only be counted if the increase in demand generated by visitor spending leads to the employment of previously unused or underused resources, e.g., labor. This is most likely to occur in areas with high unemployment. If the increase in demand merely results in a reallocation of previously employed resources among economic sectors, the "increase" in economic activity is not a true increase from an economic *impact* perspective, although it can properly be counted in an analysis of economic *significance* (see, e.g., Wells 1997 and Stynes (A) and (B)).

A second limitation derives from the fact that economic activity analysis is a type of partial equilibrium analysis which is based on input-output models. Such models tend to overstate the labor component of value-added because they use average production costs rather than marginal costs. Even computable general equilibrium (CGE) models may do this, although to a lesser degree (Lahr 2006).

APPENDIX C: CAPTURE RATES AND MULTIPLIERS FOR PUBLIC AGENCIES

As noted in the main text, SPS's operating expenditures go for a different mix of goods and services than park visitors, and therefore the various factors used to estimate economic activity for the latter cannot simply be used for the former. While as described in the main text, some of the relevant factors can be estimated from other New Jersey or US data, two key factors cannot, namely the capture rate and the sales multiplier. To estimate these factors, we therefore reviewed a sample of previously published studies.

Most economic impact studies in this general area focus on spending by visitors to parks and forests themselves rather than on spending by the parks and forest agency. However, we were able to find two studies of the economic impacts of state and local parks agencies, one for Illinois (ERA 2005) and one for Minnesota (MDNR 2002). To obtain some New Jersey-specific data points, we also consulted studies of spending on spending by New Jersey historic agencies and NGOs (Listokin and Lahr [L&L] 1997) and by Lakehurst (NJ) Naval Air Engineering Station (NJCEGC 2000).

The four studies reported a number of estimates of the relevant parameters as follows (blanks indicate no value was reported):

Table 18: Public Sector Economic Activity Parameters

Study (Year)	Type and Location of Spending	Sales Capture %	Value Added Multiplier	Income Multiplier
ERA (2005)	operating (IL)	86%		3.01
MDNR (2002)	operating (MN)		1.22	
NJCEGC (2000)	operating (NJ)	61%		1.50
L&L (1997)	operating (NJ)		1.89	1.61
ERA (2005)	capital (IL)	91%		2.15
MDNR (2002)	capital (MN)		1.94	
NJCEGC (2000)	capital (NJ)	86%		1.34
L&L (1997)	capital (NJ)		1.52	1.39
AVERAGE	**ALL**	**82%**	**1.64**	**1.83**

As can be seen, the studies took different approaches and did not estimate the same type of multiplier. Technically, the two types of multipliers shown relate to different measures of economic activity than a third type—the sales multiplier—used in this study to estimate the impacts of visitor spending. However, since we make the assumption (see main text) that the ratios of value added to sales and income to value added are the same for both direct and secondary effects, the three types of multipliers could all be regarded as in essence measures of the ratio of total effects to direct effects without regard as to whether the effects in question are sales, value added, or income.

Taking this basically intuitive approach, we compute the pooled average for the last two columns to be 1.755. However, as one authority in this field has stated, current best practice in this field generally uses multipliers less than 2.0 (Stynes et al.). If we eliminate the 3.01 income

multiplier, the pooled average becomes 1.615, and if we also eliminate the 2.15 income multiplier, it becomes 1.549. In our judgment, the last figure (rounded to 1.55) is a reasonable and conservative figure for use in estimating the effects of SPS expenditures.

As to possible differences between operating and capital multipliers, we take the position that there are too few data points here to make a meaningful determination as to what, if any, differences exist between those two types. The multipliers used in studies of the construction industry's economic significance are generally above 2.0 (see TTCA 2002); however, those multipliers were derived for residential, commercial, and highway construction, none of which relates very closely to the types of capital expenditures made by SPS. We therefore decline to adopt those more aggressive multipliers for this project to ensure that our results fall on the conservative side, i.e., so that they *under*estimate the economic benefits of SPS spending.

APPENDIX D: ECOSYSTEM SERVICES LACKING VALUE ESTIMATES

This appendix discusses ecosystem services for which reliable valuations are not available.

A. Conservation of Biodiversity and Genetic Data

The conservation of biodiversity and genetic data is often distinguished from the protection of rare species. The study of the economics of biodiversity is still in its infancy and only a few studies have attempted to quantify its value. Among these is Simpson et al. (1996) which sought to determine the private *in situ* value of the marginal[51] species for use in pharmaceutical research and private value of the marginal hectare[52] of threatened habitat for pharmaceutical research. Using demand analysis for a limited sample of pharmaceutical researchers, the study obtained one-time values of $12,040 for the "marginal" species and $10 per acre for threatened habitat (values in 2004 $). The estimates are generic and for private rather than public values. The researchers sought to explain what they viewed as relatively low values by citing the following factors:

- individual redundancy, i.e., if all representatives of a species produce a particular compound, individuals in excess of the number needed to maintain a viable population are redundant;

- species redundancy, i.e., instances in which identical drugs, or drugs with similar clinical properties, have been isolated from different species; and

- medical redundancy, where different therapeutic mechanisms may be effective in treating the same symptoms.

Given these caveats, the results of Simpson et al. at best provide indications of the order of magnitude of the benefits. Other studies point to different approaches that could yield substantially different results. Thus, at this point, there is no generally accepted approach or methodology for assessing biodiversity value.

B. Urban Form Definition

The role of parks and forests in providing definition to a region's developed areas and growth management is a significant benefit, especially in the case of a highly urbanized state like New Jersey. Urban form definition in the context of New Jersey refers to the fact that green "infrastructure" creates a buffer zone to regulate the spread of development. From another perspective, parks and forests function as protected areas around which a sustainable land use framework can be implemented in highly urbanized counties of the state.

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[51] In studies that ascertain values for genetic resources *in situ*, every "unit" (species or habitat area) of biodiversity is viewed as making an equal marginal contribution to the success of the bioprospecting enterprise; that is, one species or one hectare of habitat is about as valuable as any other.

[52] 1 hectare = 2.47 acres.

Such a framework is currently being identified by Green Acres and the New Jersey Conservation Foundation in the form of a statewide system of interconnected open space and a green infrastructure of forests, wetlands, farms, waterways and recreation lands (called collectively “Garden State Greenways”). The Greenways initiative aims to minimize the impacts of sprawl and landscape fragmentation and complement New Jersey’s smart growth efforts, and State parks and forests form the backbone of this framework since they effectively function as open space in terms of defining urban form. While the sale price per acre for the land involved can be determined, any undeveloped acre of land provides multiple ecosystem services, and the value of the urban form definition service cannot be separately quantified.

C. Public Service Benefits

Studies in other states have identified a category of benefits called "public service benefits" that parks and forests provide. These include educational benefits from interpretive programs and displays. Other conceivable benefits might include health benefits to residents of increased recreational and exercise opportunities, public safety benefits (to non-park users) from park police and fire services and forest management, and transportation benefits from trails connecting homes, businesses and workplaces. These benefits are difficult to define and quantify, and therefore this study does not attempt to estimate them.

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