ECONOMIC IMPACT STUDY OF BUSINESS ACTIVITIES

AND

ECONOMIC VALUE OF ECOSYSTEM SERVICES

ON THE RENSSELAER PLATEAU

RENSSELAER PLATEAU ALLIANCE, INC.

May 2012

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Open Space Institute

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In honor of Barney McHenry's contributions and accomplishments, the Open Space Institute has established and administers an award to celebrate his leadership and foster future leaders in the Hudson River Valley. The annual award will be used to provide financial support to promising young leaders and exemplary projects that make significant contributions to environmental protection, historic preservation and the arts in the Hudson River Valley.

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INTRODUCTION

The Rensselaer Plateau is estimated to be the fifth largest forested region in New York State, covering about 105,000 acres in the towns of Berlin, Brunswick, Grafton, Hoosick, Nassau, Petersburg, Pittstown, Poestenkill, Sand Lake and Stephentown, as well as the Village of East Nassau. The natural resources of the Plateau support the forest products industry and other businesses in the area. In addition, the Plateau is valuable for providing clean air, clean water and storm water handling. This includes providing the headwaters for seven watersheds and the public water supply for much of Rensselaer County. The Rensselaer Plateau also provides a habitat for many native plants and wildlife.

The Rensselaer Plateau Alliance (RPA) is a diverse group of organizations and people dedicated to the protection of the many economic and environmental benefits provided by the Rensselaer Plateau. A grassroots organization, the RPA is comprised of people living in the area who share a common interest in ensuring that future generations will experience and value the many benefits of the Plateau. In support of this mission, the RPA is coordinating the development of a regional conservation plan for the Rensselaer Plateau. A companion component to the Rensselaer Plateau Conservation Plan is an economic study that consists of following two research studies:

- **Impacts of Economic Activities**: This includes estimating the direct and indirect economic contributions (income, employment) to the region resulting from various industries on the Plateau.
- **Ecosystem Services/Non-Market (un-priced) Benefits**: This includes estimating the value of benefits derived from ecosystem services such as clean water for drinking, storm water handling, clean air, etc.

These studies are designed to provide critical information about the contributions of the area's natural resources to industry, tourism and recreation, as well as for less tangible values that these natural resources provide to residents of the Plateau and surrounding areas. This information will help inform a well-rounded conservation planning effort that is being done by the RPA in cooperation with the municipalities of the Rensselaer Plateau area.

Evaluating the benefits of open space is especially important for communities in these fiscally challenging times. The Office of the New York State Comptroller issued a report titled "Economic Benefits of Open Space Preservation" in March of 2010 that emphasized the importance of considering fully the impact that open space can have on the financial health of a community, the local economy and the quality of life for residents. As stated in this report: "There is a tendency to view open space as economically unproductive, contributing minimally to local economies and tax revenues, or even as fiscally damaging to municipal governments. This view fails to consider the many positive economic effects documented from open space. While conflicts may occur between open space preservation and other municipal goals, local decision-making that explicitly examines economic, environmental and quality-of-life considerations will best serve a community's long-term interests." It is in recognition of this conclusion that the RPA has sponsored the research studies that follow.

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of

THE RENSSELAER PLATEAU

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Executive Summary

The Rensselaer Plateau is one of the largest and most ecologically intact native habitats in New York State. This economic study was conducted to help guide the Rensselaer Plateau Conservation Plan that is being developed by the Rensselaer Plateau Alliance, a group dedicated to the preservation of the Plateau for future generations. The study estimated and evaluated the economic contributions of specified industry sectors on the Rensselaer Plateau on the local economy of Rensselaer County.

Economic impact analyses were conducted using IMPLAN and the Money Generation models (MGM). IMPLAN is a software package and database for estimating local economic impacts, which is one of the most widely used and accepted methodologies available. The MGM models rely on the IMPLAN economic models and are used by the National Park Service to estimate the economic impact of tourism spending and park operations on local economies.

The economic impacts that were estimated included the number of jobs supported and the value added to the local economy as a result of the economic activity generated by each industry. The estimate of value added represents the sum total of increased value to goods and services that is generated by the local activities being evaluated and is the most commonly used measure of the impact of an industry to a region. Impacts include the direct effects that accrue primarily to the industry, the indirect effects that accrue to the suppliers of these businesses, and the induced effects that result from household income produced by employees hired because of these businesses. The study estimated the following impacts for the selected industry sectors:

Industry Sector	Jobs Supported	$ Impact (Value Added)
Forest Products	96.7	$9,208,742
Mining and Quarrying Stone	11.7	$2,355,795
Agriculture	26.0	$799,548
Food Services and Drinking Places	110.2	$3,832,143
Lodging Establishments	0.0	$0
Commercial Hunting and Trapping	0.2	$17,333
Tourism and Recreation	83.6	$2,855,416

The results of the study show the forest products industry as having the largest dollar impact and also supporting a significant number of jobs. To the extent that forests can be re-grown, this is also a sustainable industry. The mining industry also has a significant dollar impact, but supports relatively few jobs. While the resources exist to expand mining on the Plateau, these resources are exhaustible and hence the mining industry is not sustainable long-term. Agriculture is a sustainable industry, but soil and drainage conditions limit the potential for this industry on the Plateau. Tourism and Recreation has a significant impact on the Plateau, both in terms of dollars and jobs supported, due in large part to visitors of Grafton Lakes State Park.

The lack of amenities for Plateau visitors, lodging establishments in particular, may be limiting the economic impact Tourism and Recreation on the local area. Potential opportunities for increasing the impact of Tourism and Recreation include improving available accommodations for visitors, increasing promotion of the Rensselaer Plateau as a tourist destination, creating a visitor information center and consideration of a NYS Scenic Byway Designation for the Route 2 and/or Route 22 Corridors.

Background

The Rensselaer Plateau is one of the largest and most ecologically intact native habitats in New York State. The preservation of this landscape for future generations is the vision of the Rensselaer Plateau Alliance (RPA). This economic impact study is a companion component to a Rensselaer Plateau Conservation Plan that is currently under development by the Rensselaer Plateau Alliance.

Objectives

This study was conducted to identify and evaluate the economic contributions (income and employment) of activities on the Rensselaer Plateau that include the following industry sectors:

- forest products
- mining and quarrying stone
- agriculture
- food services and drinking places
- lodging establishments
- commercial hunting and trapping
- recreation and tourism (public and private lands)

Evaluations of these activities include items such as the type of businesses in each category, number of people employed, a list of businesses/entities in each category, and estimated economic impacts on the region. An analysis of the sustainable benefits or negative impacts and the potential for future business in each category is also included as part of the results.

Methodology

Economic impact analyses were conducted using IMPLAN, a software package and database for estimating local economic impacts, which is one of the most widely used and accepted methodologies available. The IMPLAN database comes from data collected by the US Department of Commerce, the US Bureau of Labor Statistics and other federal and state government agencies. Data is also collected for various industrial sectors and is available for each county in the United States. Relying on information from public sources provides for use of credible information and avoids the cost of conducting primary research to collect information.

IMPLAN data for Rensselaer County was purchased for use for this project. The IMPLAN software package allows for the estimation of the impacts of economic activity generated by a particular industry within the specified county. These economic impacts include the **number of jobs supported** and the **value added** to the local economy as a result of the economic activity generated by the industry. **Value added** is the most commonly used measure of the contribution of an industry to a region and represents the sum total of increased value to goods and services that is generated by the local activities being evaluated.

The IMPLAN models are also designed to take into account the multiplier effects of economic activity when calculating the value added income and employment impact of industries on the region. These multipliers take into account the following effects of economic activity:

- **Direct Effects**: These reflect the initial impacts of local spending by the industry in question. This economic activity is calculated to only include impacts on the local economy. As such, the impact of spending on an item purchased includes only the portion of the amount paid that went to local businesses. It does not include the portion of the selling price that went to vendors located outside of the region. As such, for the purchase of a gallon of gasoline, the direct effect includes the amount paid per gallon of gas, less the amount that the gas station pays its supplier for that gallon of gasoline.

- **Secondary or "Multiplier" Effects**: Secondary effects represent the local economic activity that results from the re-circulation of money spent as a result of the industry in question. This includes the indirect effects of spending which goes to local entities that supply the local industry. It also includes the induced effect of spending by employees that are paid to provide services to the industry in question.

The **total effects** pertaining to the industry, therefore, include the **direct effects** that accrue primarily to the industry, the **indirect effects** that accrue to the suppliers of these businesses, and the **induced effects** that result from household income produced by employees hired because of these businesses. **Total effects** also include the **jobs** supported by the industry, including **jobs** supported by both direct and secondary effects.

The IMPLAN database includes information specific to the forest products industry, mining and quarrying stone, agriculture, food service and drinking places, hotels and motels/other accommodations, and commercial hunting and trapping in Rensselaer County. The information can also be segregated by zip code areas to help isolate activities to the Rensselaer Plateau. Data from 2010, the most recent year available, was used for the analyses that were conducted.

The IMPLAN database does not include information that allows for the economic impact of recreational and tourism activities to be estimated separately. To estimate the economic impact of recreation and tourism activities on the Rensselaer Plateau, the Money Generation Models (MGM) were selected. These models rely on the IMPLAN multipliers and were developed for the National Park Service by a team from Michigan State University to estimate the economic impact of tourism spending. The MGM models allowed for collection and analysis of data to generate estimates of impacts specific to the Plateau.

The MGM2 model is used to calculate the impact of spending by visitors to the Plateau on the local economy. To do this, the total local spending by visitors is first calculated, based on the number of visitors and average spending per visitor. Average visitor spending figures are provided by the model, with visitor spending profiles that depend on the characteristics of the

area where the park is located (urban, rural, etc.) and the lodging requirements of visitors (live locally, camping, staying at hotel, etc.). Economic multipliers are then applied to the local visitor spending total to compute the various impacts that this spending has on the local economy. The MGM2 model uses the IMPAN multipliers and incorporates sophisticated economic analyses that are based on the study of visitor spending at parks nationwide. Use of the MGM2 model required data to be collected from parks and recreational sites on the Rensselaer Plateau to determine the number of visitors that come to each location on an annual basis and the lodging requirements of visitors (live locally, camping, staying at hotel, etc.).

For sites that had significant staff and operational spending, the MGM2 Operate model was used to estimate the economic impact of these activities on the local economy. As with the MGM2 model, the MGM2 Operate model uses multipliers developed from research of economic activity at national parks and historic sites around the country to calculate direct and secondary impacts. The specific set of multipliers used depends on the characteristics of the area (urban, rural, etc). The following information was collected from sites with significant operational spending on the Plateau to calculate the economic impact of these activities on the local economy:

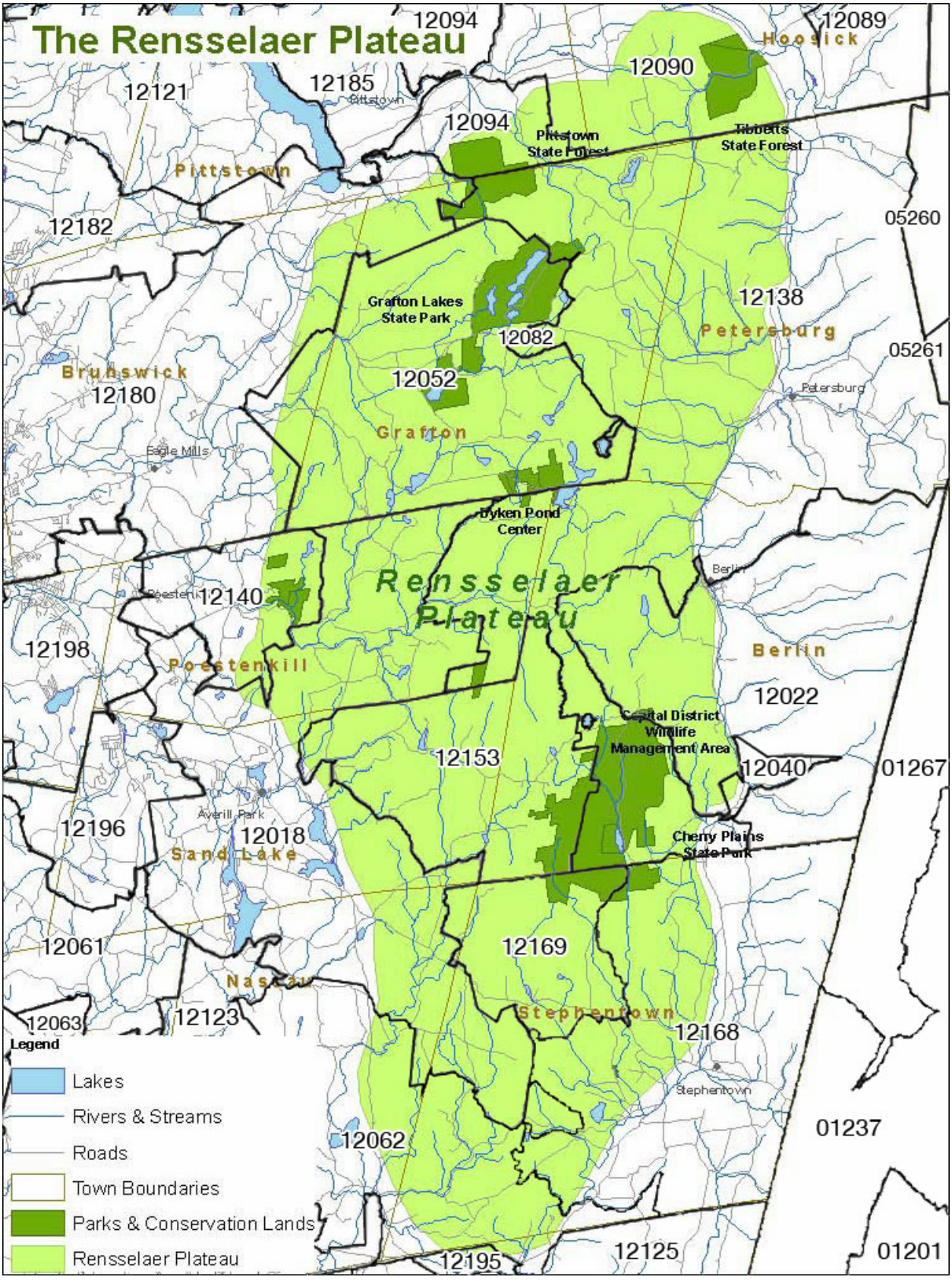
- number of employees, including year-round (part time and full time) and seasonal employees (expressed in terms of full-time equivalents)
- annual labor costs (total amount and amount spent locally)
- annual operating expenses (total amount and amount spent locally)
- annual capital spending (total amount and amount spent locally)

Like the IMPLAN model, the MGM2 model quantifies the **total effects** of visitor spending and operational activities on the local economy. The **total effects** of visitor spending include the **direct effects** that accrue primarily to recreational and tourism-related businesses in the area, the **indirect effects** that accrue to the suppliers of these businesses, and the **induced effects** that result from household income produced by employees hired because of visitor spending. **Total effects** also include the **jobs** supported by visitor spending, including **jobs** supported by both direct and secondary effects.

For site operational activities, this includes the **direct effects** associated with payments to employees and vendors that work at recreational sites. It also takes into account the **secondary effects** resulting from recirculation of money spent at the site and by employees. **Total effects** in dollars are represented as the **value added** to the local economy as a result of site operations. **Total effects** also include the **jobs** supported by these operations, including employees, as well as the **jobs** supported by both direct and secondary effects of spending on operations.

Information Collection and Calculations

The IMPLAN database for Rensselaer County that was used for this project includes information specific to the industries to be studied, with the exception of the recreation and tourism industry. The information can also be segregated by zip code areas to help isolate activities to the Rensselaer Plateau. Unfortunately, as shown in the map below, zip code boundaries do not exactly conform to the boundaries of the Plateau.


The Rensselaer Plateau
12094
12089
Hoosick
12090
12185
Pittstown
12121
12094
Pittstown State Forest
Tibbetts State Forest
Pittstown
12182
05260
Grafton Lakes State Park
12138
12082
Petersburg
05261
Brunswick
12180
12052
Petersburg
Grafton
Eagle Mills
Dyken Pond Center
Berlin
Poestenkill
12140
Rensselaer Plateau
12198
Poestenkill
Berlin
12022
Capital District Wildlife Management Area
12153
12040
01267
Averill Park
12196
12018
Cherry Plains State Park
Sand Lake
12061
12169
Nassau
12063
12123
Stephentown
12168
Stephentown
01237
12062
12125
01201
12195
Legend
Lakes
Rivers & Streams
Roads
Town Boundaries
Parks & Conservation Lands
Rensselaer Plateau

Some zip codes lie entirely within the boundaries of the plateau, but a number include some area that is on the Plateau and some area that is not. There are also some industries that may be located very near the plateau that rely on the resources of the Plateau. As such, a review of the locations of economic activity for each industry is required to determine the zip code areas that should be included to best represent the economic activities that originate from the Rensselaer Plateau. The specific methodologies used in developing impact estimates for each of the specified industries are as follows:

Forest Products: The IMPLAN database includes a number of industry categories relating to forest products, including: Forestry, Forest Products and Timber Tract Production; Commercial Logging; Sawmills and Wood Preservation; All Other Miscellaneous Wood Product Manufacturing; Pulp Mills; and Paper Mills. From discussions with the Empire State Forest Products Association and New York State Department of Environmental Conservation, it was determined that there were a number of businesses located very near to the Rensselaer Plateau that relied on the forest products of the Plateau as the source of their raw materials. For example, Green Renewable, Inc. (formerly W.J. Cowee) is located in the 12022 zip code. Based on this, information from zip codes that were located entirely on the Plateau, as well as zip codes that only partially included the Rensselaer Plateau, were used to estimate the economic impact of the various forest products industries. This was done to be sure to capture as many of the forest product businesses as possible, recognizing that, even businesses that technically were not located on the Plateau likely were generating economic impact because of the forest resources of the Plateau. The zip codes included in the analysis were: 12082, 12052, 12153, 12169, 12018, 12140, 12062, 12168, 12040, 12022, and 12138.

Mining and Quarrying Stone: Various mining related industry classifications are included in the IMPLAN database, however, the only category that occurs on the Rensselaer Plateau is identified as Mining and Quarrying Stone. This activity is located only within the 12052 zip code. There are activities identified as Mining and Quarrying Sand, Gravel, Clay, and Ceramic and Refractory Minerals which are located in the 12140 zip code, but these mining activities were determined not to be located on the Rensselaer Plateau. The IMPLAN database and software package was used to estimate the economic impact of mining based on the information pertaining to Mining and Quarrying Stone in the 12052 zip code.

Agriculture: As with forest products, the IMPLAN database includes a number of industry categories pertaining to agriculture. These include: Oilseed Farming; Grain Farming; Vegetable and Melon Farming; Fruit Farming; Tree Nut Farming; Greenhouse, Nursery and Floriculture Production; Tobacco Farming; Cotton Farming; Sugarcane and Sugar Beet Farming; All Other Crop Farming; Cattle Ranching and Farming; Dairy Cattle and Milk Production; Poultry and Egg Production; Animal Production, Except Cattle and Poultry and Eggs. The Rensselaer County Soil and Water Conservation District and the USDA Natural Resources Conservation Service were contacted to understand where agricultural activities were located relative to the Rensselaer Plateau.

From this review, it was determined that for zip code areas that included both land on the Plateau and in the Hoosick Valley, the preponderance of agricultural activity was located on the land that was not on the Plateau. As such, zip code areas were selected to limit the inclusion of farms from the Hoosick Valley in the analysis so as to provide a more accurate estimation of the economic impact of agriculture originating on the Rensselaer Plateau. The zip codes used in this analysis included: 12082, 12052, 12153, 12169 and 12062.

Food Services and Drinking Places: To estimate the economic impact of Food Services and Drinking Places, the analysis included zip codes that were primarily located on the Plateau, as well as selected zip codes areas that were located near the recreational assets of the Plateau. For example, the Berlin zip code area of 12022 was included in the analysis because it is located next to the Cherry Plain State Park and Capital District Wildlife Management Area. By including the Berlin zip code area, the economic impact of food services businesses that serve visitors to these recreational attractions is included in the analysis. The zip codes used in this analysis included: 12052, 12082, 12153, 12169, 12138, 12062, 12022, 12040, 12168 and 12140.

Lodging Establishments: The IMPLAN database includes two categories that pertain to lodging: Hotels and Motels (including Casino Hotels), and Other Accommodations. As with Food Services and Drinking Places, the analysis included zip codes primarily located on the Plateau and the selected zip codes areas that were located near the recreational assets of the Plateau. The same zip codes were also selected, which included: 12052, 12082, 12153, 12169, 12138, 12062, 12022, 12040, 12168 and 12140.

Commercial Hunting and Trapping: As the Rensselaer Plateau is one the largest and most ecologically intact native habitats in New York State, it provides significant benefit to wildlife that may be found on the Plateau or nearby lands. As such, zip codes that included land on the Plateau and rural land near the Plateau were selected for estimating the economic impact of commercial hunting and trapping. These zip codes included: 12052, 12082, 12153, 12169, 12138, 12062, and 12018.

Recreation and Tourism (Impact of Visitors): Research was conducted to identify recreational and tourist locations on the Rensselaer Plateau, as well as recreational activities that take place on the Plateau. To determine the annual number of visitors to the Plateau, attempts were made to contact the recreational and tourist locations, and also organizations that sponsored recreational activities on the Plateau. Each contact was asked to provide the number of visitors coming to the Plateau for their site or activity during calendar 2010. As the research was conducted in early 2012, information for calendar year 2010 was requested to avoid situations where visitor information for 2011 was not yet available. In addition to the number of visitors, respondents were asked to estimate the lodging that visitors required (live locally, camping, staying at hotel, etc.), if possible. Where there was no knowledge of the lodging used by visitors, it was conservatively assumed that visitors did not require paid accommodations.

The MGM2 model uses visits expressed on a party night basis, with party nights defined as one party spending one day at the recreational location. The party will generally be all the people

traveling together or staying in a single room or campsite for a given night. The MGM2 model was used to convert the total number of visitors to the Plateau to the total number of party nights spent by visitors in the area. The number of party nights can then be used to estimate visitor spending based on the estimated percentage of visitors that require different lodging alternatives (live locally, camping, staying at hotel, etc.).

Since there is no visitor survey information detailing spending by visitors to the Rensselaer Plateau, total visitor spending was calculated based on generic visitor spending profiles developed by the MGM2 model. These profiles were developed using information from visitor surveys conducted at national parks. The MGM2 model provides for three sets of generic spending profiles for park visitors; low, medium and high. The low spending levels are 30% below medium levels and high spending levels are 30% above medium. The low spending profiles were selected for this analysis. Visitors to national parks tend to spend more than visitors to state parks and protected areas, so the use of the most conservative spending profiles was selected to best represent the spending patterns of visitors to the Plateau. Total visitor spending is then calculated by multiplying the number of party nights by the visitor spending profiles that have been specified in the model.

Multipliers are applied to the total visitor spending to generate the economic impact of this spending on the local area. The MGM2 model allows for multipliers to be selected based on the area being studied (rural, small metro, large metro and state). For this analysis, the multipliers for a rural area were selected. By applying these multipliers, economic impact numbers are generated, including direct effects and secondary effects expressed as value added dollars and the number of jobs supported.

Visitor information was obtained pertaining to the following locations and recreational activities:

- **State Parks**: NYS DEC provided visitor information for Grafton Lakes State Park, and visitor and camping information for Cherry Plain State Park. All non-camping visitors were assumed to be local, based on visitor sign-in information.
- **Dyken Pond Environmental Center**: The Center estimated total annual visitors and 99% were estimated to be local, with the remaining 1% staying at area hotels.
- **Barberville Falls**: The Nature Conservancy (owner) provided an estimate of annual visitors, with all assumed to be local.
- **Camp Rotary**: Based on a review of summer programs and winter camping activities, the camp provided an estimate of annual visitors, with all visitors assumed to be local.
- **Pineridge Cross-County Ski Area**: The owner provided an estimate of annual visitors and the percentage of visitors that use hotel accommodations.
- **Equestrian**: The Grafton Trail Riders hold various events and outings on the Plateau and the organization provided an estimate of the number of visitors that attend these events. About one-third of visitors camp out when attending events.

- **Snowmobiling**: Various local snowmobiling clubs were contacted, as was the NYS Snowmobile Association. The NYS Snowmobile Association estimated that the 1863 registered snowmobile owners in Rensselaer County made an average of 10 visits to the Plateau for snowmobiling activities. All of these represent local visitors not requiring overnight accommodations. These estimates seemed consistent with feedback from the snowmobile clubs.
- **Hiking**: The Rensselaer Land Trust and Taconic Hiking Club sponsor hikes on the Plateau and they provided estimates of the number of visitors that participate in these hikes. All visitors were assumed to be local.
- **Hunting & Trapping**: NYS DEC tracks the number of deer, bears and turkey taken by hunters each year. Using the number of animals taken in the towns on the Plateau and assuming a 15% success rate that has been used by NYS DEC, the number of hunters visiting the Rensselaer Plateau can be estimated. Deer and bear numbers are tracked by town. Turkey numbers are tracked by county, so it was assumed that 50% of the turkeys taken in Rensselaer County were from the Rensselaer Plateau area.
- **Kayaking and Canoeing**: Graftondack Kayak & Canoe provides rental equipment for these activities. The owner estimated total annual visitors based on historical rental information. All visitors were assumed to be local.
- **Road Biking**: The Mohawk-Hudson Cycling Club conducts rides on the Rensselaer Plateau and estimated the number of participants, with all assumed to be local.
- **Mountain Biking**: The Saratoga Mountain Bike Association has events and hosts activities at Pittstown State Forest. They estimated annual attendance, with all of these visitors assumed to be from the local area.
- **Birding**: The Hudson-Mohawk Bird Club sponsors several events on the Plateau and provided an estimate of annual attendance, with all visitors assumed to be local.
- **Nordic Sports**: Rensselaer Plateau Nordic holds recreational ski schools at Pineridge Cross-Country Ski Area and they provided an estimate of the number of participants in these activities. All visitors were assumed to be local. The Capital Region Nordic Alliance is planning activities on the Rensselaer Plateau in the future.
- **Running**: The Albany Running Exchange holds events at Grafton Lakes State Park and Pineridge. They provided participant estimates, with all assumed to be local.
- **Triathlons**: Multi-Sport Triathlon Club/SKYHIGH Adventures hosts events on the Plateau, including their annual TriFest Weekend event that draws participants from around the northeast. They estimated the number of visitors that come to the Plateau for these events, as well as the lodging accommodations used by visitors.
- **Spelunking**: The Northeast Cave Conservancy sponsors activities at Bentley Cave. They estimated the number of visitors that participate in these activities and the number of visitors requiring hotel accommodations.
- **Berkshire Bird Paradise**: The owner provided an estimate of the number of visitors to this attraction and all visitors were assumed to be local.
- **Botanists**: David Hunt leads the Capital Region Friday Field Group and related events on the Plateau. He provided an estimate of annual attendance, with all visitors assumed to be local.

- **Orienteering**: The Empire Orienteering Club holds events at Grafton Lakes State Park and Pineridge Ski Area. They provided an estimate of the number of participants at these events, with all visitors assumed to be from the local area.

Attempts were also made to gather visitor information pertaining to the following:

- **Pittstown State Forest and Tibbetts State Forest**: Visitor information is not collected for these locations.
- **Capital District Wildlife Management Area**: Visitor information is not collected for this location.
- **Fishing**: The Home-Waters chapter of Trout Unlimited in Cropseyville, along with other parties interested in fishing, were contacted to determine the number of fisherman that come to the Plateau each year. Unfortunately, there have not been creel surveys done in recent years to estimate these numbers and no other estimates exist. Creel surveys are planned in the near future which should provide information about the number of people that come to the Plateau to fish.
- **Peace Pagoda**: This attraction declined to provide visitor information.
- **Capital District Triathlon Club**: No response to requests for information.
- **Motorcycling**: Requests for information directed to local motorcycling clubs were not returned.

RENSSELAER PLATEAU: RECREATIONAL AND TOURISM VISITORS					
Location		Local/Day	Hotel	Camping	Total Visitors
Grafton Lakes State Park		210,611			210,611
Cherry Plain State Park		21,665		1,224	22,889
Dyken Pond Environmental Center		14,850	150		15,000
Barberville Falls		1,000			1,000
Camp Rotary		7,000			7,000
Pineridge Cross-Country Ski Area		4,400	1,100		5,500
Snowmobilers		18,630			18,630
Equine: Grafton Trail Riders		133		67	200
Hiking: Rensselaer Land Trust/Taconic Hiking Club		150			150
Hunting & Trapping: Deer		2,620			2,620
Hunting & Trapping: Bears		0			0
Hunting & Trapping: Turkeys		1,870			1,870
Kayaking and Conoeing: Graftondack Rentals		500			500
Road Biking: Mohawk-Hudson Cycling Club		400			400
Mountain Biking: Saratoga Mountain Bike Assn		1,000			1,000
Birding: Hudson-Mohawk Bird Club		35			35
Nordic Sports: Rensselaer Plateau Nordic		200			200
Nordic Sports: Capital Region Nordic Alliance		0			0
Running: Albany Running Exchange		200			200
Triathlons: SKYHIGH Adventures		320	75	75	470
Spelunking: Northeast Cave Conservancy		380	20		400
Orienteering: Empire Orienteering Club		75			75
Berkshire Bird Paradise		4,000			4,000
Botany: Capital Region Friday Field Group		50			50
	TOTALS	**290,089**	**1,345**	**1,366**	**292,800**

The above information shows that there are a wide variety of locations, activities and organizations that attract visitors to the Rensselaer Plateau, with by far the most significant being Grafton Lakes State Park. The information included was restricted to visitor numbers that could reliably be estimated or documented. As such, these figures represent conservative estimates with respect to the total number of visitors and lodging accommodations.

Recreation and Tourism (Impact of Operational Spending by Facilities): In addition to the economic impact that visitors have, the spending by recreational facilities on operations and employees of these facilities also have an economic impact. To calculate this impact, information was gathered from the following recreational facilities that are located on the Rensselaer Plateau:

- **Grafton Lakes State Park**
- **Cherry Plain State Park**
- **Dyken Pond Environmental Education Center**
- **Pineridge Cross-Country Ski Area**

For each of these facilities, the following information was gathered, along with estimates of the percentage of the spending that was in the local area:

- **Number of Employees** (full-time and part-time, seasonal full-time equivalents)
- **Operating Expenses**, including wages, salaries, benefits, utilities, services, supplies (total for the year and amount spent locally)
- **Capital Expenses**, including roads & utilities, buildings, repairs (total for the year and amount spent locally)

The above information was combined for the purpose of determining the economic impact of the four entities on the local economy using the MGM2 Operate model. As with the MGM2 model, generic multipliers developed based on studies of national park operations are used to calculate economic impacts and jobs supported as a result of park/facility operations. Like the multipliers applied to visitor information, the MGM2 Operate model allows for multipliers to be selected based on the area where parks are located (rural, small metro, large metro and state). The multipliers applicable to a rural area were again selected. With these inputs specified, the MGM2 Operate model produced estimates of the economic impact of facility operations, including direct and secondary effects, expressed as value added dollars. The model also calculates the number of jobs supported, including those supported by the direct effects of facility operations and the secondary effects of these operations. Job figures include the people currently employed by the four facilities.

Results

Using the information gathered, the IMPLAN software package and database, and MGM2 models, the following results were generated to estimate the economic impact of the specified industry sectors:

INDUSTRY SECTOR: FOREST PRODUCTS

Impact Type	Jobs Supported	$ Impact (Value Added)
Direct	73.7	$7,235,854
Secondary	23.0	$1,972,888
TOTAL	**96.7**	**$9,208,742**

Local sales taxes generated: $82,910.

INDUSTRY SECTOR: MINING AND QUARRYING STONE

Impact Type	Jobs Supported	$ Impact (Value Added)
Direct	9.1	$2,111,330
Secondary	2.6	$ 244,465
TOTAL	**11.7**	**$2,355,795**

Local sales taxes generated: $12,854.

INDUSTRY SECTOR: AGRICULTURE

Impact Type	Jobs Supported	$ Impact (Value Added)
Direct	25.0	$712,699
Secondary	1.0	$ 86,849
TOTAL	**26.0**	**$799,548**

Local sales taxes generated: $5,702.

INDUSTRY SECTOR: FOOD SERVICES AND DRINKING PLACES

Impact Type	Jobs Supported	$ Impact (Value Added)
Direct	104.5	$3,342,259
Secondary	5.7	$ 489,884
TOTAL	**110.2**	**$3,832,143**

Local sales taxes generated: $95,619.

INDUSTRY SECTOR: LODGING ESTABLISHMENTS

Impact Type	Jobs Supported	$ Impact (Value Added)
Direct	.0	$0
Secondary	.0	$0
TOTAL	**.0**	**$0**

Local sales taxes generated: $0.

INDUSTRY SECTOR: COMMERCIAL HUNTING AND TRAPPING

Impact Type	Jobs Supported	$ Impact (Value Added)
Direct	.1	$14,937
Secondary	.1	$ 2,396
TOTAL	**.2**	**$17,333**

Local sales taxes generated: $398.

INDUSTRY SECTOR: RECREATION AND TOURISM

Visitors (#)	292,800
Visitor Spending	$3,925,000
Avg. Spending/Visitor	$13.41
Local Sales Taxes Generated by Visitor Spending	$144,000
Direct Effects of Visitor Spending	$1,545,000
Secondary Effects of Visitor Spending	$504,000
Total Effects of Visitor Spending	**$2,049,000**
Jobs Supported by Direct Effects of Visitor Spending	52
Jobs Supported by Secondary Effects of Visitor Spending	8
Total Jobs Supported by Visitor Spending	**60**
Annual Operations Spending (Local)	$822,101
Year-round Employees (# FT & PT)	10.0
Seasonal Employees (# FTE)	6.1
Total Effects of Operations Spending	**$806,416**
Jobs Supported by Operations Spending	**23.6**
Total Economic Impact of Recreation and Tourism on Local Economy	**$2,855,416**
Total Jobs Supported	**83.6**

Analysis

Forest Products: As the fifth largest forested region in New York State, it's not surprising that the forest products industry has a significant impact on the Rensselaer Plateau. Forest products support a number of industry sectors, including sawmills, the paper industry and miscellaneous wood product manufacturing. Forest products businesses generated an economic impact of over $9 million, the largest dollar impact of those examined. The industry also supports nearly 100 jobs in the area. This impact includes businesses that are near the Plateau, such as sawmills, and get their raw materials from timber grown on the Plateau. Potentially adding to the above results are local sales of firewood that may not be well captured in government data.

To the extent that forests are re-grown so that they can be harvested in the future, the industry is also sustainable. In addition, the forest products industry can prosper in harmony with other activities that rely on these natural resources. All of these factors serve to highlight the importance of protecting and managing well this important resource of the Plateau.
Mining and Quarrying Stone: This is a significant industry for the Rensselaer Plateau as indicated by the value added economic impact of over $2 million. The employment impact of the industry is relatively modest, however, at less than 12 jobs supported. Greywacke, a mineral resource that is well suited to road and construction applications, is found in abundance on the Plateau. As such, there is potential for significant growth in this industry. Mining, by its nature, is not a sustainable industry and also has negative impacts on road infrastructure and raises quality of life issues for neighbors. In considering these negative impacts, it should be noted that local sales taxes generated by this industry from activities on the Plateau are also relatively modest, at about $13,000.

Agriculture: Because of its poor soils and poor drainage conditions, the Rensselaer Plateau is not well suited to many agricultural enterprises. This is reflected in the relatively modest impacts indicated for agribusinesses on the Plateau, which were estimated at about $800,000 and 26 jobs supported. Some of the farms included in this estimate are likely at the edge of the Plateau or even off the Plateau but within the zip codes that were included in the analysis. Sustainable agricultural businesses that can be viable on the Plateau are likely to be those that do not require good soil conditions and might include growing berries, ornamentals or greenhouse operations.

Food Services and Drinking Places: This industry had a significant economic impact, estimated at over $3.8 million, and also supported 110 jobs, the largest number of all industries examined. It should be noted that these estimates include restaurants that are not located on the Plateau, but were included because they may benefit from the visitors that are attracted to nearby sites that are on the Plateau. Also of note, is that while there are a number of restaurants included in this area, the variety of restaurants on and near the Plateau is limited. Of the nine restaurants identified, three are pizza shops and three are fast food or limited selection establishments.

Lodging Establishments: Interestingly, this industry generated no economic impact on the Plateau. There is known to be one bed & breakfast on the Rensselaer Plateau and there are several private campgrounds near the Plateau, but the available data did not reflect any impacts from these businesses. It is reasonable to conclude that there are limited lodging alternatives on the Plateau and, as a result, the economic impacts generated by the lodging industry are negligible.

Commercial Hunting and Trapping: Although the Rensselaer Plateau is one the largest and most ecologically intact native habitats in the state, the economic impact of hunting and trapping for commercial purposes is very limited. Although some impact was measured in different areas of the Plateau, the impact was small and fragmented.

Recreation and Tourism: The information gathered in this study shows that there are a large number and wide variety of recreational activities and locations that attract visitors to the Rensselaer Plateau. By far the most significant is the Grafton Lakes State Park, which attracts over 70% of the nearly 300,000 visitors that come to the Plateau. In total, these visitors and the cost of operating the facilities that they visit generate nearly $2.9 million in economic impact and support over 80 jobs. Visitor spending also produces $144,000 in local sales taxes.

Growing recreation and tourism industries represents an attractive opportunity for the Rensselaer Plateau, as such industries are sustainable and can be developed in harmony with the distinctive natural environment of the area. There also appears to be significant opportunities for increasing the economic impact and number of jobs supported by recreation and tourism industries. Opportunities for consideration include the following:

- **Improve Accommodations for Visitors**: Of the nearly 300,000 visitors that were estimated to have visited the Plateau, 99% were believed to be day visitors. Significantly more economic impact can be generated by visitors that stay overnight in the area, but lodging options available for these visitors are very limited. Similarly, dining options are also relatively limited. These limitations were mentioned by a number of individuals contacted during the collection of data for this study. There was a consensus that if there were improved accommodations on the Plateau, visitor numbers and spending would increase. Improving this situation would benefit event sponsors that are trying to host participants and guests, and would also encourage longer visits to the Plateau for activities such as fishing and cross-country skiing. Consideration should be given to working with Rensselaer County Economic Development, the Rensselaer County Regional Chamber of Commerce and other economic development organizations to encourage new hospitality businesses to locate on the Plateau. In the short term, there also may be opportunities for developing cooperative relationships with lodging and dining establishments in Troy that could partner with or sponsor events on the Plateau.

- **Promote the Rensselaer Plateau as a Tourism Destination**: There is currently no significant promotion of the Rensselaer Plateau as a destination for recreational activities and little advertising that mentions Plateau attractions, other than Grafton Lakes State Park. Due to its close proximity to Albany, Saratoga and the Berkshires, there would seem to be an opportunity to attract visitors that are interested in outdoor recreation that is much closer than the Adirondacks or the Catskills. Promotional opportunities should be explored with Rensselaer County Tourism, the Rensselaer County Regional Chamber of Commerce and the I Love NY program. Development of a website dedicated to recreation on the Plateau should also be considered as a cost-effective way to promote tourist activities.

- **Create a Rensselaer Plateau Information Center**: Such a location could be developed in conjunction with an existing retail business, library or similar venue to provide visitors with a central location to get information to make their visit to the Plateau easier. Not

only would this be a way for visitors to get information to answer their travel questions, but it would also be an opportunity for recreational venues, restaurants and other businesses to promote their offerings.

- **Consider a NYS Scenic Byway Designation for the Route 2 and/or Route 22 Corridors**: Such a designation could allow for planning and infrastructure funding to enhance these corridors. This designation could also serve to promote the Rensselaer Plateau as a tourist destination.

Listing of Businesses in Specified Industry Sectors

Mining and Quarrying Stone:

- RJ Valente Gravel, Cropseyville

Forest Products:

- Berlin Lumber, Berlin
- Fiske Lumber, Stephentown
- Hankle Lumber, E. Nassau
- L.J. Valente, Averill Park
- Paulson Wood Products, Petersburg
- Rynard G. Gundrum Lumber, Grafton
- Green Renewable, Berlin

Agriculture:

- Homestead Farms, Cropseyville
- WooBerry Farm, Grafton
- Soul Fire Farm, Petersburg
- Tassawassa Ridge Farm, East Nassau
- Momrow Farm, Sand Lake

Food Services and Drinking Places:

- Subway, Cropseyville
- The Sedgwick Inn, Berlin
- Papa's Pizzeria, Petersburg
- Bubie's Pizza & Deli, Poestenkill
- Pizza Plus, Stephentown
- Gardners' Ice Cream & Coffee, Stephentown
- Stephentown Donuts, Stephentown

- Bridgeway Pub, Cherry Plain
- J&J Café, Cropseyville

Lodging Establishments:

- Grafton Inn, Grafton

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- Grafton Lakes State Park; Melissa Miller
- New York State DEC Forester Michael Mulligan
- Dyken Pond Environmental Education Center; Lisa Hoyt
- New York State Department of Environmental Conservation; Nancy Heaslip
- The Nature Conservancy; Matt Levy
- Rotary Scout Reservation; Joel Uline
- Pineridge Cross-Country Ski Area; Walter Kirsch
- New York State Snowmobile Association; Dominic Jacangelo
- Stephentown Trail Riders; John Linton
- Black River Raiders; Mark Bonesteel
- Grafton Trail Blazers; David Kiely
- Grafton Trail Riders; Mark Wehnau
- Rensselaer Land Trust; Christine Young, Nick Conrad
- Taconic Hiking Club; Sharon Bonk
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- Trout Unlimited, Home-Waters Chapter; Frank Cuttone
- Fisherman; Steve Pentak and Ken James
- Graftondack Kayak & Canoe Rentals; David Buckley
- Adirondack Paddle 'n Pole; Rick Macha
- Mohawk-Hudson Cycling Club; John Petiet, Dick Gibbs
- Saratoga Mountain Bike Association; Chris Cavanaugh
- Hudson-Mohawk Bird Club; Jim de Waal Malefyt
- Rensselaer Plateau Nordic; Dawn Bishop

- Capital Region Nordic Alliance; Russ Myer
- Albany Running Exchange; John Kinnicutt
- Multi-Sport Triathlon Club/SKYHIGH Adventures; John Slyer
- Northeastern Cave Conservancy; Bob Addis
- Berkshire Bird Paradise; Peter Dubacher
- Capital Region Friday Field Group; David Hunt
- Empire Orienteering Club; Susan Hawkes-Teeter
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- Directory of Primary Wood-Using Industry In New York State**;** New York State DEC, March, 2009
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THE ECONOMIC VALUE OF ECOSYSTEM SERVICES ON THE RENSSELAER PLATEAU

Prepared by Sarah Parks

Prepared for the Rensselaer Plateau Alliance

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Tables

Figures

Executive Summary

Ecosystem services are the benefits people obtain either directly or indirectly from ecosystems. These services are essential to human well-being, as they provide a multitude of benefits such as clean water, medicine, recreation, crop pollination and protection from natural hazards. Although these services are highly valuable, they often go unaccounted for in development or management decisions. Placing economic values on these non-marketed ecosystem services can help provide an understanding of the true value provided by natural resources. The Rensselaer Plateau offers a multitude of ecosystem services, which significantly contribute to the human welfare of Rensselaer Plateau residents, Rensselaer County citizens, and others.

The purpose of this report is to estimate the economic values of non-market ecosystem services provided by the Rensselaer Plateau. For this study, the Rensselaer Plateau was divided into six land cover types: cropland, forest, lakes and reservoirs, riparian buffer, rivers and streams, and wetlands. Each land cover type provides a unique set of ecosystem services. The ecosystem services valued include: biological control, disturbance prevention, gas and climate regulation, habitat refugium and biodiversity, nutrient regulation, cultural, pollination, recreation and aesthetics, soil retention and formation, waste assimilation, and water regulation and supply. Spatial value transfer methodology was used to estimate the economic values of these ecosystem services on the Rensselaer Plateau.

The values estimated in this report intend to provide an idea of the general magnitude of the economic value of the ecosystem services on the Plateau, and do not represent precise estimates. The numbers are generated using standard economic techniques, and are in line with other studies conducted in similar areas. By regulating and supplying water, reducing severity of disturbances, such as floods, and providing pollination and waste treatment services, as well as other benefits, the ecosystems on the Rensselaer Plateau provide over $300 million in benefits each year. In terms of land cover type, the forest provides the majority of this value at around $274 million, as the forest covers a large proportion of the area of the plateau. In terms of ecosystem services, habitat refugium and biodiversity services offer the highest total value at around $78 million per year, followed by nutrient regulation at around $53 million per year, and pollination at around $49 million per year. However, the per acre value is highest for wetlands, as this land cover type provides us with disturbance prevention services valued at around $3,600 per acre, as well as nutrient regulation services valued at around $2,000 per acre, and water regulation and supply services valued at around $1,100 per acre.

When flood protection provided by ecosystems is lost, this service must be replaced by levees and flooded houses restored. When local climate, pollination and drinking water benefits are lost, the economy suffers directly, as well as indirectly through increased taxes and construction costs to replace the services originally provided by those ecosystems. The economic values of ecosystem services estimated in this report can help to increase awareness of the value of ecosystem services on the Rensselaer Plateau. This valuation is an initial step in the process of developing policies, plans and indicators which will guide future development choices.

Background

Introduction

Ecosystem services are the benefits people obtain, either directly or indirectly, from ecosystems.[1] These services are essential to human well-being, as they provide a multitude of benefits such as food, fibers, clean water, medicine, recreation, nutrient cycling, crop pollination and protection from natural hazards.[2] Many of these ecosystem services are not traded on the market (e.g. they are non-market goods and services), therefore their values are not captured in conventional accounts; hence, their values are not taken into account during the decision making process.[3,4] Concern of the depletion and degradation of the world's natural resources has influenced economists and policymakers to consider the value of ecosystem services in management decisions.[2,5] The process of identifying and quantifying ecosystem services is increasingly recognized as a valuable tool for decision making regarding environmental resources. By estimating economic values of ecosystem goods and services, and acknowledging the full value of an ecosystem, the true social costs and benefits of these services can be measured, and therefore more balanced decision-making can occur.[3,4] While we may not ever know the economic value with full accuracy, an attempt to partially value can better reflect the otherwise hidden costs, and is better than the status quo of assigning a zero value to ecosystem services.[6,7]

The Rensselaer Plateau offers numerous natural resources which are beneficial to the local, regional and even global populations. Its extensive boreal forest with abundant Eastern White Pine, Eastern Hemlock, Red Spruce and Balsam Fir contains the headwaters of seven watersheds.[8] The area is additionally spotted with numerous wetlands, ponds and streams. These ecosystems provide numerous goods and services from opportunities for recreation to fresh water supply to the reduction of flood intensity to wildlife habitat. While there are numerous ways to value ecosystems, such as ecological or community values, this report provides estimations of the economic values of a variety of non-market ecosystem goods and services offered by the Rensselaer Plateau.

Ecosystem Services and Valuation

Ecosystems services are frequently categorized into various classes. Table 1 displays a typology of ecosystem services, put forth by The Economics of Ecosystems and Biodiversity (TEEB).[9] The classes include provisioning, regulating, habitat, and cultural and amenity services. These services work at various spatial scales, from climate regulation at a global scale to flood protection and waste treatment at local and regional scales.[10]

Table 1. Typology of Ecosystem Services

Provisioning Services	Regulating Services
• **Food** • **Water** • **Raw Materials** • **Genetic Resources** • **Medicinal Resources** • **Ornamental Resources**	• Air quality regulation • Climate regulation • Moderation of extreme events • Regulation of water flows • Waste treatment • Erosion prevention • Maintenance of soil fertility (incl. soil formation) and nutrient cycling • Pollination • Biological control
Habitat Services	**Cultural and Amenity Services**
• **Maintenance of life cycles of migratory species** • **Maintenance of genetic diversity**	• Aesthetic information • Opportunities for recreation and tourism • Inspiration for culture, art and design • Spiritual experience • Information for cognitive development

Based on the typology of TEEB (2010)[9]

The Rensselaer Plateau produces many of these goods and services. Detailed description of the ecosystem services used in this particular study can be found in Table 3, but a few Plateau-specific examples are discussed here:

Water Regulation & Supply: The boreal forest on the Rensselaer Plateau contains the Tomhannock Reservoir watershed, which is a public water supply for more than 100,000 people.[11]

Flood Protection: The extensive forests, wetland and riparian areas on the Plateau provide valuable flood protection services. Without these ecosystems, oftentimes other infrastructure, such as levees, must be constructed to provide the same protection.

Habitat: The Rensselaer Plateau is one of the largest forested regions in New York State, containing relatively large continuous blocks with few dividing roads. This unbroken forest provides a healthy habitat for numerous native plants and wildlife, including fisher, bobcat, bear, moose, porcupine, hermit thrush and black-throated blue warbler. Many plants found on the Plateau do not exist anywhere else in Rensselaer County. The area is also included on the National Audubon Society's list of important Bird Areas in New York.[8, 11]

These types of ecosystem goods and services are highly valuable to society, and estimating their economic values can help in decision-making regarding trade-offs between conservation and development options. Numerous methodologies are used to estimate the economic value of non-marketed ecosystem goods and services. These methodologies, along with brief examples, are described in Table 2.

Table 2. Ecosystem Valuation Methodologies

Avoided Cost (AC): Ecosystem services allow society to avoid costs that would have been incurred in the absence of those services. For example, flood control provided by wetlands avoids property damages.

Replacement Cost (RC): Ecosystem services could be replaced with man-made systems. For example, waste treatment provided by wetlands can be replaced with costly treatment systems.

Factor Income (FI): Ecosystem services provide for the enhancement of income. For example, water quality improvement increase commercial fisheries catch and therefore fishing incomes.

Travel Cost (TC): Ecosystem service demand may require travel, which have costs that can reflect the implied value of the service. For example, recreation areas attract distant visitors whose value placed on that area must be at least what they were willing to pay to travel to it.

Hedonic Pricing (HP): Ecosystem service demand may be reflected in the prices people will pay for associated goods. For example, housing prices along a coastline tend to exceed the prices of inland homes.

Marginal Product Estimation (MP): Ecosystem services demand is generated in a dynamic modeling environment using a production function (Cobb-Douglas) to estimate the change in the value of outputs in response to a change in material inputs.

Contingent Valuation (CV): Ecosystem service demand may be elicited by posing hypothetical scenarios that involve some valuation of alternatives. This method is often used for less tangible services like wildlife habitat or biodiversity. For example, people would be willing to pay for increased preservation of forested areas.

Group Valuation (GV): Approach is based on principle of deliberative democracy and the assumption that public decision-making should result, not from the aggregation of separately measured individual preferences, but from open public debate.

Adapted from Breunig (2003)[12] and Schmidt, Batker, & Harrison-Cox (2011)[13]

Spatial Value Transfer Methodology

Although there has been an adequate amount of research globally on the economic value of ecosystem services[1], there is relatively little research that has specifically valued ecosystem services in the Northeastern United States.[12] Ideally, to estimate the economic value of ecosystem goods or services for a specific area, detailed ecological and economic studies that use the methods described above would be commissioned. However, these types of studies are expensive and time-consuming.[14,15] Hence, this requires that economic values be "transferred" from outside of the study area to land cover within the Rensselaer Plateau. Value transferi is an accepted economic methodology that yields an estimate of the economic value of non-market goods or services through the transfer of previously calculated economic values from an original study site to the policy site. The methodology has been widely applied from global studies to local studies (see, for example Costanza et al (1997)1; Herrera Environmental Consultants, Northern Economics, Inc., Spatial Informatics LLC (2004)[15]; Wilson and Troy (2003)[16]). A recent trend of this method of valuing ecosystem services is to combine it with Geographic Information System (GIS) methods. This allows for a spatially disaggregated valuation by specific land cover types and ecosystem services.

Project Methods

Value transfer was coupled with Geographic Information Systems (GIS) methodologies to create maps and geographic summaries and to calculate total economic values. The steps used in this study are based on the decision support framework developed by Troy and Wilson (2006),[7] and include the following: (1) Study Area Definition, (2) Land Cover Typology Development, (3) Literature Search and Analysis, (4) Mapping, (5) Total Value Calculation, and (6) Geographic Summary. Steps 2 and 3 are combined below due to the iterative nature of the process.

Step 1: Study Area Definition

The study area is the Rensselaer Plateau, which covers about 105,000 acres over ten towns and one village, and is displayed in Figure 1.

[i] Also referred to as benefit transfer, environmental benefits transfer, environmental value transfer, or economic value transfer

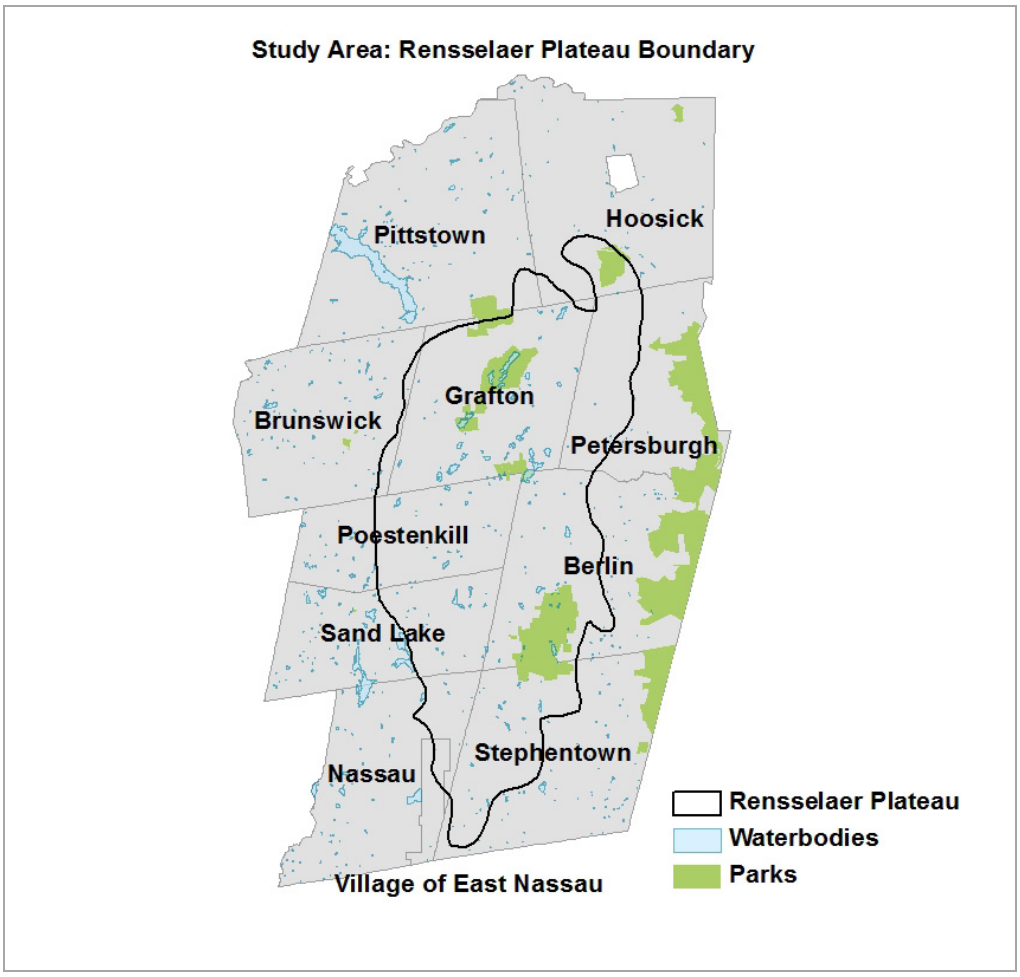

Figure 1. Study Area: Rensselaer Plateau Boundary

Steps 2-3: Land Cover Typology Development and Literature Search

The National Land Cover Database 2006 (NLCD2006)[17] was used as a base to determine land cover types. Through a literature search, this typology was altered to better fit the classes found in primary valuation studies. Empirical studies were identified mainly through review of benefit transfer studies[6, 13, 15, 18 – 22], as well as searches of the Environmental Valuation Reference Inventory (EVRI)[23], EnValue[24], GecoServ[25], and journal databases. Selected valuation studies include peer reviewed and published in recognized journals, and "gray literature" studies. The studies were focused on temperate regions in either North America or Europe, and focused primarily on non-consumptive use. Some studies were excluded due to incompatibility of the study area, such as studies focused on urban or coastal areas. Other primary studies were also not included, as they did not provide enough information, such as land area or user population, to allow for the conversion to geographically-based estimates ($/acre-yr). Through this search a customized categorization of ecosystem services was developed. The typology is based on that of the TEEB[9], but with some modifications to better fit the categories found in the literature. Due to lack of ecosystem valuation studies in the literature, some ecosystem service categories were combined. Table 3 provides a list and description of the ecosystem services used in this analysis.

Table 3. Description of Ecosystem Services Used in this Study

Good/Service	Description
Biological Control	Natural control of diseases and pest species
Disturbance Prevention	Protection from storms and floods (e.g. by wetlands and forests)
Gas and Climate Regulation	Generation of atmospheric oxygen, regulation of sulfur dioxide and other gaseous atmospheric components; Regulation of global and local temperature, climate and weather including evapotranspiration, cloud formation and rainfall
Habitat Refugium & Biodiversity	Providing suitable habitat for wild plants and animals; Maintaining biological and genetic diversity
Nutrient Regulation	Storage and recycling of nutrients (e.g. transferring nutrients from one location to another, transformation of critical nutrients from one form to another
Other Cultural	Variety in natural features to provide cultural, artistic, spiritual, historical, scientific or educational value (e.g. use of nature as motive in books or painting; use of natural systems for school excursions or research)
Pollination	Pollination of wild plant species and crops
Recreation and Aesthetics	Variety in landscape with (potential) recreational uses; Attractive landscape features for enjoyment of scenery
Soil Retention and Formation	Prevention of damage from erosion and maintenance of arable land; Formation of sand and soil through weathering of rock and accumulation of organic material
Waste Assimilation	Removal of nutrients and compounds (e.g. pollution control/detoxification, filtering of dust particles, abatement of noise pollution)
Water Regulation and Supply	Regulating runoff and river discharge; Filtering, retention and storage of fresh water for consumptive use (e.g. drinking, irrigation and industrial use)

Descriptions adapted from de Groot et al (2002)[5] and Schmidt et al (2011)[13]

Through this iterative process, the land cover typology was revised to fit the literature. Land cover types were aggregated in an effort to match land types found in valuation studies. For example, various forests types found in the NLCD data were lumped under one category, "forest." In cases where there were no existing valuation studies, land cover types were assigned to the "other" category. The land

cover types included in this analysis are: Forest, Rivers and Streams, Lakes and Reservoirs, Riparian Buffer, Wetlands, and Cropland. Further description can be found in Table 4 and Appendix 1 (including NLCD categories and methodologies).

Table 4. Land Cover Typology

Land Cover Class	Acres	Description
Forest	89,619	Areas characterized by tree cover (natural or semi-natural woody vegetation, generally greater than 6 meters tall); tree canopy accounts for 25% to 100% of the cover
Cropland	3,015	Areas characterized by herbaceous vegetation that has been planted or is intensively managed for the production of food, feed, or fiber; or is maintained in developed settings for specific purposes. Herbaceous vegetation accounts for 75% to 100% of the cover
Riparian Buffer	5,956	Areas that are adjacent to lakes, reservoirs, rivers and streams; (100 foot buffer)
Lakes and Reservoirs	838	Areas of open water or permanent ice/snow cover
Rivers and Streams	536	Areas which includes streams/rivers, connectors, canals/ditches and artificial paths
Wetlands	504	Areas where the soil or substrate is periodically saturated with or covered with water as defined by Cowardin et al (1979)
Other (Check map to see if includes all these)	5,064	Includes barren land, developed (high, medium and low intensity, and open space), herbaceous and shrub/scrub

Description from NLCD (2006)[17]

The search yielded 90 viable studies which provided 208 valuation data points. (A bibliography of the studies used can be found in Appendix 2 and the specific value transfer estimates by land cover type can be found in Appendix 3). The values were standardized to 2012 US dollar equivalents. Due to the fact that research on the value of ecosystem services is non-exhaustive, some ecosystem services were not able to be assigned an economic value. Table 5 displays the coverage of value estimates for the Rensselaer Plateau, and while many ecosystem service values have been estimated for various land cover classes, there is a lack of data to complete the table. The closed circles represent the ecosystem services that have been measured empirically and that are used in this report. Open cells represent conditions where an economic estimate could not be found under the search conditions. Gray cells represent conditions where we would not expect to a given land cover type to provide that particular ecosystem service. A detailed breakdown of the number of studies and value estimates for each land cover type and ecosystem service is provided in Appendix 4. A cross tabulation of per acre ecosystem

service value estimates by land cover type and ecosystem service is displayed in Table 6. The values are the mean per acre per year flow values in 2012 US dollars. (Where only one study existed, only that value is provided). The final column provides the total estimated value of all ecosystem services by land cover type.

Table 5. Coverage of Value Estimates

Ecosystem Services	Land Cover					
	Forest	Lakes & Reservoirs	Cropland	Riparian Buffer	Rivers & Streams	Wetlands
Biological Control	●		●			
Disturbance Prevention	●					●
Gas & Climate Regulation	●		●	●		●
Habitat Refugium	●		●	●	●	●
Nutrient Regulation	●	●	●	●		●
Other Cultural	●	●	●		●	●
Pollination	●		●			
Recreation & Aesthetics	●	●	●	●	●	●
Soil Retention & Formation	●		●			
Waste Assimilation	●					●
Water Regulation & Supply	●	●		●	●	●

Total $ estimates: 208; Total studies: 90

(See Appendix 4 for detailed breakdown of number of studies & valuation points for each land cover type & ecosystem service)

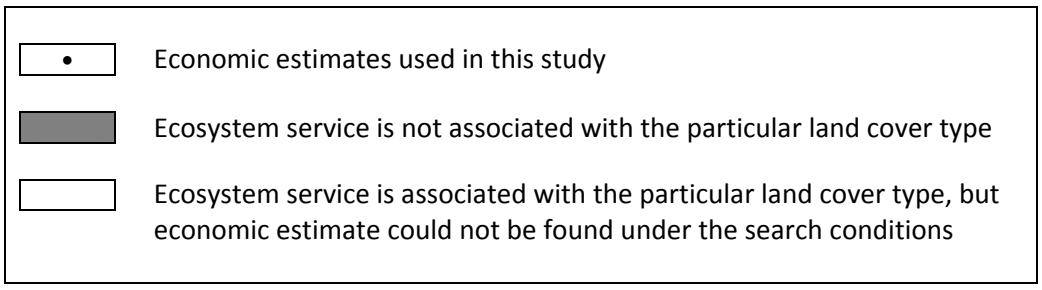

Table 6. Per Acre Ecosystem Service Value Estimates Cross Tabulated by Ecosystem Service and Land Cover Type

	Biological Control	Disturbance Prevention	Gas & Climate Regulation	Habitat Refugium	Nutrient Regulation	Other Cultural	Pollination	Recreation & Aesthetics	Soil Retention & Formation	Waste Assimilation	Water Regulation & Supply	Total
Cropland	15		141	996	9	55	149	29	2			$1,397
Forest	2	417	113	834	563	114	539	104	49	14	312	$3,062
Lakes & Reservoirs					235	10		750			390	$1,385
Riparian Buffer			381	30	239			1,534			1,104	$3,287
Rivers & Streams				4		10		2,995			4,977	$7,986
Wetlands		3,650	223	272	2,011	878		542		834	1,069	$9,478

Values are in 2012 US dollars per acre per year

Step 4: Mapping

Once the typology was finalized, a map was created based on this typology, as displayed in Figure 2. The map was based on the National Land Cover Database 2006 (NLCD2006)17, but was combined with the USGS National Hydrography Dataset (NHD)26 in order to include rivers and streams and to create riparian buffers. The acreage of each land cover type can be found in Table 4 above. A detailed description of the steps taken to create the classes is located in Appendix 1.

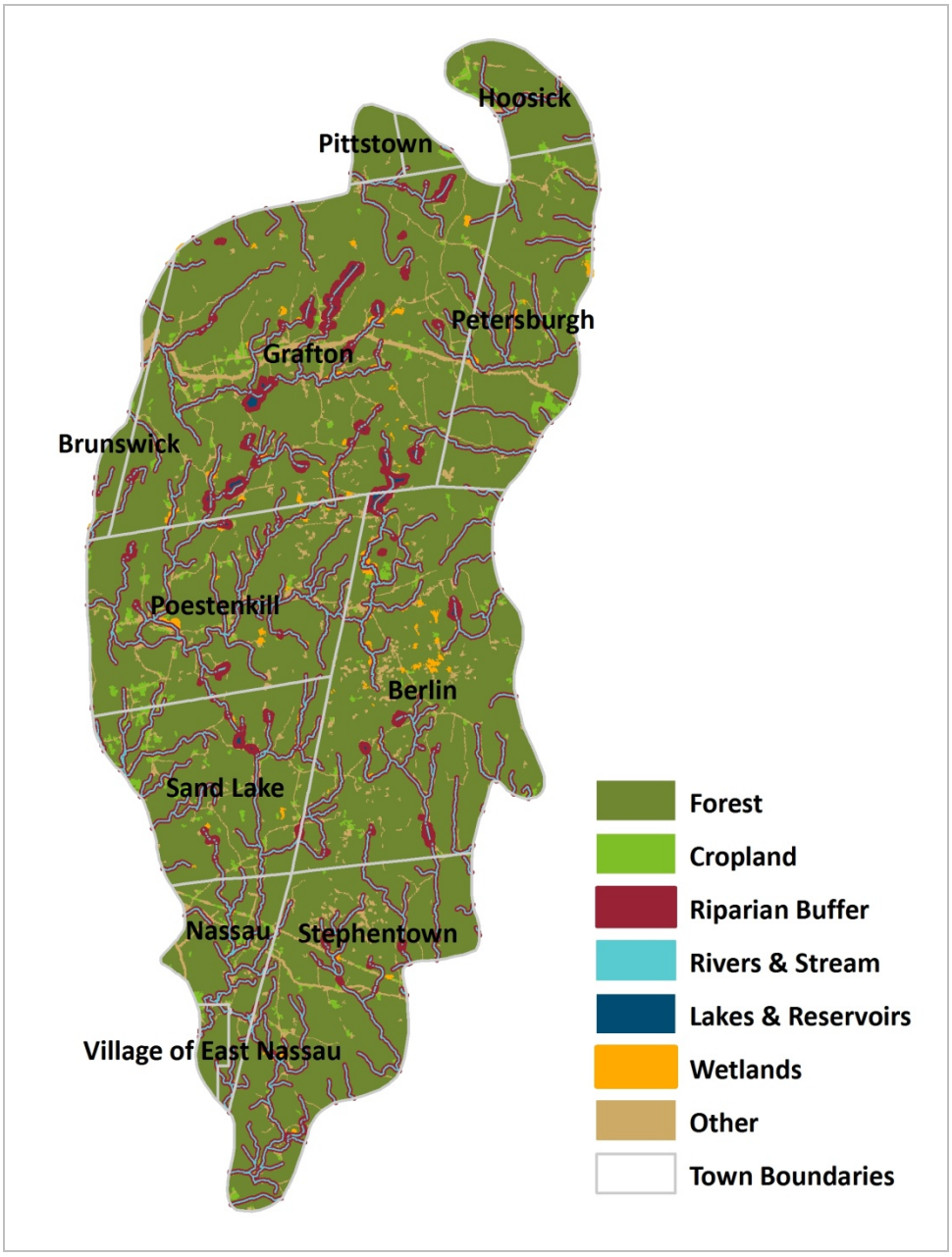

Figure 2. Land Cover on the Rensselaer Plateau

Step 5: Total Value Calculation

The annual value of ecosystem services provided by the Rensselaer Plateau totaled to $308.4 million. This was calculated by summing the products of the acreage by the per acre value for each land cover type, as follows:

$$V(ES_i) = \sum_{k=1}^{n} A(LU_i) \times V(ES_{ki})$$

Where $A(LU_i)$ = area of land use (i) and $V(ES_{ki})$ = per acre annual value of ecosystem services (k) for each land use (i).

This total value is broken down in two ways, by land cover type and by ecosystem service, as displayed in Figures 3 and 4, respectively. The forested land cover provides by far the most value at $274.4 million, mainly due to the fact that the forest covers a major proportion of the Plateau. This means that each year the forest provides us with $274.4 million worth of ecosystem services. Likewise, riparian buffers provide us with $19.6 million, wetlands with $4.8 million, rivers and streams with $4.3 million, cropland with $4.2 million, and lakes and reservoirs with $1.2 million worth of services

Analyzed in different way, we can see the value provided by each ecosystem service, as displayed in Figure 4. These range from $0.3 million for biological control to $78.1 million for habitat and biodiversity. This means that each year, we are provided with, for example, $0.3 million worth of biological control services, or with $21.1 million worth of recreation services, or with $39.2 million worth of disturbance prevention services.

A Simple Example of Trade-offs

Each year, our wetlands and forests provided us with $39.2 million disturbance prevention services. Disturbance prevention services provide us protection from storms and flooding. If, for example, the forest and wetlands were developed, while we would gain benefits from the development, we would lose the services provided by the ecosystems and may instead need to pay for other man-made protections or for damages caused by the storms or flooding.

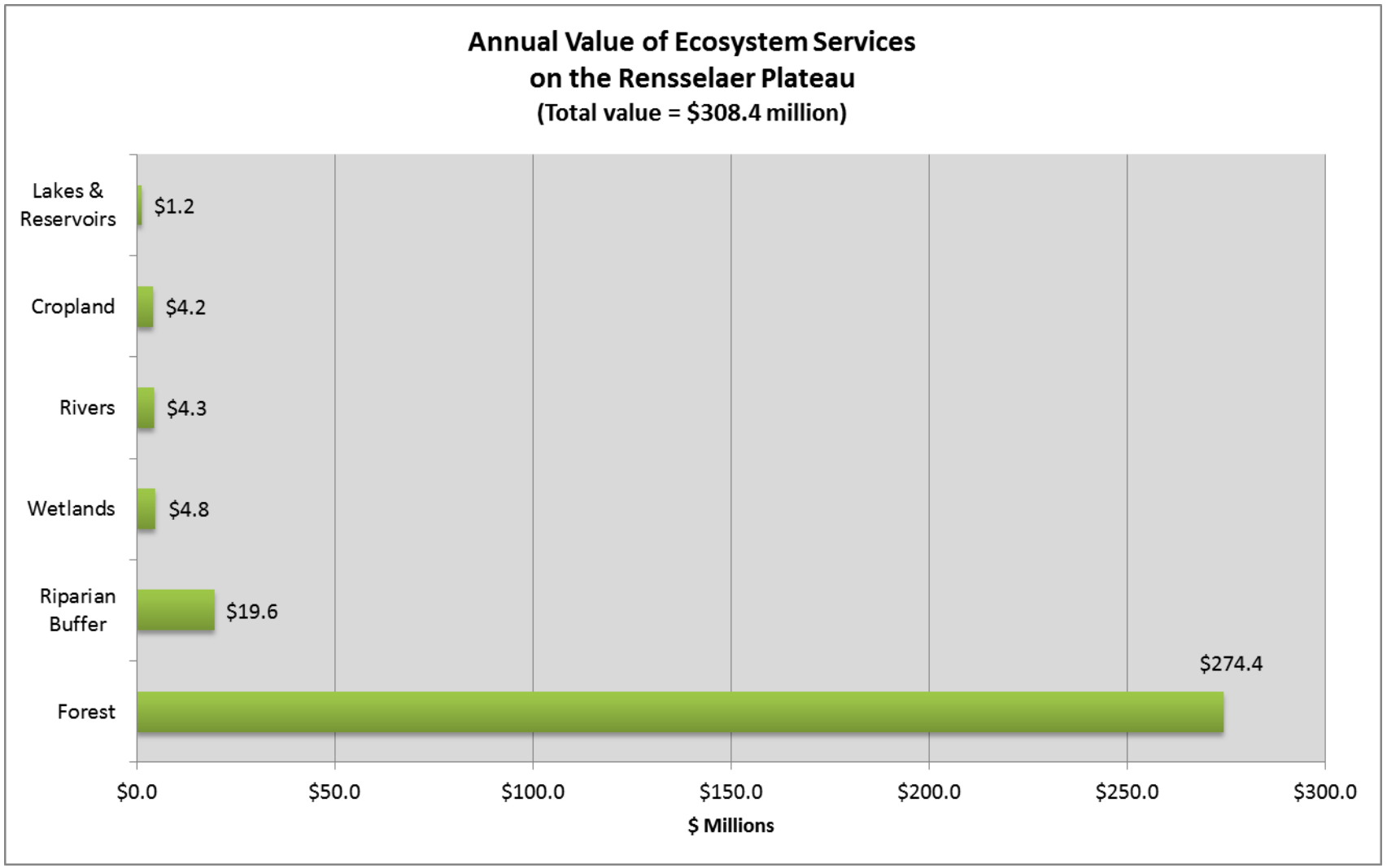

Figure 3. Total Annual Value of Ecosystem Services by Land Cover Typeii on the Rensselaer Plateau

[ii] Land Cover Type based on 2006 NLCD data, with modifications to include (1)NHD flowline data and (2) author-calculated riparian buffers on rivers and lakes

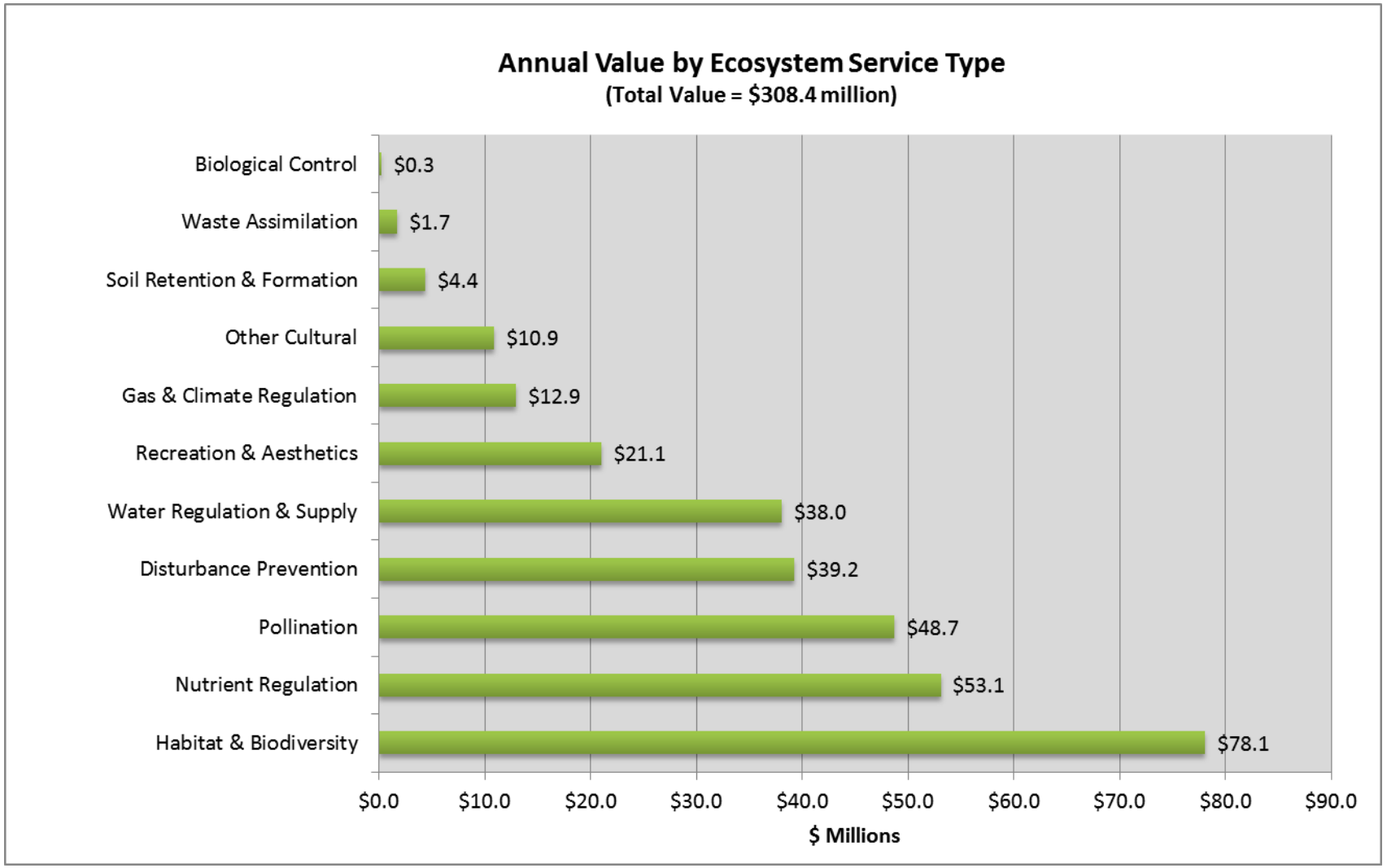

Figure 4. Total Annual Value by Ecosystem Service Type on the Rensselaer Plateau

Step 6: Geographic Summary

First, a 50-acre grid of the study area was created in ArcGIS. The dollar per acre values were then summarized by this 50-acre grid, as displayed in Figure 5, which shows the estimated total ecosystem service value flow by 50 acre grids. The lightest green grids represent an area in which the ecosystems provide less than $100,000 worth of services each year. Many of the lighter green grids correspond to areas in which there are roads. The darkest green grids represent an area in which the ecosystems provide greater than $175,000 worth of services each year.

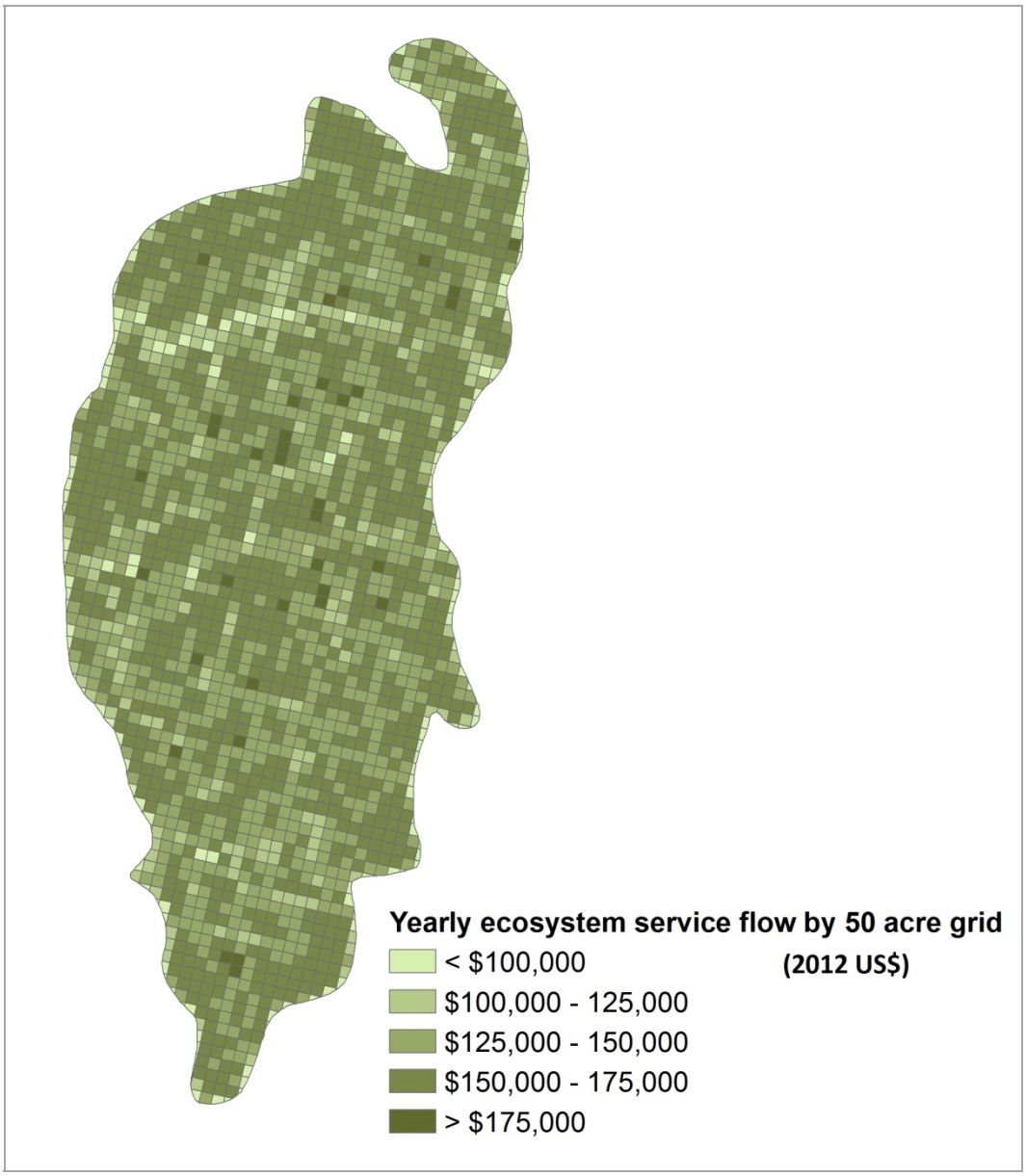

Figure 5. Yearly Ecosystem Service Value Flow by 50 Acre Grid (2012 US$ per year)

Study Limitations

The economic values provided by this report represent estimations of the values of ecosystem services on the Rensselaer Plateau. Like all economic analyses, value transfer has its strengths and weaknesses. While current valuation transfer methodologies have limitations that must be recognized, this should not diminish the fact that ecosystems provide considerable economic value to society. Given the list of limitations below, it is likely that the value of ecosystem services is actually underestimated.

Limitations of the value transfer methodology:[13]

- As every ecosystem is unique, per-acre values derived from another location may be inappropriate for the ecosystems being studies.
- For a single ecosystem, the per-acre value depends on the size of the ecosystem. In most instances, as the ecosystem size decreases, the value per acre is likely to increase and vice versa.
- As gathering all of the data needed to estimate the specific value for each ecosystem within the study area is not viable, the true value of all wetlands, forests, etc. cannot be determined.
- Valuing all, or a sizeable share, of the ecosystems in a large geographic area is questionable in terms of the standard economic definition of an exchange value. A transaction in which all or most of a large area's ecosystems would be bought and sold is highly unlikely. The value estimates for large areas (as opposed to per-acre values) are more analogous to national income account aggregates, rather than exchange values.

Limitations of Benefit Transfer/Database:[13]

- Because there is incomplete coverage of ecosystems that have been valued or studied, it is likely that the value of ecosystem services is significantly underestimated. More complete coverage would increase the values estimated in this report.
- Like any appraisal methodology, bias can occur in selecting the valuation studies.

General limitations:[12,13]

- The analysis is static, as it ignores interdependencies and dynamics.
- The study does not consider the minimum scale in order for a given ecosystem to function properly, or the impact of land use degradation or fragmentation on ecosystem service provision.
- As the sources of ecosystem services become more limited or scarce, the value of ecosystem services increases. If the ecosystem services are scarcer on the Rensselaer Plateau than assumed in this study, the value of the services has been underestimated.
- People value ecosystems purely for their existence (existence value), even if they never benefit from them in any direct way; however, dollar estimates of existence values are rare. If these values were included in this study, the total values would increase.

GIS limitations:[13]

- The GIS layers may contain inaccuracies due to land cover changes after the data was made available, inaccurate satellite readings or other issues.
- As the NLCD2006 dataset did not contain all of the required land cover categories, steps were taken to include these land cover types. This process may produce some inaccuracies in the final acreage and thus affect the final valuation.

- This methodology assumes spatial homogeneity of services, i.e. every acre of a wetland produces the same ecosystem services, which is obviously not the case. It is unclear how this would affect the values.

Primary Study Limitations:[13]

- Many ecosystem services value estimates are based on willingness-to-pay values. These types of values are limited by people's perceptions and knowledge.
- Valuations do not consider thresholds or non-linear effects. Presence of these would likely produce higher values in this study.
- Value estimates are not generally based on sustainable use levels. Supply would be reduced if limited to sustainable use levels, resulting in higher values for ecosystem services.

Conclusion

The Rensselaer Plateau offers a multitude of ecosystem services, which significantly contribute to the well-being of Rensselaer Plateau residents, Rensselaer County citizens, and others. Using spatial value transfer methodology, this study estimated the economic value of the annual services provided by ecosystems on the Rensselaer Plateau. The values estimated in this report intend to provide an idea of the general magnitude of the economic value of the ecosystem services on the Plateau, and do not represent precise estimates. The numbers are generated using standard economic techniques, and are in line with other studies conducted in similar areas. By regulating and supplying water, reducing severity of disturbances, such as floods, regulating nutrients, and providing pollination services and waste treatment, as well as other benefits, the ecosystems on the Rensselaer Plateau provide over $300 million in benefits each year. In terms of land cover type, the forest provides the majority of this value at around $274 million, as the forest covers a large proportion of the area of the plateau. In terms of ecosystem services, habitat and biodiversity services offer the highest total value at around $78 million per year, followed by nutrient regulation at around $53 million per year, and pollination at around $49 million per year. However, the per acre value is highest for wetlands, as this land cover provides us with disturbance prevention services valued around $3,600 per acre, as well as nutrient regulation services valued around $2,000 per acre, and water regulation and supply services valued around $1,100 per acre.

When resources allow, primary valuation research is the preferred strategy. However, it is unlikely that economic values could be estimated for all land cover types and all ecosystem services. In this case, spatial value transfer methodology is viewed as a meaningful, second-best strategy. While this methodology does have its limitations, as addressed in the previous section, the estimates are much more accurate than assuming that ecosystem services have a value of zero. Given the limitations, it is likely that the values provided in this study are underestimated.

In general, ecosystem services are often unaccounted for in decisions regarding development and planning choices. When flood protection provided by ecosystems is lost, this service must be replaced by levees and flooded houses restored. When local climate, pollination and drinking water benefits are lost, the economy suffers directly, as well as indirectly through increased taxes and construction costs to replace the services that were originally provided by those ecosystems. The economic values of ecosystem services estimated in this report can help to increase awareness of the value of ecosystem services provided by the Rensselaer Plateau. This valuation of ecosystem service is an initial step in the process of developing policies, plans and indicators which will guide future development choices.

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Appendices

Appendix 1: Description of Land Cover Typology, Layers Used, and Spatial Methods Used to Develop Classes

Land Cover Class	Description and Layer(s) Used
Forest	NLCD 41, 42, 43 minus Riparian Buffer
Freshwater Wetland	NLCD 90, 95 minus Riparian Buffer
Cropland	NLCD 81, 82 minus Riparian Buffer
Riparian Buffer	NHD flowline buffered by 100 feet
Lakes and Reservoirs	NLCD 11, 12 minus Riparian Buffer
Rivers and Streams	NHD flowline buffered by 10 feet
Other	NLCD 21, 22, 23, 24, 31, 52, 71 minus Riparian Buffer

NLCD Code	Land Cover Class
11	Open Water
12	Perennial Ice/Snow
21	Developed, Open Space
22	Developed, Low Intensity
23	Developed, Medium Intensity
24	Developed, High Intensity
31	Barren Land (Rock/Sand/Clay)
41	Deciduous Forest
42	Evergreen Forest
43	Mixed Forest
52	Shrub/Scrub
71	Grassland/Herbaceous
81	Pasture/Hay
82	Cultivated Crops
90	Woody Wetlands
95	Emergent Herbaceous Wetlands

River:

1. As the NHD “Flowline” dataset is a line shapefile, the “buffer” tool was used to create 10 foot buffer around NHD Flowline.

Riparian Buffer (around rivers, streams, lakes and reservoirs):

1. Rivers and Streams Buffer: Used “buffer” tool to create 100 foot buffer around NHD Flowline. Used “union” tool to union newly-created river layer and riparian buffer layer. Selected only buffer area and exported as a new dataset.
2. Lakes and Reservoirs Buffer: From NLCD dataset, selected FTYPE 11 and 12 (i.e. Water) and exported as new dataset. Used “buffer” tool to create 100 foot buffer around this newly-created dataset. Used “union” tool to union lakes and reservoirs layer and riparian buffer layer. Selected only buffered area and exported as a new dataset.
3. Union (new) River layer, (new) Riparian buffer layers, to create a single riparian buffer layer. Add field to input correct attributes: “River/Stream” or “Riparian Buffer.”

Forest, Freshwater Wetland, Cropland, Lakes and Reservoirs, Rivers and Streams, Other:

1. Union newly-created layer with river and riparian buffer data with NLCD dataset. Added fields and reattributed to create a final land cover typology.

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Appendix 3: Value Transfer Estimates by Land Cover Type

Land Cover	Ecosystem Service	Study (Author)	2012 US$ per acre per year
Cropland			
	Biological Control	Costanza et al. (1997)	$14.57
	Gas & Climate Regulation	Wilson (2008)	$12.06
		Wilson (2010)	$270.64
	Habitat Refugium & Biodiversity	Christie, Hanley & Warren (2004)	$502.74
		Christie, Hanley & Warren (2004)	$1,490.24
	Nutrient Regulation	Wilson (2008)	$9.11
	Other Cultural	Alvarez-Farizo et al. (1999)	$5.57
		Turner et al. (1988)	$105.93
		Wilson (2008)	$53.56
	Pollination	Robinson et al. (1989)	$13.20
		Southwick & Southwick (1992)	$5.20
		Wilson (2008)	$430.01
	Recreation & Aesthetics	Alvarez-Farizo et al. (1999)	$4.80
		Knoche & Lupi (2007)	$52.71
	Soil Retention & Formation	Wilson (2008)	$2.17
		Wilson (2008)	$2.34
Forest			
	Biological Control	Pimentel et al. (1997)	$2.47
	Disturbance Prevention	Dodds et al. (2008)	$1.56
		Wilson (2010)	$589.42
		Wilson (2010)	$660.83
	Gas & Climate Regulation	Azar & Stemer (1996)	$79.19
		Azar & Stemer (1996)	$12.00
		Azar & Stemer (1996)	$242.37
		Azar & Stemer (1996)	$36.00
		Birdsey (1992)	$380.95
		Dodds et al. (2008)	$38.82
		Fankhauser (1994)	$47.99
		Fankhauser (1994)	$20.40
		Fankhauser (1994)	$22.80
		Hope & Maul	$33.60
		Maddison (1995)	$19.20
		Mates & Reyes (2004)	$13.36
		Newell & Pizer (2003)	$18.00
		Newell & Pizer (2003)	$26.40
		Nordhaus (1991); (1993)	$6.00
		Nordhaus (1991); (1993)	$8.40

		Nordhaus (1991); (1993)	$1.20
		Nordhaus (1991); (1993)	$37.20
		Nordhaus & Popp (1997)	$13.20
		Nordhaus & Popp (1997)	$7.20
		Nordhaus & Yang (1996)	$0.28
		Nordhaus & Yang (1996)	$7.20
		Pimentel et al. (1997)	$15.60
		Plambeck & Hope (1996)	$502.74
		Plambeck & Hope (1996)	$24.00
		Reilly & Richards (1993)	$58.79
		Reilly & Richards (1993)	$50.39
		Reilly & Richards (1993)	$24.00
		Reilly & Richards (1993)	$16.80
		Roughgarden & Schneider (1999)	$46.79
		Schauer (1995)	$381.56
		Schauer (1995)	$27.60
		Tol (1999)	$68.39
		Tol (1999)	$362.36
		Wilson (2008)	$146.23
		Wilson (2008)	$15.17
		Wilson (2010)	$191.93
		Wilson (2010)	$662.64
		Wilson (2010)	$744.81
	Habitat Refugium & Biodiversity	Amigues et al. (2002)	$158.38
		Amigues et al. (2002)	$1,978.58
		Dodds et al. (2008)	$2.95
		Garrod & Willis (1997)	$18.00
		Garrod & Willis (1997)	$3,889.97
		Garrod & Willis (1997)	$2,291.75
		Haener & Adamowicz (1998)	$73.55
		Haener & Adamowicz (2000)	$39.47
		Kenyon & Nevin (2001)	$511.14
		Shafer et al. (1993)	$3.64
		Wilson (2008)	$208.21
	Nutrient Regulation	Dodds et al. (2008)	$562.81
	Other Cultural	Sverrisson et al. (2008)	$28.06
		Turner et al. (1988)	$22.41
		Turner et al. (1988)	$171.11
		Turner et al. (1988)	$236.29
	Pollination	Wilson (2008)	$430.01
		Wilson (2010)	$647.13
	Recreation & Aesthetics	Dodds et al. (2008)	$699.41
		Haener & Adamowicz (2000)	$1.63

		Halstead et al. (1991)	$5.20
		Hunt et al. (2005)	$0.01
		Maxwell (1994)	$12.00
		Prince & Ahmed (1989)	$1.20
		Scarpa et al. (2000)	$3.64
		Shafer et al. (1993)	$550.74
		Walsh et al. (1990)	$3.83
		Willis (1991)	$14.40
		Willis (1991)	$6.00
		Willis (1991)	$1.20
		Willis & Garrod (1991)	$4.80
		Wilson (2008)	$129.80
		Wilson (2008)	$183.78
		Wilson (2010)	$49.24
	Soil Retention & Formation	Dodds et al. (2008)	$89.94
		Pimentel et al. (1997)	$7.29
	Waste Assimilation	Pimentel et al. (1997)	$6.18
		Wilson (2008)	$22.49
	Water Regulation & Supply	Dodds et al. (2008)	$29.48
		Loomis (2002)	$10.93
		Wilson (2008)	$590.52
		Wilson (2010)	$741.28
Lakes & Reservoirs			
	Nutrient Regulation	Sutherland & Walsh (1985)	$234.99
	Other Cultural	Forsyth (2000)	$9.63
	Recreation & Aesthetics	Bouwes & Scheider (1979)	$636.47
		Burt & Brewer (1971)	$471.55
		Cordell & Bergstrom (1993)	$2,628.06
		Cordell & Bergstrom (1993)	$2,800.29
		Cordell & Bergstrom (1993)	$257.99
		Cordell & Bergstrom (1993)	$699.69
		D'Arge (1989)	$355.54
		D'Arge (1989)	$113.58
		D'Arge (1989)	$214.80
		Kealy & Bishop (1986)	$13.20
		Kreutzwiser (1981)	$184.78
		Mullen & Menz (1985)	$4,740.99
		Patrick et al. (1991)	$14.40
		Piper (1997)	$245.97
		Rollins et al. (1997)	$6.30
		Rollins et al. (1997)	$25.83
		Rollins et al. (1997)	$9.12

		Young & Shortle	$83.99
	Water Regulation & Supply	Henry, Ley & Welle (1998)	$366.00
		Piper (1997)	$33.60
		Ribaudo & Donald (1984)	$771.51
River			
	Habitat Refugium & Biodiversity	Knowler et al. (2003)	$0.05
		Knowler et al. (2003)	$10.70
		Knowler et al. (2003)	$1.13
	Other Cultural	Forsyth (2000)	$9.63
	Recreation & Aesthetics	Ahn et al. (2000)	$81.64
		Desvousages et al. (1987)	$15,356.55
		Garrod & Willis (1997)	$5,739.78
		Garrod & Willis (1997)	$1,496.80
		Patrick et al. (1991)	$14.40
		Rollins et al. (1997)	$6.30
		Rollins et al. (1997)	$25.83
		Rollins et al. (1997)	$9.12
		Shafer et al. (1993)	$6,007.23
		Shafer et al. (1993)	$1,213.90
	Water Regulation & Supply	Brox et al. (2003)	$4,977.29
Riparian Buffers			
	Gas & Climate Regulation	Birdsey (1992)	$380.95
	Habitat Refugium & Biodiversity	Amigues et al. (2002)	$15.94
		Amigues et al. (2002)	$69.87
		Haener & Adamowicz (2000)	$4.86
		Shafer et al. (1993)	$3.10
	Nutrient Regulation	Wilson (2008)	$238.65
	Recreation & Aesthetics	Bowker et al. (1996)	$7,782.81
		Duffield et al. (1992)	$1,066.68
		Haener & Adamowicz (2000)	$0.63
		Kulshreshtha & Gillies (1993)	$51.59
		Mullen & Menz (1985)	$393.56
		Sanders et al. (1990)	$2,348.14
		Shafer et al. (1993)	$557.39
		Willis & Benson (1989)	$67.35
	Water Regulation & Supply	Berrens et al. (1996)	$2,152.56
		Danielson et al. (1995)	$4,913.46
		Kahn & Buerger (1994)	$0.55
		Kahn & Buerger (1994)	$7.20
		Oster (1977)	$15.60
		Rich & Moffitt (1982)	$4.80
		Wilson (2008)	$633.53

Wetland			
	Disturbance Prevention	Dodds et al. (2008)	$15,596.08
		Gupta & Foster (1975)	$420.91
		Hovde & Leitch (1994)	$4.25
		Roberts & Leitch (1997)	$662.05
		Wilson (2008)	$1,565.88
	Gas & Climate Regulation	Dodds et al. (2008)	$130.23
		Gren (1995)	$199.88
		Wilson (2008)	$5.05
		Wilson (2010)	$555.24
	Habitat Refugium & Biodiversity		
		Costanza et al. (2006)	$6.07
		Dodds et al. (2008)	$188.71
		Gupta & Foster (1975)	$286.29
		Hovde & Leitch (1994)	$3.53
		Johnston et al. (2002)	$100.97
		Knowler et al. (2003)	$28.01
		Knowler et al. (2003)	$128.40
		Stevens et al. (1995)	$138.69
		van Kooten & Schmitz (1992)	$6.00
		Willis & Benson(1988)	$23.72
		Wilson (2008)	$2,086.36
		Woodward & Wui (2001)	$85.90
	Nutrient Regulation	Brauer (2004)	$11.14
		Bystrom (2000)	$4,027.24
		Dodds et al. (2008)	$7,855.54
		Gren (1993)	$17.23
		Lant & Roberts (1990)	$28.14
		Lant & Tobin (1989)	$1,956.83
		Lant & Tobin (1989)	$177.73
	Other cultural	Whitehead (1990)	$1,734.82
		Whitehead & Blomquist (1991)	$21.28
	Recreation & Aesthetics	Azevedo et al. (2000)	$56.92
		Azevedo et al. (2000)	$151.25
		Dodds et al. (2008)	$1,777.51
		Gupta & Foster (1975)	$920.21
		Kreutzwiser (1981)	$202.98
		Lant & Roberts (1990)	$27.11
		Poor (1999)	$443.06
		Shafer et al. (1993)	$107.00
		van Vuuren & Roy (1993)	$1,027.39
		Whitehead (1990)	$1,607.82
		Wilson (2008)	$129.89

		Wilson (2010)	$49.24
	Waste Assimilation	Wilson (2008)	$1,169.80
		Wilson (2010)	$497.47
	Water Regulation & Supply	Costanza et al. (1997)	$8.22
		Costanza et al. (1997)	$4,661.92
		Dodds et al. (2008)	$1,451.69
		Lant & Roberts (1990)	$0.00
		Lant & Tobin (1989)	$203.98
		Lant & Tobin (1989)	$2,241.35
		Roberts & Leitch (1997)	$141.49
		Wilson (2008)	$183.78
		Wilson (2010)	$732.83

Appendix 4: Cross Tabulation of Number of Studies by Land Cover and Service Type

Ecosystem Services	Land Cover					
	Forest	Lakes & Reservoirs	Cropland	Riparian Buffer	Rivers & Streams	Wetlands
Biological Control	1(1)		1(1)			
Disturbance Prevention	2(3)					4(4)
Gas & Climate Regulation	20(39)		2(2)	1(1)		4(4)
Habitat Refugium	8(11)		1(2)	2(3)	1(3)	10(11)
Nutrient Regulation	1(1)	1(1)	1(1)	1(1)		6(7)
Other Cultural	2(4)	1(1)	3(3)		1(1)	2(2)
Pollination	2(2)		2(2)			
Recreation & Aesthetics	13(16)	11(18)	2(2)	8(8)	6(10)	11(12)
Soil Retention & Formation	2(2)		2(2)			
Waste Assimilation	2(2)					2(2)
Water Regulation & Supply	4(5)	3(3)		6(7)	1(1)	7(9)

The first number indicates the total number of studies; the second number (in parentheses) indicates the number of valuation point estimates for each ecosystem service and cover type.

Appendix 5: Geographic Summary Methods

1. A 50-acre grid of the study area was created using the ArcGIS "Create Normal Raster" tool. This grid was clipped by the Rensselaer Plateau boundary. The acreage for each grid was then calculated using Calculate Geometry (as there were some edges that were not 50 acres).
2. Per-acre values for each land cover type were added as an attribute to the land cover dataset.
3. The zero dollar per-acre value of the "other" land cover type was reclassed as "no data."
4. Using the "Zonal Statistics as Table" tool, the dollar per acre values were then summarized (mean) by the 50 acre grid and this table was then joined to the 50 acre grid dataset. This was then exported as a new dataset, which contained the ecosystem service values per 50-acre grid. Finally, the mean value was multiplied by the acreage of the grids. This final value was used to create the map.

CONCLUSION

The results generated by these two studies commissioned by the Rensselaer Plateau Alliance offer information that quantifies the economic impact of industries on the Plateau and also the benefits of ecosystem services provided by the natural resources of the Plateau. In particular, these studies substantiate the value of the forested land that occupies much of the open space of the Rensselaer Plateau. These forests support the forest products industry, which generated the largest dollar impact of the industries studied, and they also support ecosystem services that were shown to have significant value to area residents. The impacts of other industries and ecosystem services that were estimated also provide information that can be used to value the open space resources of the Rensselaer Plateau.

By quantifying these impacts, decision makers are better able to compare various alternatives that may be considered when planning for the future. As noted in the report from the New York State Comptroller ("Economic Benefits of Open Space Preservation," March 2010), "Decision-making that explicitly considers and values the positive economic effects of open space, as well as environmental and quality-of-life implications, will best serve a community's long term interests." The Comptroller's report also found that:

- Open space supports industries that generate significant economic activity
- Open space protection can be financially beneficial to local governments by reducing costs for public infrastructure and programs, lessening the need for property tax increases
- Open space protection can support regional economic growth
- Well-planned open space protection measures need not conflict with meeting other vital needs, such as economic development and municipal fiscal health.

Consistent with these findings, the information generated by the two studies will help municipalities make decisions that maximize the economic and quality of life benefits that are generated by the natural resources of the Rensselaer Plateau. This information is also an important component to the Rensselaer Plateau Conservation Plan and its goal of conserving and sustaining the natural and community values of the Rensselaer Plateau.