CYBER SECURITY

NEW YORK STATE DIVISION OF HOMELAND SECURITY AND EMERGENCY SERVICES

THE NELSON A. ROCKEFELLER INSTITUTE OF GOVERNMENT

UNIVERSITY AT ALBANY

State University of New York

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The New York Statewide Digital Orthoimagery Program

Its Uses in the Public and Private Sectors and Its Return on Investment

New York State Office of Cyber Security

Final Report

March 2013

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Executive Summary

The New York Statewide Digital Orthoimagery Program (Program), managed by the NYS Office of Cyber Security (OCS), has produced regularly updated orthoimagery of the state since 2001. The orthoimagery has served as a trusted, high-resolution, and spatially accurate base layer for data development and other Geographic Information System (GIS) activities. Since its inception, the Program has emphasized timely and widespread distribution of the orthoimagery. The images are delivered to the relevant counties and made freely available to all for viewing and downloading; bulk deliveries are provided to federal, state, and county agencies; and Web service availability has existed since 2008.

This report is intended to estimate the return on investment (ROI) of the Digital Orthoimagery Program. Understanding the value of the Program to its users is especially important now, given the Program's reliance on scarce public resources (a combination of state, county, and federal funding) as well as the greater availability of alternative sources of imagery.

To estimate the return on investment, the study — which was conducted in 2012 by the NYS OCS with assistance from the Nelson A. Rockefeller Institute of Government of Albany, New York — surveyed public sector and some private sector users regarding their uses of orthoimagery originating from the Program. The survey was conducted through in-person interviews, electronic surveys, and phone calls. Public sector users in the survey included

nine state agencies, fifteen NYS counties, and nine agencies in New York City. Private sector users included representatives of selected industries and occupations expected to use the images, including surveyors, real estate professionals, engineers, and nonprofit land trusts.

The surveys attempted to identify productivity savings by asking users to estimate actual savings (usually labor costs) compared to the counterfactual situation of not having the images. The surveys also sought to understand the values of products with the imagery compared to their value without the imagery. Finally, the surveys sought to determine other benefits to users, with or without dollar savings.

We found that many public and private users felt that they could not carry out their functions without the Program, or if they did, their costs would be much higher or the quality of their services or products would be lower. But we also attempted to estimate productivity savings and compare them to actual costs over the time period, 2006-11. Based on data collected on public sector users alone for this six year period, we estimated that the Program broke even in the first year of the study, 2006. In a sample of fifteen counties and New York City, benefits totaled $24.7 million between 2006 and 2011. In nine state agencies, benefits equaled $17.8 million. During this same period, OCS and its funding partners spent around $13.4 million, for a net benefit of $29.1 million from 2006 to 2011.

Based on data collected on public sector users alone for this six year period, we estimated that the Program broke even in the first year of the study, 2006.

In addition to the net benefits calculated from a limited sample of counties, we estimate that a more complete reckoning of public sector users would substantially increase the net benefits, even using very conservative assumptions in extrapolating to other counties. Indeed, a phone survey of all counties in New York found that nearly all counties used the Program, often extensively and in multiple offices. If the average benefits estimated in the study sample of 15 counties is extrapolated to this larger number of counties (35 additional counties) which we know use orthoimagery, estimated net benefits of the Program increase from $29 million to $48-60 million dollars for 2006-11, depending on assumptions. We also found many examples of productivity and strategic savings among private sector users. In sum, it is clear that even a study that is limited in its coverage of all Program users — and limited in its capacity to translate all reported benefits into quantitative terms — shows that the NY Statewide Digital Orthoimagery Program provides extensive net benefits to the state of New York.

Introduction

History of the Program

The New York Statewide Digital Orthoimagery Program (Program) has its origins in 2000 and 2001, as the final U.S. Geological Survey (USGS) National Aerial Photography Program (NAPP)

Map provided by the New York City Department of Design and Construction

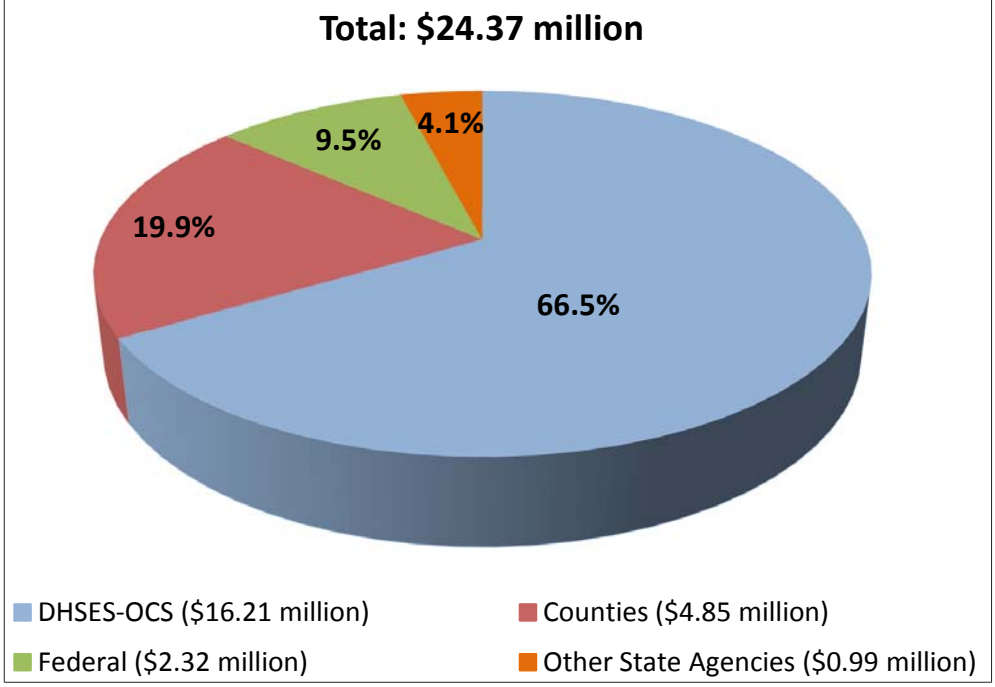
orthoimagery was being completed and distributed. The Program was developed through the NYS Geographic Information Systems (GIS) Coordinating Body. This is a collaborative effort including representatives of federal, state, and county agencies as well as academia and the private sector. The program was conceived with the goals of updating orthoimagery coverage of the state, while improving the resolution and spatial accuracy of the final products. Specifications were developed so that the orthoimagery would serve as a trusted base layer for data development and other GIS activities. Upgrade options were developed to allow agencies with specific needs (higher resolution, Color Infrared (CIR) imagery, etc.) to fund these changes beyond the base specifications. In 2008, production of terrain data from light detection and ranging (LIDAR) collection was added as an option to take advantage of the synergy between LIDAR and orthoimagery production, and to increase the coordination of LIDAR collection in NY. (See Appendix H for a brief description of LIDAR collection in NY.)

Since its inception, the Program has emphasized timely and widespread distribution of the final orthoimagery. Once the final orthoimagery is available, it is delivered to the relevant counties and made available for viewing and downloading through the NYS GIS Clearinghouse site (http://gis.ny.gov/gateway/mg/). Bulk deliveries are made to federal and state agencies, typically as a year's production (a Yearly Update) is completed. Web services became another means of making the imagery available in 2008, first in partnership with USGS and now through NYS applications. (More information on bulk distribution and Web service usage is provided in Appendices D and E, respectively.)

The NYS Office of Cyber Security (OCS) manages the Program. OCS works closely with the NYS Department of Transportation (NYSDOT) to ensure the quality of the final products. Starting with the spring 2001 flying season, the Program has successfully updated a portion of the state every year. Counties that had recently produced orthoimagery on their own were skipped in the first few years, but all counties and NYC are now included in the Program. All counties have been flown at least three times as of 2012, with higher reflight rates over more urbanized areas. The core funding for the program is New York State funds, but funding partnerships with federal, state, and local agencies have played a key role in improving the quality and extent of the coverage. OCS funds are used to pay for staff ($2.1 million over the six-year study period). All of the partnerships funds are applied to the contractual costs of producing the final products. The funding source breakdown for orthoimagery and LIDAR products, summed across all years from 2001 through 2011, is shown on Figure 1.

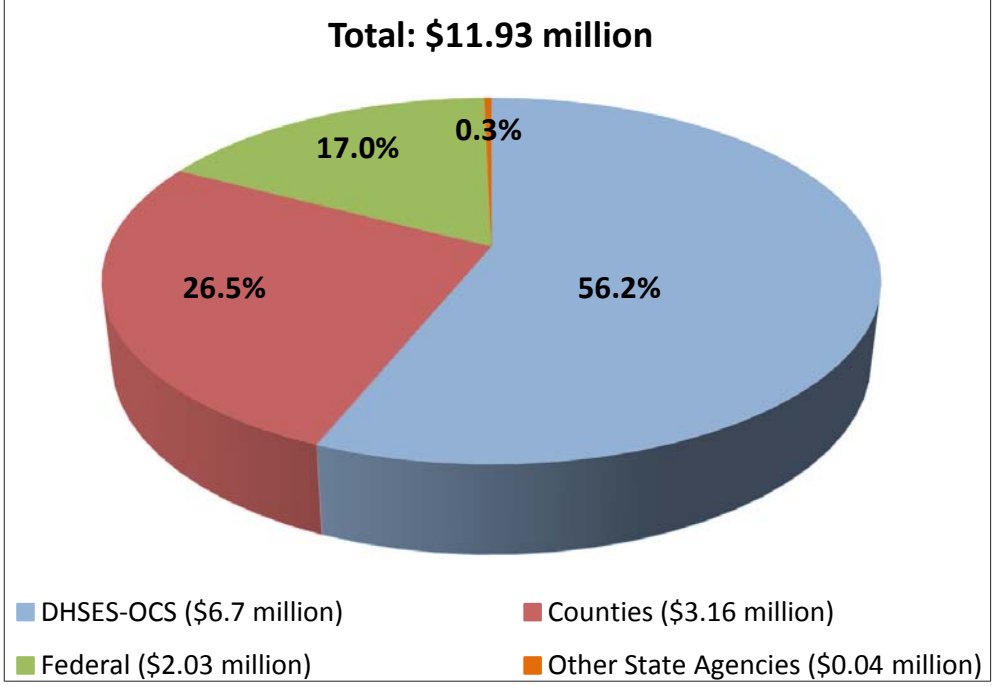
The current study covers only orthoimagery production expenses and resulting benefits for the period from 2006 through 2011. The funding sources for orthoimagery alone (not including

Figure 1. Program Funding Sources for Orthoimagery and LIDAR, 2001-11



LIDAR) for the period 2006-11 are shown in Figure 2. Most of the funding comes from New York State through DHSES-OCS (56.1 percent of all support for orthoimagery). The second largest amount comes from counties (26.5 percent), with nearly all the rest coming from the federal government (17.0 percent). (Other state agencies made only a small contribution to orthoimagery during this period.) This plurality of funding sources has helped sustain the Program even during difficult budget periods for the state. Funds from county and local agencies have been a part of every Program year except one. Federal funding has been available each year since 2005. In 2009, when OCS funds for the Program were greatly reduced on short notice, commitments for funding from federal, county, and local sources kept the Program going.

Figure 2. Program Funding Sources for Orthoimagery Only, 2006-11



The first twelve years of the Program have seen a marked increase in imagery available from numerous sources. As the Program started in 2000/2001, the USGS NAPP (National Aerial Photography Program) orthoimagery of New York, mostly flown in 1994 and 1995, was just becoming widely available. The Program was seen as an update to the NAPP imagery. U.S. Department of Agriculture (USDA) NAIP (National Agriculture Imagery Program) imagery provided partial coverage of New York starting in

2004, with complete coverage achieved in 2009 and 2011. Oblique imagery from vendors such as Pictometry has been acquired by many counties in New York. Google has gone from using Program imagery in their applications (Google Maps and Google Earth) to creating their own imagery for many areas. Microsoft uses a combination of imagery sources in the Bing Maps application. GIS software vendor ESRI makes copies of imagery from numerous sources available through Web services. This creates potential competition for the Orthoimagery Program. This study is conducted with full awareness of these sources of imagery, and comparisons with Program imagery are described in several portions of the report.

Overview of ROI Study Goals

Since it started, the Program has depended on several different sources for the core New York State funds. Several of the earlier sources were one-time only or limited term grants, so in 2005, the Program worked with NYS Division of Budget to set up a more permanent funding stream. During this effort, orthoimagery users supplied statements of support for the Program and its continuation. These statements were primarily qualitative, describing the importance of the orthoimagery in various workflows without attaching a measure of productivity increases or costs savings. While these statements were critical in the successful effort to get permanent funding for the Program in 2006, OCS wanted to collect information to measure the return on the investment made by New York State, local, and federal agencies. This goal has become more important as government budgets shrink.

The period from 2006 through 2011 was selected for the study for several reasons. The commitment of New York State funds on a regular basis began in 2006. New York City was added to the Program in 2006, meaning that all parts of the state were included in the Program. Each county received updated Program orthoimagery at least once during the study period. The most recent major changes to imagery specifications (use of digital cameras and replacement of panchromatic imagery with natural color) were implemented in 2006. Overall, the Program during the study period has the fundamental properties that OCS envisions carrying forward into future years.

When it launched the study, OCS expected the return to be positive, but a detailed ROI study was viewed as a way to show this positive return while also learning more about how orthoimagery is used. This information will be valuable as the Program continues into its second decade. The Program has changed in many ways since its beginning, and it will continue to change. Technological advancements, the availability of imagery from other sources, budget pressures, and increased interest in other data such as LIDAR will all influence the Program in the years to come. The ROI study will provide feedback from

end-users to help guide decisions about how the Program should treat these future developments.

Data Collection Process

When accepting the Cooperative Assistance Program (CAP) Grant award, OCS agreed to use the ROI study methodology developed by the Geospatial Information & Technology Association (GITA). Training in the methodology was received in October 2011. OCS received general guidance on how to scope and execute a study as well as very specific information on how to edit the spreadsheets used to calculate the ROI values. Throughout the study, this guidance proved valuable, especially when dealing with the wide range of responses received during data collection.

Initially, there wasn't a specific method or procedure for collecting data. The "Data Collection in Preparation for ROI Training" document received from the trainer before ROI training began was modified by adding items specific to orthoimagery and deleting the rest. Several benefits of using orthoimagery and examples of time savings and cost savings were added. A section for data collection expectations, spelling out the importance of time and money savings was added: "*Actual Savings (salaries X hours saved), values of products with/without imagery); Anecdotal benefits, try to assign dollar amounts.*"

Appendix A provides information on the entities supplying input for the study.

Public Sector Users

Data collection from public sector users began with counties and New York State agencies where we knew orthoimagery had been used. We contacted the persons to whom OCS delivered orthoimagery updates. The orthoimagery ROI overview document was sent by email to several county and state agency contacts in advance of scheduled meetings. It was expected this would get participants thinking about the information we wanted.

With the exception of one county, our first few meetings did not get the information we had hoped for. The consensus among public officials was that orthoimagery was essential and an integral part of their work, but specific monetary benefits were difficult to express. One state agency meeting was well attended and produced a list of contacts with general descriptions of benefits. All of the contacts had to be interviewed by phone or reached by email in order to collect specific data.

Another deficiency in the process was a lack of participants attending the meetings. Although many were invited by our contacts, few attended, and those who did often could only spare a brief amount of time.

It was decided that we needed better preparation for meetings, and a method of reaching more people. During our training, we learned of the state of Maine's online Orthoimagery Usage Survey and went to the site for information on orthoimagery use.

It had a variety of questions, some of which were appropriate for our study. We developed a similar survey that would be sent by email; responses, in "xml" format, would also be returned by email. Some questions in the Maine survey were not used and others were added, including checkboxes on the usage of other sources of imagery. It was sent to our county contacts and to key state agency contacts, most notably NYS DOT and NYS Thruway Authority. (Both of these had a central GIS Coordinator who forwarded the survey by email, yielding over forty responses per agency.) The data from the survey was received and imported into Microsoft Access databases, one for each state agency and county in our study.

The responses were reviewed; follow-up calls and emails were used to refine the information received. Additional information was gathered in order to convert survey responses like "saves a lot of time" into hours saved and hourly rates that could be used to calculate monetary benefits. Many responders had to be prompted for "best estimates" to get numbers. Others requested that questions be rephrased in an email, which they then used to poll inhouse staff. In counties where the survey did not produce useable quantitative information, phone calls were made to specific departments where significant returns had been found in other counties. Overall, there was not one specific method that worked in all cases, but the one-on-one interview was usually essential, either conducted by phone or in person.

While this report refers to data collected from counties, in many cases the county response included information from cities and towns. Sometimes the inclusion of these governments stemmed from the fact that the agency served both the county and a city. Other times, responses came directly from city or town agencies.

Whether the responses came from county agencies or state agencies, it was apparent that the responses were only a sample of the orthoimagery users and uses within each entity. Some groups were more willing or able to estimate benefits from their use of orthoimagery. Sometimes the persons we interviewed were more comfortable with giving a range of values rather than a point estimate. When presented with a range, we used the conservative estimates — those that would generate a lower ROI — in order not to overstate benefits. If we were unable to get any estimate of a quantitative benefit, we recorded statements of strategic benefits, which are discussed later in this report. See Appendices A and B for more detail on responses from the public sector, including information on responding agencies and the ratio of responses with quantified benefits to those without.

This study did not attempt to gather benefit information from federal agency users of the Program imagery. Nonetheless, this use is significant, as indicated by the number of federal agencies requesting and receiving the imagery (Appendix D).

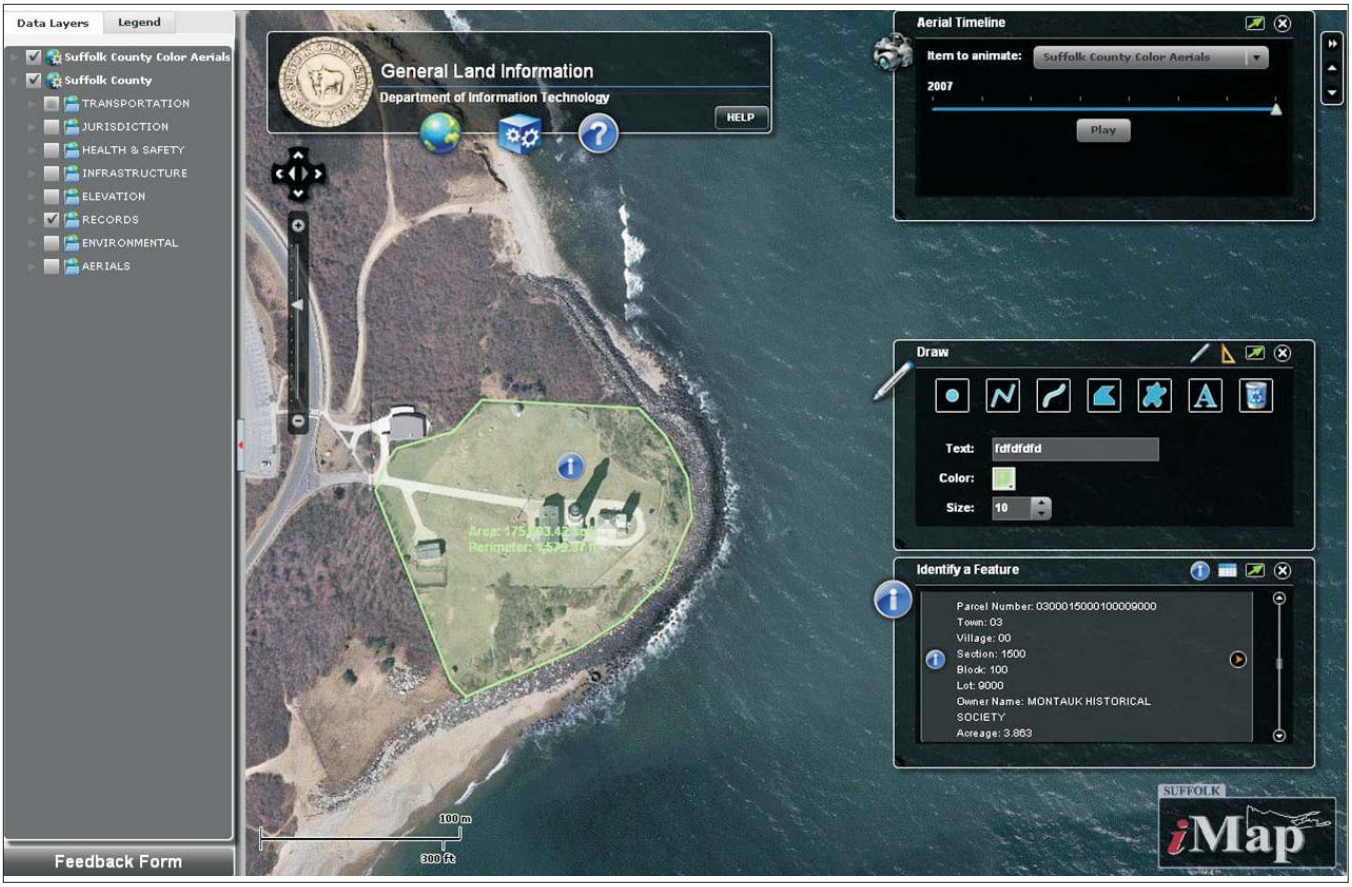


Image provided by Suffolk County.

Private Sector Users

Because of the large number of potential private sector applications, we approached the problem of finding users of New York's orthoimagery at both the state and the local levels. At the state level, we contacted New York State trade associations in industries where we expected to find some usage. Those associations included representatives of land surveyors, real estate brokers, commercial developers, engineers, and nonprofit land trusts. Where possible, we got information from the trade associations about how their members might use the images; or if they did not know the answer to that question, we asked them to provide contact information for firms that might be able to assist us. Where a trade association in New York was not available or not helpful, we contacted large individual firms in these industries directly. At the local level, one county — Broome County — distributed our survey to all Web site users of the orthoimagery that the county government makes available for free. Eighteen responses to the Broome County survey were received from private firms or individuals.

In general, our method was to interview a variety of private users to get a rough estimate of how the images were used in that industry or occupation and what types and magnitudes of

productivity and strategic benefits they got from the images. As part of the interview, we asked whether they thought their usage was similar to or different from others in their industry. We also asked for names of other users in their industry or occupation in order to help us get a more complete picture. Where estimating productivity savings appeared to be feasible, we requested information about salaries and other information needed to estimate those savings. To help us extrapolate our findings to the statewide industry, we sought state occupational, license, or other business data to estimate the number of similar businesses or practitioners in New York State; and survey data of persons and their occupations collected and made available at the state level by the U.S. Bureau of Labor Statistics. We also relied on such data to estimate average salaries of individuals working in such businesses.

These various approaches to finding orthoimagery users in the private sector uncovered a wide variety of applications. We summarize below the different ways in which we sought to estimate private sector use of orthoimagery in different industries and occupations. More specific descriptions and estimates of benefits are found in later sections.

Surveyors. We approached surveyors by discussing usage of orthoimagery with leaders of the New York State Association of Professional Land Surveyors. Then we checked and confirmed their statements by speaking with additional surveyors. We found that all or nearly all licensed land surveyors in New York use publicly generated and distributed orthoimagery extensively.

Real Estate Industry. We received information from real estate professionals both by talking to staff at state associations and members they referred us to, and by getting information from persons in the industry via the list of image users in Broome County. We found some differences in opinion among real estate professionals about the use of orthoimagery within the industry. At the state association level, staff talked to several association members and reported to us that few real estate firms, brokers, and associates used orthoimagery for *residential* properties. However, state association staff (and the real estate professionals they referred us to) said that the images were used frequently by firms involved in *commercial* real estate transactions. Nonetheless, we did find among the Broome County users that some real estate professionals also used the orthoimagery for residential markets. Based on this initial finding, our interviews with commercial real estate firms are probably generalizable to the other such firms, while our reports by usage in the residential real estate market are much harder to extrapolate to the statewide industry.

Engineers. Although we contacted several statewide engineering associations, their staff members were unable to provide specific information about whether and how their members used public orthoimagery. One possible reason for the lack of information at the state level is the wide variation in engineers' projects and activities, which would lead them to vary greatly in their use

of orthoimagery. We therefore called large individual firms and used the Broome County information on individual users, which included several engineers. The interviews suggest that use of orthoimagery is fairly common among engineers in the private sector. (Additional evidence of the likelihood of extensive use comes from the reported widespread use by engineers employed in the public sector.) Nonetheless, it is difficult to extrapolate any findings, given the apparent differences among engineers in their usage.

Nonprofit Land Trusts. Based on several interviews with staff at nonprofit land trusts, we found that their usage of orthoimagery was widespread and intensive. We interviewed staff at several land trusts out of twelve accredited land trusts statewide.[1] All of them reported that most or all of their staff used orthoimagery from their respective counties — and often many times per day.

Other. The Broome County user survey also uncovered several individuals who used the orthoimagery as private individuals. We report those uses here, but we did not attempt to find other sources of information on these private uses. Also, our review of usage data for the Program's Web application and Web services shows that many users appear to originate at private firms.

Data Analysis (Costs/Benefits)

The stakeholders of the Program are varied, including both public and private sector agencies. Orthoimagery is a particularly valuable tool for the GIS community. The Program is provided free of charge and can be used by anyone. The Program is widely used by counties, state government agencies, and private sector agencies, among others. It would be virtually impossible to capture the true benefits realized due to use of the Program.

As mentioned above, cost and benefit data was collected by a sample of county, state government agency, and private sector users (see Appendix A for the complete list of county, state agency, and private sector agencies that are included in the study sample). The cost/benefit data were then transferred to a Microsoft Excel workbook. A separate workbook was prepared for each county and agency included in the study sample. The workbooks organized the data in a fairly standardized manner. For instance, data on time or work effort saved were required, as were data on the salaries or wages and the benefits of persons whose time was saved. Where benefits were reported for a group, an average or representative salary was used. The spreadsheets also allowed entry of data on travel costs and other types of savings.

After the data were added to the spreadsheets, we attempted to calculate the ROI for the past six years, from 2006 to 2011. Data from individual counties, state agencies, and private firms were linked to another single workbook that consolidated financial details for different combinations. The costs and benefits were utilized to calculate:

- Net present value,

- Annual return on investment,
- Break-even point, and
- Payback period.

To compare 2011 dollar to the base year (2006) dollar, the 2011 dollar was discounted back by the rate of inflation using the U.S. Bureau of Economic Analysis's overall GDP index.

Public Sector Users

Our interviews and surveys of public sector users of orthoimagery uncovered a wide range of applications that increased productivity or otherwise saved costs. Many public workers said that the orthoimagery allowed them to reduce their field trips, site visits, and other travels, all of which saved them considerable time and expense. Examples include county engineers as they prepare paving contracts; researching permit applications; preplanning and follow-up work on survey jobs; building inspections; and tax mapping, such as confirming parcel changes and noting creek movements over time.

Public sector users often mentioned savings in research activities, such as checking the borders of park lands for farmers who may be encroaching, highway design and planning, and many other research tasks. A county economic development official, for instance, said that the imagery saves them from digging through files for deeds when they need to verify a property line. An economic development official said the imagery was used for "all kinds of things," such as home locations, locating cellular towers, monthly reviews of zoning, installing fiber-optic cables, and site availability. In many of these applications, the orthoimagery is used in conjunction with other data layers, such as roads and parcel boundaries. Many users said they needed the orthoimagery for presenting or communicating information. For example, one county planner noted that the "industry norm" is that any proposed project needs the orthoimagery along with the topography before approval is possible.

Some users reported savings in time (and greater effectiveness) in responding to 911 calls and other emergency response functions. The images gave emergency personnel quick information about the type of terrain, other buildings, water bodies, and other obstacles they need to prepare for. Orthoimagery also made it much easier to formulate emergency plans and identify problems in advance. We also heard from officials who used the orthoimagery to help them manage property inventories, such as parks and other recreational areas.

As already noted, we asked to quantify the savings from these and other applications in the public sector, and though many times we were unable to assign clear values to the benefits, we were able to do so in many cases. When these estimates are combined within counties and state agencies, we can estimate the benefits by these entities. These estimates are displayed in Table 1,

which shows the annual benefits for the study sample of nine state government agencies, fifteen counties, and New York City. Table 2 adds the annual estimates in Table 1 sequentially and presents the cumulative benefits over the period 2006 through 2011. The tables also show the annual and cumulative costs of the orthoimagery program.

Based on these calculations for just the sample of users in state, county, and New York City government, the Project's net cumulative value as of 2011 is $29.1 million (see the bottom right corner of Table 2). The annual return on investment is 36.2 percent. Based on the preliminary data in the last six years, the project broke even during the first year of the study, in 2006 (Table 1, lower left corner). The data analyses indicate a cumulative benefit of $42.5 million, of which $24.7 million is reported for the sample of fifteen counties and New York City and a benefit of $17.8 million is reported for the sample of nine state agencies. In terms of costs, OCS has spent around $13.4 million from 2006 to 2011 (Table 2). These costs include contractual costs for orthoimagery production (about 85 percent of the total costs) plus the OCS staff hours with overhead (approximately 15 percent of the total costs).

Based on reported values, New York City is the largest beneficiary of the Program. The survey results indicate a net benefit of $11.9 million from 2006 to 2011, which makes up about 41 percent of total net benefits. New York City is a unique partner in the New York State orthoimagery program. The number and density of tall buildings in the city, especially Manhattan, require extra

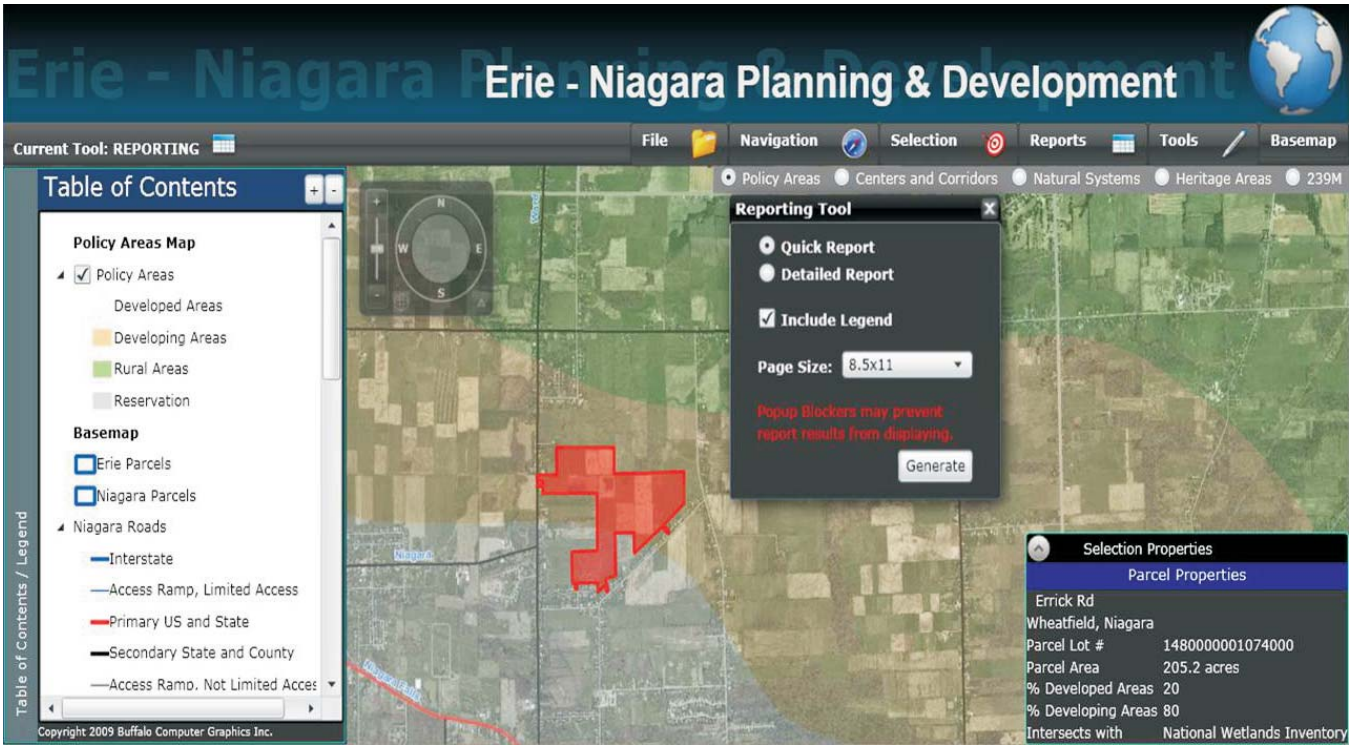


Image provided by Suffolk County.

Table 1. Annual Costs and Benefits for Counties and State Agencies, 2006-11						
County/Agency	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NYC	1,867,278	1,921,431	1,963,647	1,981,137	2,049,150	2,092,846
Albany	137,995	144,897	149,320	151,929	155,292	159,985
Broome	138,715	145,663	151,920	156,424	161,787	168,643
Chemung	72,666	76,419	79,816	82,298	85,238	88,971
Dutchess	45,659	47,028	48,107	48,583	64,853	76,637
Erie	327,815	337,737	345,591	349,117	354,266	362,303
Jefferson	72,902	76,667	80,075	82,566	85,515	92,521
Oneida	115,753	121,421	126,502	130,118	134,442	140,000
Onondaga	63,943	67,245	70,234	72,419	75,005	78,290
Putnam	22,854	24,034	25,102	64,529	26,807	27,981
Rockland	28,138	28,954	29,591	29,854	30,255	30,900
Schenectady	241,704	254,185	265,485	273,742	283,519	295,935
St. Lawrence	71,373	75,059	78,395	80,834	93,512	97,387
Suffolk	440,232	453,851	464,713	469,770	477,026	488,190
Warren	71,983	74,226	76,019	76,864	78,069	79,915
Westchester	82,468	179,340	88,329	186,567	92,025	94,891
Total County Benefits	***3,801,477***	***4,028,157***	***4,042,847***	***4,236,751***	***4,246,759***	***4,375,395***
AG	141,056	145,147	148,336	149,657	151,666	154,900
APA	128,720	132,636	135,742	137,149	139,194	214,512
DEC	1,564,644	1,610,657	1,838,234	1,855,292	1,880,901	1,921,750
DMNA	1,749	1,824	1,889	1,932	1,984	2,223
DOT	90,777	98,777	102,811	131,541	185,364	217,598
OGS	123,910	127,504	130,305	131,466	133,230	136,071
Power Authority	204,891	210,833	215,466	217,385	220,302	225,000
Police	8,462	8,707	8,898	8,978	9,098	9,292
Thruway	354,945	372,766	388,819	400,389	414,158	431,754
Total Agency Benefits	***2,619,153***	***2,708,851***	***2,970,499***	***3,033,788***	***3,135,898***	***3,313,100***
Total Benefits	**6,420,630**	**6,737,008**	**7,013,346**	**7,270,539**	**7,382,657**	**7,688,495**
OCS Costs	**-2,145,486**	**-3,222,955**	**-1,586,088**	**-2,847,167**	**-2,132,755**	**-1,463,771**
Net Value	**4,275,144**	**3,514,052**	**5,427,258**	**4,423,372**	**5,249,903**	**6,224,724**
ROI	**33.20%**	**18.20%**	**57.00%**	**25.90%**	**41.00%**	**70.90%**
Note: Amounts adjusted to overall GDP price index.						

work. There needs to be more exposures taken and flights flown closer together than in the rest of the State. There is also extra processing to remove "lean" from all buildings over six stories tall. The cost per square mile can be as much as twenty times greater than imagery in the rest of the state. This enhanced imagery is used extensively in the city for accurate mapping of streets and buildings and other types of infrastructure. It is the base map layer for most of the construction in the city and saves millions of dollars for a large number of city agencies.

Among the state agencies, the Department of Environmental Conservation (DEC) reported the largest share of cumulative benefits at $10.7 million. The total benefits reported by the DEC make up about 37 percent of total county and agency benefits included in the study sample.

In sum, data analyses of the benefits and costs for state agencies and a sample of fifteen counties show that the orthoimagery program is an excellent investment and is beneficial to a wide range of users in the public sector. In many ways, however, even these strong and positive returns from implementing the program clearly underestimate its value. Our interviews with state agencies yielded many examples of how orthoimagery is used in their work, but the orthoimagery has become such a core part of their activities, it was very difficult for them to imagine what they would do without the Program — and in many cases, we were thus unable to get any quantitative estimates of productivity savings. Also, our response rates from agencies in different counties varied a great deal, with some counties providing much less

Table 2. Cumulative Costs and Benefits for Counties and State Agencies, 2006-11						
County/Agency	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NYC	1,867,278	3,788,708	5,752,355	7,733,492	9,782,642	11,875,488
Albany	137,995	282,892	432,213	584,142	739,433	899,418
Broome	138,715	284,378	436,298	592,722	754,508	923,151
Chemung	72,666	149,085	228,901	311,199	396,437	485,407
Dutchess	45,659	92,687	140,794	189,378	254,230	330,867
Erie	327,815	665,552	1,011,143	1,360,260	1,714,526	2,076,829
Jefferson	72,902	149,569	229,644	312,210	397,725	490,246
Oneida	115,753	237,173	363,676	493,794	628,236	768,236
Onondaga	63,943	131,188	201,422	273,841	348,846	427,136
Putnam	22,854	46,887	71,989	136,518	163,326	191,307
Rockland	28,138	57,093	86,683	116,538	146,793	177,693
Schenectady	241,704	495,889	761,374	1,035,116	1,318,635	1,614,570
St. Lawrence	71,373	146,432	224,827	305,661	399,173	496,560
Suffolk	440,232	894,083	1,358,796	1,828,566	2,305,592	2,793,782
Warren	71,983	146,208	222,228	299,091	377,160	457,075
Westchester	82,468	261,808	350,137	536,704	628,729	723,619
Total County Benefits	***3,801,477***	***7,829,634***	***11,872,480***	***16,109,231***	***20,355,990***	***24,731,386***
AG	141,056	286,203	434,540	584,197	735,863	890,763
APA	128,720	261,356	397,099	534,248	673,442	887,954
DEC	1,564,644	3,175,301	5,013,534	6,868,826	8,749,727	10,671,477
DMNA	1,749	3,572	5,461	7,393	9,377	11,600
DOT	90,777	189,554	292,364	423,905	609,269	826,867
OGS	123,910	251,414	381,719	513,184	646,414	782,485
Power Authority	204,891	415,725	631,190	848,575	1,068,878	1,293,878
Police	8,462	17,169	26,067	35,044	44,142	53,434
Thruway	354,945	727,711	1,116,530	1,516,918	1,931,076	2,362,830
Total Agency Benefits	***2,619,153***	***5,328,004***	***8,298,503***	***11,332,291***	***14,468,189***	***17,781,289***
Total Benefits	**6,420,630**	**13,157,638**	**20,170,984**	**27,441,522**	**34,824,179**	**42,512,675**
OCS Costs	**-2,145,486**	**-5,368,441**	**-6,954,530**	**-9,801,696**	**-11,934,451**	**-13,398,222**
Net Value	**4,275,144**	**7,789,197**	**13,216,454**	**17,639,826**	**22,889,729**	**29,114,453**
ROI	**33.20%**	**24.20%**	**31.70%**	**30.00%**	**32.00%**	**36.20%**
Note: Amounts adjusted to overall GDP price index.						

information than others; and in most cases, the responses came from only a fraction of the orthoimagery users in the agency or county.

We should also note that there is another downward bias in our estimates of ROIs. While the benefits realized from the Program are not always easy to quantify, the costs are, since they are the contract and labor costs paid by OCS in order to operate the program. Thus, although the cost-benefit analysis of the Program accounts for nearly all of the costs, we know that only a fraction of the benefits are converted into quantifiable fiscal benefits. (Appendix A provides detailed information on responders from the 15 counties.) Some of these strategic benefits described by the survey respondents indicate that the Program has certainly produced additional positive net benefits for New York State, and they are discussed later in this report.

Extrapolation of County Government ROI Estimates

As already noted, the estimated benefits of the Program probably underestimate its value for all local governments in New York. One reason for this underestimation is the fact that our surveys of county government users did not include data from the forty-two other counties in New York State. Although we did not have the resources to conduct extensive surveys of orthoimagery users in these forty-two counties, they should not be ignored in calculating statewide benefits and the ROI. In this section, we extrapolate our fifteen-county survey findings to all other counties that report using the state's orthoimagery.

The first step in our extrapolations was to determine how many of the forty-two counties not in our fifteen-county sample used the state orthoimagery program. To do that, we conducted a phone survey of all forty-two counties. Calls were initially made to the individuals to whom the state sent the orthoimages. In many cases, those individuals were the appropriate ones to ask questions about whether their counties used the state program — and how the orthoimagery was used. In some cases, other county officials were surveyed after getting referrals from the initial contact person. Of the forty-two counties surveyed, thirty-eight provided useable responses. The remaining four counties failed to respond to repeated efforts to talk to someone about their use of orthoimagery.[2]

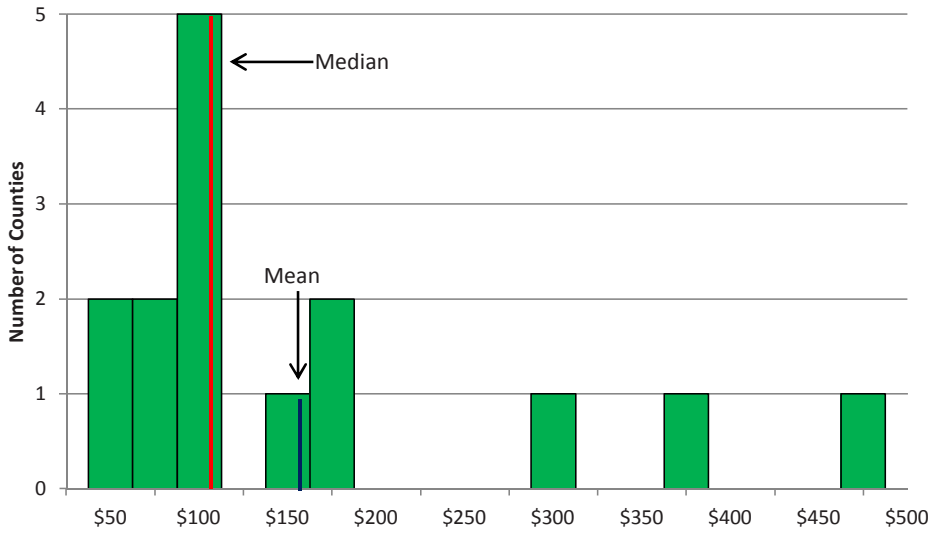
The Rockefeller Institute researchers asked 1) whether one or more of the county agencies used the orthoimagery provided by the state of New York; 2) which agencies were the most frequent users; and 3) whether there were other frequent users of the orthoimagery in the county but not in the county government (such as private firms, nonprofits, certain occupations, or other governments; and, if there are, what are they).

Of the thirty-eight counties responding to the phone survey, thirty-five reported that they used the state's orthoimagery in one or more county offices. Only three counties reported that they did not use the state's orthoimagery.[3] A listing of the responses may be found in Appendix F. Most of the counties said that the program's imagery was used by multiple offices and purposes. Typical functions involved real property assessment, taxes, soil and water conservation, environmental planning, 911 systems, transportation planning, emergency management, land use planning, law enforcement (such as crime scene analysis), economic development, and public health (such as West Nile virus coverage). Some counties indicated that nearly every department used the imagery.

Since so many counties use the state's orthoimagery program, it is clear that the surveys conducted in the fifteen counties plus New York City underestimated the statewide benefits of the program. It is not easy, however, to extrapolate from our ROI estimates in the fifteen counties to the thirty-five counties we know that use the program but in which we did not conduct interviews or distribute surveys to county officials — and thus do not have detailed, quantitative data on ROI savings. One challenge is the variation in the estimated benefits across counties. Figure 3 shows these differences. About two-thirds of the counties reported annual benefits of slightly more than $100,000 or less, while the remaining one-third ranged widely. The median benefit for these fifteen counties was $92,025, while the mean value was much higher, $146,507, as the latter was affected by the long tail of the distribution.

One approach to estimating the statewide benefits for all county governments would be to assume that the thirty-five

Figure 3. Distribution of Estimated Annual Returns on Investments by Fifteen Counties, 2010



counties that we know use orthoimagery have benefits as least as high as the average values of counties in the sample. Table 3 shows these extrapolations. The top rows of the table indicate the median and mean values of the benefits for the fifteen sample counties over the period, 2006-11. As already noted, the median values are much lower than the mean values. If we assume that the other thirty-five counties that report using orthoimagery are roughly similar in their benefits, then we can simply multiply these average values by thirty-five and estimate a statewide benefit.

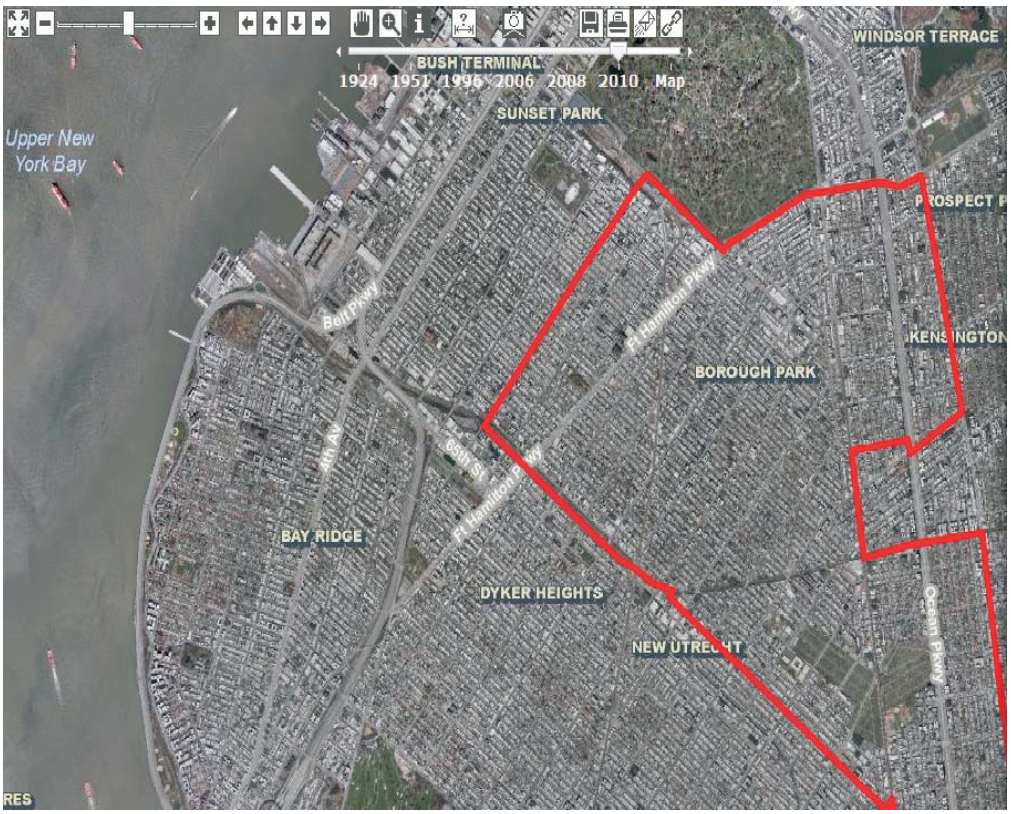
The lower rows in Table 3 show these estimates. These would be additional benefits: that is, these benefits would be *added* to those shown in Table 1. These extrapolations would substantially increase the total benefits produced by the state orthoimagery program. The last two rows, for instance, sum to $17.5 million (where the median value in the sample is used for extrapolation) and $30.0 million (where the mean value in the sample is used for extrapolation). These extrapolations would increase the total cumulative benefits shown in Table 2 from $42.5 million to $59.9 million (using the median value) and $72.5 million (using the mean value). Net public sector benefits over the period 2006-11 would then be increased from $29.1 million to $46.6 million (median values used) or $59.1 million (using the mean values). Or, roughly speaking, net public sector benefits in New York State are probably at least $50 million.

Table 3. Calculating Annual Benefits for Counties Not in the Study Sample, by Year

(Dollars in thousands)

	2006	2007	2008	2009	2010	2011
Averages (15 counties)						
Median	$72.9	$76.7	$80.1	$82.6	$92.0	$94.9
Mean	$128.9	$140.4	$138.6	$150.4	$146.5	$152.2
Extrapolations to 35 non-sample counties						
Based on median	$2,551.6	$2,683.3	$2,802.6	$2,889.8	$3,220.9	$3,329.2
Based on mean	$4,513.1	$4,915.7	$4,851.5	$5,263.1	$5,127.8	$5,325.9

Notes: Average benefits for the counties in the sample; and extrapolations to other counties (known to use orthoimagery) based on these average values.



Screenshot from http://gis.nyc.gov/doitt/nycitymap/.

Private Sector Users

The diverse contexts and sources of information among private sector users make it more reasonable to treat the different industries and occupations separately in estimating productivity benefits.

Surveyors. Staff at the New York State Association of Professional Land Surveyors estimated that land surveyors in New York increased their productivity by 5-10 percent by using the orthoimagery provided by the state and the counties. This estimate was confirmed by other calls to surveyors. The productivity savings stemmed from several applications. According to our interviews, orthoimagery is used in every map product the surveyors produce. For instance, when surveyors are hired to help on wind and gas projects, designs for new projects are laid on top of the orthoimagery to help clients and regulators see the actual areas and consider a wide range of environmental concerns during the project design stage; this application saves considerable time in the approval process.

Surveyors also use the orthoimagery in conjunction with GIS data to prepare for and focus field visits. They learn what types of features they need to be prepared to handle — such as creeks, woods, and roads (or their absence) — as well as the equipment they will need and the places where they will want to focus their work. Surveyors find that the images help their clients read and understand their map products; time is thus saved in communicating with clients and helping them see the significance of certain features. Many clients want the images, and if the state and counties did not provide the images, the surveyors would need to do requests for proposals for other companies to take aerial photos and then wait for completion of image capture.

The estimated statewide savings for surveyors are large. Based on NYS Department of Labor data, there were 1,488 licensed surveyors in 2010.[4] Their median hourly wage was $28.30.[5] If each of the licensed surveyors saw an increase in productivity of 6.25

Table 4. Estimated Annual Productivity Savings in Four Nonprofit Land Trusts			
Land Trust	**Hours saved per year**	**Average hourly rate**	**Savings**
Tug Hill	390	$23.08	$9,000
Thousand Islands	488	$19.23	$9,375
Scenic Hudson	416	$25.64	$10,667
Columbia Land Conservancy	195	$17.95	$3,500
Averages	**372**	**$21.47**	**$8,135**

percent (the average value from our interviews), total productivity savings in 2010 for surveyors would equal $4.7 million — and total cumulative savings between 2006 and 2011 would equal $28.6 million.

Land Trusts. We interviewed six nonprofit land trusts, and four of them were able and willing to estimate productivity savings. The trusts used the orthoimagery heavily in assessing new properties or other functions involving land acquisition. The images let them understand "what's there," how the property has changed in recent years, how the property may be navigated during field visits, what features (e.g., wetlands) should be given special attention during the site reviews, and what equipment will be required to conduct the field research. The images are also useful in assessing biodiversity — including the possibility of rare habitat — and in creating detailed maps of ecological habitats. The trusts were less likely to use the images for monitoring their properties. Estimates of annual productivity savings for each of these land trusts are described in Table 4.[6] If these average savings per trust ($8,135) are extrapolated to the twelve accredited land trusts in New York State, total annual savings would equal $97,625 in 2012. Cumulative savings between 2006 and 2011 equal $545,224.

Real Estate Industry. We found that five of the eighteen Broome County private sector respondents were in real estate. They reported using the orthoimagery in several ways. Productivity savings include confirming owners' statements; reviewing legal descriptions of the property; money saved traveling to new properties, especially in distant municipalities; getting descriptive information for potential buyers; matching tax parcel ID numbers with deed descriptions; and others. Private sector respondents from Broome County suggested that the commercial real estate firms were more likely to use the orthoimagery than those who dealt primarily with residential properties, though we found some residential real estate agents who used the images. The real estate professionals we spoke to were generally unable to provide us with quantitative estimates of savings.

Engineers. Although state engineering associations were unable to provide estimated savings from orthoimagery, a number of private engineering firms in New York offered us qualitative information about applications. Most firms identified a variety of benefits of having the state-supplied images. One estimated savings of $10,000-20,000 savings per year, though the savings varied according to the particular projects. The respondent indicated that, on a large-scale project, savings were about one day over a

two week project. The savings came from using the images for planning of field activities as well as in the initial proposal work.

These largely qualitative accounts of savings are described below in the section on strategic benefits. But it should be noted that engineers and engineering firms often reported reliance on the state's orthoimagery. In fact, eight of the eighteen Broome County private sector respondents were engineers. They reported using the images to develop plans for projects; create aerial maps of properties being developed; provide maps and engineering reports to clients, such as municipalities that are applying for state and federal project grants; determine boundaries; trace topographic changes over time; and generally "see" what is in the field.

Benefits to Private Sector Users in a County. As we noted above, Broome County surveyed many of its users,[7] including those in the private sector, and we were thus able to get a rough estimate of benefits to private sector entities in this comparatively small county in the Southern Tier of New York State. (Broome County has a population a bit less than 200,000, which places it in the bottom quartile of counties by population.) Nonetheless, when we summarized the reported benefits to private sector firms and agencies, they were substantial. Table 5 indicates that annual benefits were between $85,000-88,000 from 2006 to 2009, and the total cumulative benefits for the private sector users in Broome County were around $499,000 as of 2011.

Summary of Private Sector. We found that the Program's orthoimagery benefited a wide variety of private sector users, including surveyors, nonprofit land trusts, commercial real estate firms, and engineers. However, though it was feasible to make

Table 5. Financial Summary of Private Sector Users From Broome County

Historical Cash Flows	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Internal Labor Costs	$0	$0	$0	$0	$0	$0
Contract/Procurement Costs	$0	$0	$0	$0	$0	$0
Productivity Benefits	$26,234	$26,812	$27,401	$28,004	$28,620	$29,250
Other Benefits	$59,000	$59,000	$59,000	$59,000	$59,000	$59,000
Total Benefits	**$85,234**	**$85,812**	**$86,401**	**$87,004**	**$87,620**	**$88,250**
GDP	*103.24*	*106.23*	*108.57*	*109.53*	*111*	*113.37*
2011 Values						
Internal Labor Costs	$0	$0	$0	$0	$0	$0
Contract/Procurement Costs	$0	$0	$0	$0	$0	$0
Total Annual Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
Cumulative Costs	*$0*	*$0*	*$0*	*$0*	*$0*	*$0*
Productivity Benefits	$23,890	$25,123	$26,240	$27,056	$28,023	$29,250
Other Benefits	$53,727	$55,285	$56,500	$57,003	$57,768	$59,000
Total Annual Benefits	*$77,617*	*$80,409*	*$82,740*	*$84,060*	*$85,791*	*$88,250*
Cumulative Benefits	*$77,617*	*$158,026*	*$240,766*	*$324,825*	*$410,616*	*$498,866*
Cumulative Net Benefits	**$77,617**	**$158,026**	**$240,766**	**$324,825**	**$410,616**	**$498,866**

rough estimates of benefits from orthoimagery for surveyors and land trusts, statewide estimates of real estate firms and engineers were not calculable. Some of the difficulties may stem from the challenge in getting private sector firms to share information about their costs, salaries, and other data essential to estimates, though another obstacle is the great variety of projects and contexts that engineers are involved in. A credible estimate for the private sector as a whole would require a costly statewide survey of many hundreds of firms in selected industries, a task that is beyond the scope of this study. Nonetheless, it is clear from the information we did collect that many firms and individuals in the private sector used orthoimagery extensively, and that these uses often generated sizeable savings.

Strategic Benefits Overview

Public Sector Users

As described above, much effort was needed to translate the benefits of using the Program's orthoimagery into quantitative, financial values. Many benefits were clearly stated, but were qualitative or strategic in nature. These strategic benefits, some of which are described individually above, capture valuable information even if they cannot be included in the numerical ROI calculations. OCS believes these strategic benefits are crucial to fully understanding the Program's value. This section summarizes the most common strategic benefits.

Nearly all end-users participating in the ROI study stated something similar to "orthoimagery is critical to doing our job." While many respondents use imagery from other sources in addition to Program imagery, most stated they relied on the Program's imagery because of its stated horizontal accuracy, leaf-off conditions, and vintage.[8] As orthoimagery has become essential to many workflows, the ability to redistribute the imagery or products made from the imagery has also been critical. Since the Program is designed to allow this, the Program's imagery is seen as having that advantage over other imagery. A survey and discussion with the NYS GIS Coordinating Body showed that while members saw value in other imagery such as USDA NAIP, commercially available imagery, and oblique imagery, the members overwhelmingly stated that the Program should continue because imagery with the specifications and distribution model of the Program's was needed.

The users of the Program indicated that the orthoimagery assists them enormously in terms of information retrieval, information verification, time savings, and costs savings due to the elimination of the site visits. While benefits of an orthoimagery program are not always quantifiable, they are critical for efficient and effective mapping, analysis, planning, and decision support.

The Program is intended to share and sustain benefits statewide. Strategic benefits realized from the use of the Program are

diverse and vary from one user community to another. In general, orthoimagery is widely used in the following domains: homeland security, economic development, health services, transportation, agriculture, surveying and mapping, hazards and wildfire response, energy development, and land use. Most commonly cited strategic benefits in general can be grouped into the following major categories:

- Homeland Security and Emergency Services
- Economic Development
- Value of Multi-temporal Coverage
- Orthoimagery Creating a Common View

Homeland Security and Emergency Services

The provision of up-to-date imagery is critical for Homeland Security and Emergency Services. Orthoimagery is used to protect people and properties, either as part of planning or in response to events. Orthoimages are widely used in 911 centers, fire departments, and police departments. For example, one user from Broome County indicated that orthos help "to line up 911 addresses with buildings on properties so that dispatchers can give exact locations to rescue crews." Another respondent, also from Broome County, said, "The fire department uses it [orthoimagery] for emergency planning during natural disasters, seeing building relations during multiple alarm fires, checking property/boundary lines as well as hydrant locations. Layers of the maps have also been ported to the mapping software in use on our mobile computers in all fire apparatus." In Suffolk County, the mapping technician in the Department of Fire Rescue and Emergency Services stated, "I am responsible for the maintenance of 911 map data. It is not possible to incorporate a new street, address point or apartment without putting the aerial imagery as a base layer."

"I am responsible for the maintenance of 911 map data. It is not possible to incorporate a new street, address point or apartment without putting the aerial imagery as a base layer."

Suffolk County Department of Fire Rescue and Emergency Services Mapping Technician

Another user explained,

> *The orthoimages are used quite frequently on a daily basis in our 911 center. These images serve as a base layer in our computer-aided dispatching software (CAD) GIS Map Layers. Using these photos, the dispatchers have the ability to use landmarks to verify an emergency callers' location. In addition, on a couple of occasions we have had the ability to use these images (while plotting a hiker's latitude/longitude cell phone coordinates while lost on the Appalachian Trail) to guide the caller towards emergency responders (who were also being plotted). Having the ability to "see" how far off the trail they were was invaluable. We were even able to ask the lost hikers if they could see the "row of tall pine trees" (which they could, and eventually led to their rescue).*

Another county emergency response person related the situation where a fire fighting unit was cut off from their access route by fire.

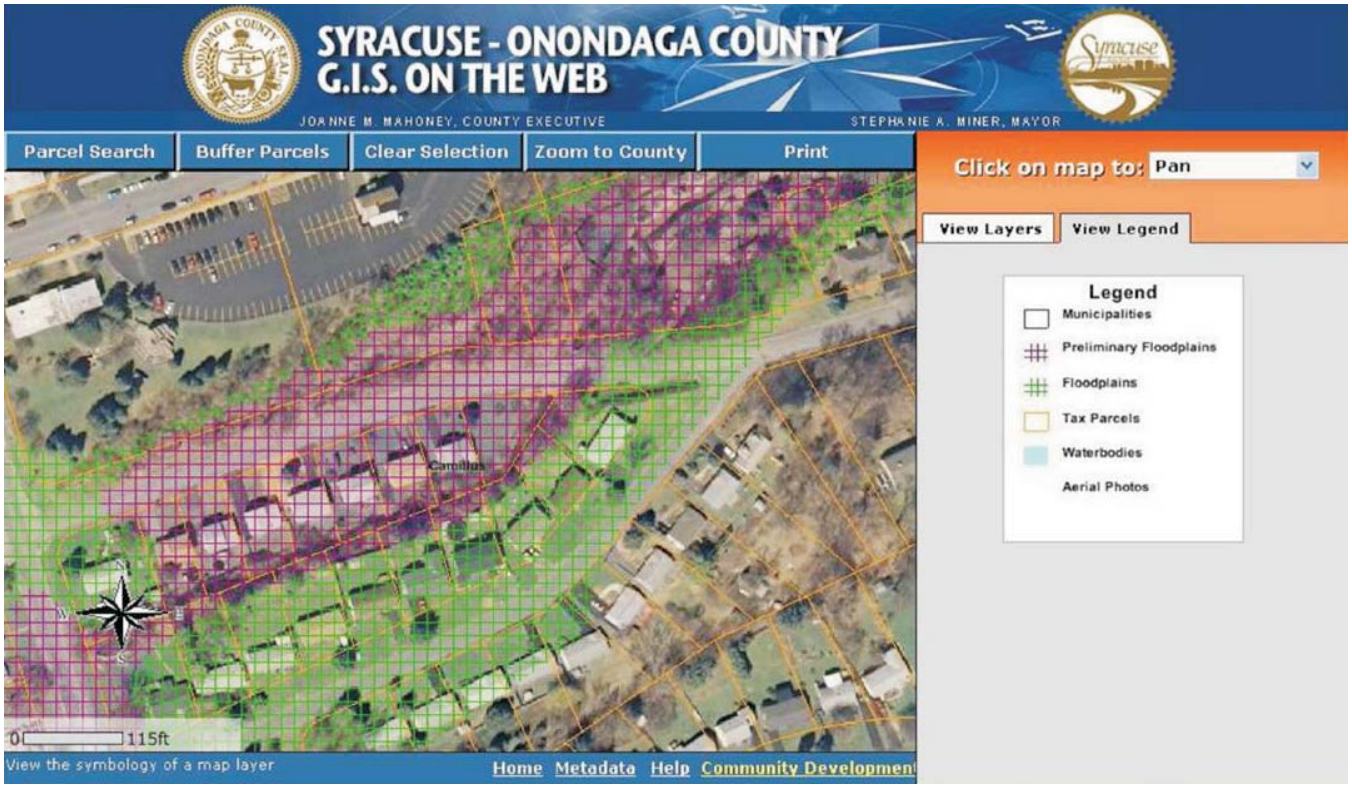


Image supplied by Onondaga County.

The unit had to rely on the Computer Aided Dispatch system with orthoimagery and radio contact with the dispatcher to be directed to an evacuation site where they were rescued by helicopter.

Within the NYS Division of Homeland Security and Emergency Services (of which OCS is a part), the orthoimagery is widely used. OCS uses the imagery in developing and improving GIS datasets for critical infrastructure. The Division's Office of Emergency Management uses the orthoimagery as a base for many of their status maps during emergency response. Information received during an emergency is not always clearly stated, and the imagery often helps to resolve issues of location. Maps with an orthoimagery base provide planning staff and responders with a common understanding of situations.

Economic Development

Orthoimagery plays an essential role for economic development throughout the State. For example, orthoimagery is often used to advertise development sites, which in return attracts new businesses to move to the state and results in new jobs. Orthoimagery assists companies wanting to relocate to New York with site selection. Local governments use orthoimagery to locate and guide new development through effective building and zoning ordinances. Utility companies utilize orthoimagery for building and extending service networks.

Orthoimagery helps agencies to focus on business applications of real property data to support economic development. For example, a planner in Dutchess County stated:

> *Our GIS Executive Committee thinks the role of government is to assist the private sector without doing their job for them. To this end, all our data purchases and participation in the NYS Orthophoto Program "greases the wheels" of the private sector.… We opted for one-foot and six-inch imagery for its content and accuracy, easing initial private real estate project development costs. Most private development proposals coming to our office for approval include the orthophotography as a base for the engineering. And we continually get requests from engineers for data created from the orthophotography.*

Another respondent, from Warren County, notes, "I use NYS orthoimagery with my GIS software to approximate property lines, observe developments on property, and assist property owners [when they] plan developments." Also, according to Chemung County Planning staff, CVS Pharmacy built a new, 750,000 square foot distribution warehouse near Elmira, opening in 2011, influenced in part by the quality of the orthoimagery used in the site selection process. The warehouse will eventually provide 600 local jobs.

Value of Multitemporal Coverage

Orthoimagery is a very useful tool since it provides multitemporal coverage of the same geographic area. The continued availability of older orthos helps local governments and state agencies with projects and assists them with keeping more imagery online.

For example, a respondent from NYS Department of Transportation indicated that orthoimagery is critical for hydraulic engineering for bridges and highways:

> *We use it all the time for comparison of old vs. new orthoimagery to determine stream lateral migration behavior, and time rate of migration.… With adjustment in layers, different time period orthoimagery can be directly superimposed to assess stream migration patterns over time, and whether they pose a threat to NYSDOT bridges or highway embankments.*

Other users of multitemporal orthos said that they reveal development pressure over time. Multitemporal imagery is useful in environmental applications such as tracking the expansion of landfills and tire dumps and the illegal filling of protected wetlands. The Attorney General's Office and the Department of Environmental Conservation use the imagery to protect the environment and to prosecute violators of environmental regulations.

Orthoimages also provide local governments with a new source of information to help improve property tax administration and related services. For example, a respondent from Putnam

County indicated that the use of orthoimages help "to review changes to structures over time and relationship to others for real property valuation and property taxation." Orthoimagery assists in accurate valuation of properties, leading to more equitable tax rolls for localities

Environmental site assessment is required for commercial real estate transactions. These reports include a historical review of past uses of the property. Multitemporal orthoimagery in conjunction with parcel, environmental, and infrastructure data layers make this process much more efficient for public and private users.

Orthoimagery Creating a Common View

Orthoimagery is fundamental to understanding the location of features surrounding all types of GIS data. People in the same room or across a county or in opposite ends of the state may view the same data with an ortho backdrop and have a common understanding. More than one respondent to our survey have used the phrase "one picture is worth a thousand words"

One NYS Thruway survey responder stated:

> *As a manager of field staff located across the state, any information I could use to understand the field issues was important. However, none was more important than the orthoimagery. Where the true benefit to me is in the ability to understand the area quickly when having a phone conversation with field staff. The ability to bring up photo imagery in a matter of moments while being briefed about an issue is invaluable. I honestly don't know how I would have been able to be as effective managing from afar without the orthoimagery.*

"The orthoimagery [is] the most effective way to communicate to community groups, developers and other stakeholders about the existing neighborhood conditions and proposals under consideration."

New York City Planner

Public meetings are a part of project planning, and invariably require maps with orthoimagery. As one New York City planner said, "The orthoimagery [is] the most effective way to communicate to community groups, developers and other stakeholders about the existing neighborhood conditions and proposals under consideration." Public meetings on proposed highway construction often depend on orthoimagery. A DOT employee said, "Orthoimages are also commonly used at public meetings and are often overlaid with base mapping, detour layers, or project plans. Orthoimages help the public to more quickly orient themselves to a project, to better understand the proposed work, and to quickly see how it will impact them."

Private Sector Users

We interviewed a number of private engineering firms operating in the state. While only a couple of firms were able to assign dollar estimates, most firms could identify a variety of benefits of having the state images available. One firm gave a rough estimate of annual savings of $10,000 on man hours or the cost of purchasing the imagery themselves. Another firm also indicated that the imagery saves thousands of dollars a year, given the costs associated with site visits

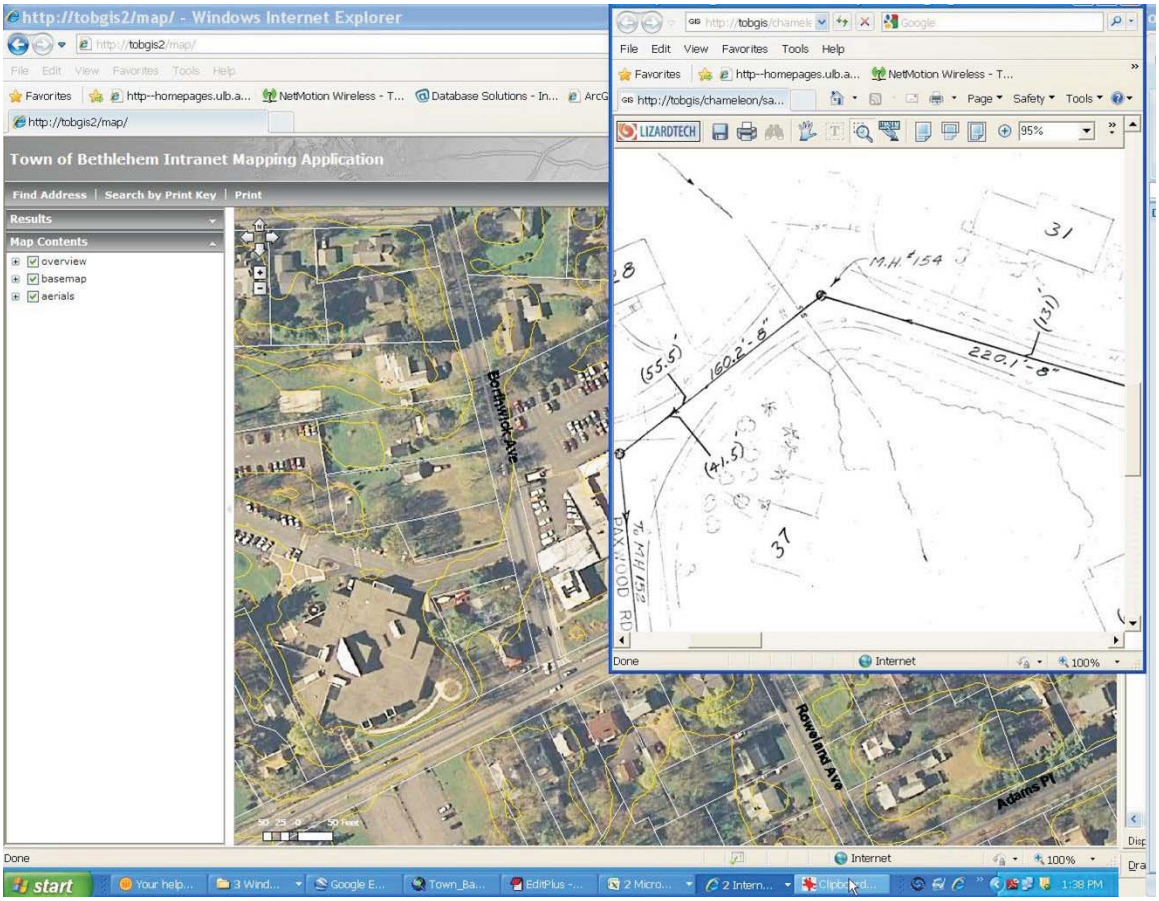


Image supplied by the Town of Bethlehem, NY.

or the cost of purchasing the images themselves. Nearly all the respondents indicated that the images have become an industry norm. A third firm, for example, claimed that the images were critical in the preliminary study phase and saved on site visits. Since site studies typically cost about $50,000, having the images for the preliminary phase is critical to securing funding for them. In general, every firm we interviewed claimed to use the imagery as a base for mapping, for reporting purposes, and to limit site visits or identify the need for one. Additionally, while every firm struggled to assign an exact value to the imagery, every firm agreed that the images were being used regularly in day-to-day operations and not having access to them would be a huge step backwards.

Although private sector users of orthoimagery often found it challenging to quantify its value for their work, they frequently noted large strategic benefits, i.e., benefits in terms of what services the firm or individual can provide, or in the quality of those services. One widespread benefit was in the much higher quality of the maps produced and used by private firms and professionals — quality that makes their products more marketable and effective. A surveyor noted that, "When it comes time to produce a drawing or map of information, lots of people can't read a map or understand the data, but with a photograph, once they recognize the roads and creek they can better understand how it impacts them.… [The images are] outstanding for presentations — a picture is worth a thousand words."

A land trust also found the quality of the images to be critical in their work. As one staff member said, "We use [the orthoimagery] for our Habitat Mapping Program, where we create detailed maps of ecological habitats and large areas throughout the Hudson Valley.… [We] find the ortho provides a much higher resolution and we would not be able to afford this type of high resolution otherwise for these projects." She went on to say, "We could not do the work we are doing without it," and we "don't know how to put a value on everything it does." Other land trusts that were able to report data on productivity gains said that, in addition, the imagery is "integral" to their work and improves its "quality." Land trusts also echo the point made by the surveyors: the images are particularly effective in presentations, such as the many presentations the trusts must make to government officials and landowners.

"When it comes time to produce a drawing or map of information, lots of people can't read a map or understand the data, but with a photograph, once they recognize the roads and creek they can better understand how it impacts them.… [The images are] outstanding for presentations — a picture is worth a thousand words."

A Surveyor

Another common strategic benefit is the availability of multitemporal orthoimagery coverage, similar to that cited by the public sector. Several users noted that they could hire others to fly over a particular area and take good photographs. It would be much more expensive, but engineers working on project plans and proposals could do that and pass along the extra costs to their clients. What they cannot do, however, is easily replace the capacity to compare images over time and track historical changes in the use of properties, note evidence of prior flooding or shifts in the course of waterways, or see changes in plant life or other biological shifts.

The strategic benefits are particularly great for individuals using the images for their own, private applications. Although firms may be able to find alternative sources of high quality images for their projects, the individuals who reported using the images in Broome County said they could not find adequate alternatives. As one person noted, she knew of "no other affordable way in which she could overlay parcels with clear, high-quality images." Other property owners or prospective owners found the images to increase their "productivity" in some sense, though it was not possible to estimate a real savings, since their time was their own. For instance, people in the market for new houses or properties said the images saved them considerable time and money by reducing their reliance on realtors, town engineers, or town clerks.

Outcome of the Study

We think the "loud and clear" message received from the study is that the Program should continue. This is in line with the repeated statements that users could not do their jobs without the orthoimagery, and it is supported by the calculated return on investment and significant strategic benefits detailed above. However, it is worth reviewing some of the shortcomings of the study before turning to plans for the future in the next section.

The greatest challenge in the study was to get users of the Program to estimate their quantitative savings, based on their

thoughts of how their work would change (and especially what productivity losses they would experience) if the Program did not exist. In part, the challenge was a result of the Program's long-time success. The Program has been in place for a decade, and many individuals in state and local government agencies, nonprofit institutions, and private firms and vocations have incorporated the NY Statewide Digital Orthoimagery Program into their routines and the basic services they provide to their citizens and clients. Their understanding of how they use the orthoimagery was detailed and concrete, while their constructions of how they would do their work in the absence of the Program was often vague.

Another challenge for the study was getting comparable "response rates" across agencies and counties. Some counties, for instance, were simply more responsive to the surveys we asked them to complete, and those differences make it harder to compare counties and their actual ROIs. Thus, Schenectady County's very high ROI compared to other, larger counties may reflect its greater actual usage of the Program plus its agencies' greater responsiveness to our survey — and it is difficult to determine with any precision the contribution of those two different factors. Another possible bias is the selection of counties to be in the study. In the planning stages, it was assumed that better, more knowledgeable responses would come from the counties who had paid for upgrades to the imagery. Out of the fifteen counties in the study, ten of them had paid for upgrades in the years from 2006 to 2011. Not all of the counties that paid for upgrades reported greater return than comparable, nonupgrading counties. In hindsight, a better geographic distribution of counties would have normalized the sample, since the high concentration of downstate, "richer" counties may have skewed the results. It would have also been useful to have a more balanced sampling with fewer upgraders and more counties that had not paid for upgrades. This being said, it must still be emphasized that all of the counties in the sample were under-reported as far getting data from all users of orthoimagery.

A third challenge was the private sector. There is little doubt that many private firms and organizations use the Program's data, but we admit that we only scratched the surface of these applications. Although we did find a couple of instances where the usages appeared to be widespread enough to be generalizable to the occupation or industry (such as surveyors and nonprofit land trusts), it is also true that some private sector industries are so varied in their work and uses of orthoimagery — as in the case of engineers — it would require a very large survey to gauge the true return on investment.

Overcoming these challenges would be a difficult task. One approach might be to take advantage of the few counties, such as Broome, where the survey responses were widespread and distributed across the public and private sectors. If these few

counties can be measured well and in a comparable manner, then perhaps the extrapolations would be firmer for all sectors. We might also ask counties to include online surveys that pop up when users access the Program's materials. Although these online surveys are also hard to put into context, they may generate a greater variety of responses, especially from the private sector.

Nonetheless, our experiences from this study would make it easier to conduct future analyses. One thing we would consider doing in future studies would be to rely more exclusively on phone interviews and put fewer resources into site visits. Although the visits were illuminating with respect to the great variety of uses, they were costly in terms of time, while the phone interviews were typically very helpful and informative and at a much lower cost.

Plans for Moving Forward

Future of the Program

Survey respondents consistently stressed the importance of leaf-off imagery for increased visibility, consistent spatial accuracy to support data development, and widespread use to establish a common reference.

The outcome of the study presents OCS with both confirmation of the value of many of the characteristics of the Program, and indications of where the Program can and should be improved. Beyond confirming the Program's value and the need to continue, the study highlighted the importance of producing regular updates to high quality imagery with known specifications and which is made widely available. Survey respondents consistently stressed the importance of leaf-off imagery for increased visibility, consistent spatial accuracy to support data development, and widespread use to establish a common reference. OCS plans to carry these qualities of the Program forward, while keeping all versions of the orthoimagery available to support the many applications of multitemporal imagery. Even with limited feedback from the private sector, OCS acknowledges that nearly all of that usage is made possible by availability of the imagery through Web applications and Web services. OCS plans to continue to support and expand these means of imagery access.

Opportunities for improvement were highlighted in the study. Among the most significant are the following.

- **Increased Access.** This improvement opportunity is especially evident for city and town agencies. OCS typically deals with counties when planning and distributing orthoimagery updates. OCS can increase outreach to cities and towns to increase their awareness of the Program and available products. Web services offer efficient means to make the imagery more widely accessible to all sectors.
- **More Frequent Updates.** Many respondents expressed a desire to have the imagery updated more frequently. It is likely this is most consistently the case in areas that are neither part of extensive urban/suburban areas (typically updated every three years) nor part of extensive forest

areas (updated every four-five years). These areas have considerable development pressures, but often are not updated more often than every four to five years. OCS will explore the possibility of increasing the update cycle to every three years for more of the state, but costs, budget, and capacity will set limits on what is possible.

- **Increased Resolution**. Users of the Program provided many examples of increased benefits due to being able to see more features on higher resolution imagery. Upgrades to the imagery are typically done to replace two-foot resolution imagery in rural areas with one-foot resolution, and to replace one-foot resolution imagery in urban areas with half-foot imagery. For many applications, the one-foot and half-foot imagery gets users close to the functionality of field visits. Several users reported utilizing older, higher resolution imagery instead of newer but lower resolution imagery. OCS will explore ways to increase the resolution of the imagery for more areas, but, as with the increased update cycle, costs, budget, and capacity will set limits on what is possible.

Spreading ROI Analysis

OCS is committed to helping interested government agencies complete ROI studies on their own. This will consist of follow-up on data already gathered as well as informational sessions. For many of the participants in the orthoimagery ROI study, most of the data are compiled if they wish to calculate ROI on their investment in orthoimagery. This also points the way toward potential comprehensive ROI studies for investments in geospatial technologies.

In addition to several presentations to discuss the results of this ROI study, OCS will offer presentations on the ROI process. Regional GIS user meetings are likely forums for presenting to county and local agencies, while several workgroups of the NYS GIS Coordinating Body offer avenues to reach New York State agencies. OCS will provide the framework for performing ROI studies, using lessons learned during the current study. Presentation materials and links to relevant resources will be provided on the Clearinghouse Web site.

Conclusions

The study reported here found that many public and private users felt that it would be difficult to carry out their functions without the Program, and if they did, their costs would be much higher and the quality of their services or products would be lower. Based on preliminary and admittedly incomplete benefit data for this six year period on public sector users alone, we estimated that the Program broke even in 2006. In a sample of fifteen counties, benefits totaled $24.7 million during this period. In five state agencies, benefits equaled $17.8 million. During this same

period, OSC spent around $13.4 million, for a net cumulative benefit of $29.1 million by the end of 2011.

In addition to these net benefits, we found that a more complete survey of public sector users would substantially increase the net benefits, even using very conservative assumptions in extrapolating to other counties where we know that orthoimagery is used. These extrapolations indicate that net public sector benefits over the period 2006-11 are increased from $29.7 to between $47-60 million, depending on assumptions used for the extrapolation.

Also, we found many narratives of productivity and strategic savings among private sector users. Surveyors in New York were estimated to have saved about $28.6 million, while nonprofit land trusts saved at least $0.5 million. We also found evidence that a wide variety of engineers use the orthoimagery in many aspects of their work, though the gains are not always in greater productivity. For example, one respondent from a privately owned business specializing in the implementation of GIS and other geospatial technology insisted that the orthoimagery does not save them time. Instead, the "real value added is for the end user or consumer. Having the aerial photography images has become an industry norm and not having them would be a hindrance." In sum, it is clear that even a study that is limited in its coverage of all Program users — and limited in its capacity to translate all reported benefits into quantitative terms — shows that the NYS Digital Orthoimagery Program provides net benefits to the State of New York.

Endnotes

1 On accredited land trusts, see http://www.landtrustalliance.org/land-trusts/accredited-land-trusts.

2 The four nonresponding counties were Chenango, Clinton, Essex, and Orleans. All four are relatively small counties in population.

3 These three counties were Franklin, Ontario, and Steuben. All three used other sources instead, including Google Maps and Pictometry.

4 See http://www.labor.ny.gov/stats/olcny/land-surveyor.shtm.

5 For information on wages for surveyors, see http://www.careerinfonet.org/occ_rep.asp?optstatus=011000000&soccode=171022&id=1&nodeid=2&stfips=36&search=Go.

6 One land trust, Hudsonia, estimated annual productivity savings of $50,000 per year. Its much greater savings compared to the other land trusts, plus the fact that the trust could not break down the savings in terms of staff hours, salaries, etc., led us to leave this estimate out in our extrapolations.

7 The survey had been placed on the county's public Web site for a week or so rather than distributed "in-house" for only government responses; a fortunate accident, resulting in many good responses from the private sector.

8 For example, a respondent from the Department of Transportation indicated that they use New York State imagery every day for a wide range of uses. The main benefit of New York State imagery is that the images can be used in their own GIS or CADD software along with other data layers for advanced operations such as spatial analysis, route analysis, or 3D modeling. Another benefit is that with the New York State imagery the horizontal accuracy is known and checked through a rigorous Quality Assurance/Quality Control (QA/QC) review process. Therefore, the portrayal of transportation features such as bridges and elevated roadways are usually better in the New York State imagery. The New York State imagery is also usually better in regards to tree cover as well (leaf-on vs. leaf-off conditions). The four-band imagery in the New York State program allows the user to choose natural color or color infrared, which may be important for some environmental applications. This is not the case with Google or Bing maps.

Appendix A: Study Sample

List of agencies and other organizations surveyed

Counties	NYS State Agencies	Other Agencies
Albany	DHSES – OEM	NYC – Various city agencies
Broome	Adirondack Park Agency	NYC Department of Environmental Protection, Upstate
Dutchess	Department of Environmental Conservation	Real Estate Associations
Chemung	Department of Transportation	Engineering Associations
Erie	Division of Military & Naval Affairs	Surveyors
Jefferson	Office of Attorney General	Land Trusts
Oneida	Office of General Services	
Onondaga	State Police	
Putnam	Power Authority	
Rockland	Thruway Authority	
Schenectady		
St. Lawrence		
Suffolk		
Warren		
Westchester		

County survey sample and survey response rate

(Response rates are number of towns/cities/etc. that responded, divided by total number of towns/cities/etc. in county.)

Counties	# towns	# cities	# villages	Towns responded	Cities responded	Villages responded	Total responses*	% responses with values†	% towns response†	% cities response†	% village response†
Albany	10	3	6	1	1	1	22	45.5%	10.0%	33.3%	16.7%
Broome	16	1	7	6	1		24	66.7%	37.5%	100.0%	0.0%
Dutchess	11	1	5		1		9	77.8%	0.0%	100.0%	0.0%
Chemung	20	2	8				7	85.7%	0.0%	0.0%	0.0%
Erie	25	3	15				2	100.0%	0.0%	0.0%	0.0%
Jefferson	22	1	20		1		19	52.6%	0.0%	100.0%	0.0%
Oneida	26	3	19				1	100.0%	0.0%	0.0%	0.0%
Onondaga	19	1	15		1		6	83.3%	0.0%	100.0%	0.0%
Putnam	6		3	3			6	50.0%	50.0%		0.0%
Rockland	5		19	1			2	50.0%	20.0%		0.0%
Schenectady	5	1	2	2			4	100.0%	40.0%	0.0%	0.0%
St. Lawrence	32	1	13				5	100.0%	0.0%	0.0%	0.0%
Suffolk	10		32				19	47.7%	0.0%		0.0%
Warren	11	1	1	3			6	83.3%	27.3%	0.0%	0.0%
Westchester	19	6	23			2	12	50.0%	0.0%	0.0%	8.7%
Total	**237**	**24**	**188**	**16**	**5**	**3**	**144**				

Notes: * Sum of responses. † Response rates are calculated as the number of towns (or cities/etc.) that responded, divided by the total number of towns (or cities, etc.) in each county.

Appendix B: ROI Survey Administration

Data collection procedures for public agencies

	Initial contact	Meeting	Survey	Follow-up	Procedure notes
COUNTIES					
Albany	phone / email			phone / email	County contact sent her own survey to known users and compiled responses, additional phone calls made to towns not covered in county survey
Broome	phone / email	yes	yes	phone / email	Survey was attached to County website briefly by county GIS contact, phone calls made to respondents
Chemung	phone / email	yes	yes	phone / email	Initial meeting, additional calls to more, sent survey
Dutchess	phone / email	yes	yes	phone / email	After meeting and explaining survey, survey sent to central contact, some responses were received by internal emails and not through survey
Erie	phone / email	yes		phone / email	Additional phone calls made, one good response from initial meeting
Jefferson	phone / email	yes	yes	phone / email	Survey, meeting, follow up phone calls both to survey responders and additional city personnel, sent survey to additional city staff
Oneida	phone / email			phone / email	One central contact reported usage throughout county
Onondaga	phone / email	yes	yes	phone / email	Meeting, follow-up phone calls, finally sent survey for more information, then more phone calls to city contact
Putnam	phone / email		yes	phone / email	Survey sent to county contact, who distributed by email, calls made to survey
Rockland	phone / email		yes	phone / email	One central contact reported usage throughout county
Schenectady	phone / email	yes		phone / email	Multiple discussions with 1 contact who organized meeting and responses
St. Lawrence	phone / email	yes	yes	phone / email	Survey, meeting, follow up phone calls both to survey responders and additional
Suffolk	phone / email		yes	phone / email	Emailed survey to county GIS contact, follow-up calls to respondents
Warren	phone / email		yes	phone / email	Emailed survey to county GIS contact, follow-up calls to respondents
Westchester	phone / email		yes	phone / email	Was original test case for survey, sent to GIS user group by county GIS contact, many additional phone calls had to be made, additional county contacts suggested

STATE AGENCIES					
DHSES – OEM	email / personal	yes			Multiple visits to individual contact in 5 divisions, strategic benefits only
Dep. of Environmental Conservation	phone / email	yes	yes	phone / email	Document sent to contact, meeting held, a list of contacts made, multiple phone calls and e-mails for follow-up, survey sent to a few people to distribute within their division.(DEC is a multiple division Agency)
Department of Transportation	phone / email	yes	yes	phone / email	Survey sent to contact, distributed to multiple users (over 40), multiple phone follow-up calls
Office of Attorney General	phone / email	yes		phone / email	Phone calls and emails to a single contact, multiple discussions and clarifications
Office of General Services	phone / email		yes	phone / email	Initial phone discussions, survey sent, more telephone follow-up
Division of Military & Naval Affairs	phone / email		yes	phone / email	Phone calls made, survey sent to contact, forwarded to one additional user, follow-up calls and emails
Thruway Authority	phone / email		yes	phone / email	Survey sent to contact, distributed to multiple users (over 40), multiple phone follow-up calls
Police	phone / email			phone / email	One contact, one user in GIS, gave one example with savings
Power Authority	phone / email			phone / email	One contact, giving benefit of Program to agency
Adirondack Park Agency	phone / email		yes	phone / email	Survey sent to contact, phone and email follow-up
OTHER					
NYC	phone / email		yes	phone / email	Survey sent to contact, distributed by email to users in multiple agencies, phone calls made to respondents
NYC - DEP	phone / email			phone / email	One contact, GIS manager for agency, multiple calls and emails

NEW YORK STATE
DIVISION OF HOMELAND SECURITY AND EMERGENCY SERVICES

OFFICE OF CYBER SECURITY

Andrew M Cuomo, Governor **Thomas D. Smith, Director**

New York Statewide Orthoimagery Program ROI Survey
(for guidance on questions, please see 2nd page)

Name:		**Phone:**	
Organization:		**Email:**	
Address:		**Position:**	

Organization Type (please check one)

- ○ Municipal / County Government
- ○ Business / Engineering
- ○ Business / Real Estate
- ○ Education
- ○ Not for Profit
- ○ State Government
- ○ Other

Select each way you have used New York State Imagery:

- ☐ Downloaded files from website
- ☐ Used files as a layer in GIS Software
- ☐ Used WMS or services as layer in GIS
- ☐ Just viewed online application
  http://www.orthos.dhses.ny.gov

Please describe how you use the NYS orthoimagery and the benefits of the uses (see page 2):

If possible, can you provide specific cost or time savings as a result of using NYS orthoimagery?

Would you be able to do your job without NYS orthoimagery, and if so, how would you do it?

What other source(s) of imagery do you use?

- ☐ Google Earth
- ☐ Google Maps
- ☐ BingMaps
- ☐ Pictometry
- ☐ Satellite
- ☐ Other

Clicking this button will send an .xml file with your responses to:

Ray Faught
NYS DHSES, Office of Cyber Security
rfaught@dhses.ny.gov
ph. 518 242-5200

NEW YORK STATE
DIVISION OF HOMELAND SECURITY AND EMERGENCY SERVICES

OFFICE OF CYBER SECURITY
Orthoimagery ROI Survey

Andrew M Cuomo, Governor **Thomas D. Smith, Director**

Purpose of this survey

The New York Statewide Digital Orthoimagery Program (NYSDOP) has been in existence for over 10 years. With each succeeding year there has been pressure to trim budgets in all State agencies. Ours is no exception.

We have long held the belief that the orthoimagery program is an invaluable resource to both government and private users in the state, but haven't acquired quantitative verification. We applied for and received a grant from the National Spatial Data Infrastructure Cooperative Agreements Program to do a Return on Investment (ROI) study of the program and we need your help in gathering information for this project. Before completing the survey, please review the following examples for some ideas on how to respond.

Thank You

Ray Faught
NYS DHSES OCS

BENEFITS

Example/Sample Productivity benefits from NYSDOP consumers

Reduced need to collect data in field – heads-up digitizing of features
Enhanced query capabilities "what's on the ground"
Reduced cost of project planning
Increased productivity for Data Improvement
Cost savings in projects (no need to acquire imagery)
Improved planning for fieldwork if necessary

Other benefits

Improved mapping with orthoimagery base
Improved assessment updates
Analysis of change over time (historical imagery available)
Fee and Fine collection
Use of orthos in internal and external internet sites (parcel viewers, multi-layer data sites)

WHAT TO COLLECT FOR STUDY

Uses of Imagery – tasks, work flows, products
Associated costs if imagery was not available (acquisition of imagery or alternative workflow)
Actual Savings (salaries X hours saved), values of products with/without imagery)
Anecdotal benefits, try to assign dollar amounts.

Appendix C: Summary of Financial Analysis Worksheets

Survey Respondent State Agencies and Counties			
#	**Agency/County Name**	**Workbook Name**	**NPV**
1	***NYS Office of Cyber Security***	***Past6_OCS.xlsx***	***($13,398,222)***
2	New York City	Past6_NYC.xlsx	$11,875,488
3	Attorney General	Past6_NYS AG.xlsx	$890,763
4	Adirondack Park Agency	Past6_NYS APA.xlsx	$887,954
5	Dep. of Environmental Conservation	Past6_NYS DEC.xlsx	$10,671,477
6	Division of Military & Naval Affairs	Past6_NYS DMNA.xlsx	$11,600
7	Department of Transportation	Past6_NYS DOT.xlsx	$826,867
8	Office of General Services	Past6_OGS.xlsx	$782,485
9	Power Authority	Past6_NYS PA.xlsx	$1,293,878
10	Police	Past6_NYS Police.xlsx	$53,434
11	Thruway	Past6_NYS Thruway.xlsx	$2,362,830
12	Albany County	Past6_County_Albany.xlsx	$899,418
13	Broome County	Past6_County_Broome.xlsx	$923,151
14	Chemung County	Past6_County_Chemung.xlsx	$485,407
15	Dutchess County	Past6_County_Erie.xlsx	$330,867
16	Erie County	Past6_County_Erie.xlsx	$2,076,829
17	Jefferson County	Past6_County_Jefferson.xlsx	$490,246
18	Oneida-Herkimer County	Past6_County_Oneida.xlsx	$768,236
19	Onondaga County	Past6_County_Onondaga.xlsx	$427,136
20	Putnam County	Past6_County_Putnam.xlsx	$191,307
21	Rockland County	Past6_County_Rockland.xlsx	$177,693
22	Schenectady County	Past6_County_Schenectady.xlsx	$1,614,570
23	St. Lawrence County	Past6_County_StLawrence.xlsx	$496,560
24	Suffolk County	Past6_County_Suffolk.xlsx	$2,793,782
25	Warren County	Past6_County_Warren.xlsx	$457,075
26	Westchester County	Past6_County_Westchester.xlsx	$723,619

Financial Summary For All County and Agency Respondents						
Total Cash Flow	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Costs (Future Value)	($2,356,051)	($3,439,516)	($1,656,273)	($2,946,905)	($2,178,233)	($1,463,771)
Benefits (Future Value)	$7,050,771	$7,189,689	$7,323,686	$7,525,232	$7,540,085	$7,688,495
GDP	*103.24*	*106.23*	*108.57*	*109.53*	*111*	*113.37*
2011 Values:						
Annual Project Costs	*($2,145,486)*	*($3,222,955)*	*($1,586,088)*	*($2,847,167)*	*($2,132,755)*	*($1,463,771)*
Cumulative Costs	*($2,145,486)*	*($5,368,441)*	*($6,954,530)*	*($9,801,696)*	*($11,934,451)*	*($13,398,222)*
Annual Project Benefits	*$6,420,630*	*$6,737,008*	*$7,013,346*	*$7,270,539*	*$7,382,657*	*$7,688,495*
Cumulative Benefits	*$6,420,630*	*$13,157,638*	*$20,170,984*	*$27,441,522*	*$34,824,179*	*$42,512,675*
Cumulative Net Benefits	**$4,275,144**	**$7,789,197**	**$13,216,454**	**$17,639,826**	**$22,889,729**	**$29,114,453**
Breakeven Year:	2006					
Net Present Value:	$29,114,453					
Present Value of Costs:	$13,398,222					
Return on Investment:	36.22%					

Financial Summary For OCS and All Other State Agency Respondents						
Total Cash Flow	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Costs (Future Value)	($2,356,051)	($3,439,516)	($1,656,273)	($2,946,905)	($2,178,233)	($1,463,771)
Benefits (Future Value)	$2,876,205	$2,890,867	$3,101,944	$3,140,064	$3,202,768	$3,313,100
GDP	*103.24*	*106.23*	*108.57*	*109.53*	*111*	*113.37*
2011 Values:						
Annual Project Costs	*($2,145,486)*	*($3,222,955)*	*($1,586,088)*	*($2,847,167)*	*($2,132,755)*	*($1,463,771)*
Cumulative Costs	*($2,145,486)*	*($5,368,441)*	*($6,954,530)*	*($9,801,696)*	*($11,934,451)*	*($13,398,222)*
Annual Project Benefits	*$2,619,153*	*$2,708,851*	*$2,970,499*	*$3,033,788*	*$3,135,898*	*$3,313,100*
Cumulative Benefits	*$2,619,153*	*$5,328,004*	*$8,298,503*	*$11,332,291*	*$14,468,189*	*$17,781,289*
Cumulative Net Benefits	**$473,667**	**($40,437)**	**$1,343,974**	**$1,530,595**	**$2,533,738**	**$4,383,067**
Breakeven Year:	2008					
Net Present Value:	$4,383,067					
Present Value of Costs:	$13,398,222					
Return on Investment:	5.45%					

Financial Summary For OCS and All County Respondents						
Total Cash Flow	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Costs (Future Value)	($2,356,051)	($3,439,516)	($1,656,273)	($2,946,905)	($2,178,233)	($1,463,771)
Benefits (Future Value)	$4,174,566	$4,298,822	$4,221,743	$4,385,168	$4,337,317	$4,375,395
GDP	*103.24*	*106.23*	*108.57*	*109.53*	*111*	*113.37*
2011 Values:						
Annual Project Costs	*($2,145,486)*	*($3,222,955)*	*($1,586,088)*	*($2,847,167)*	*($2,132,755)*	*($1,463,771)*
Cumulative Costs	*($2,145,486)*	*($5,368,441)*	*($6,954,530)*	*($9,801,696)*	*($11,934,451)*	*($13,398,222)*
Annual Project Benefits	*$3,801,477*	*$4,028,157*	*$4,042,847*	*$4,236,751*	*$4,246,759*	*$4,375,395*
Cumulative Benefits	*$3,801,477*	*$7,829,634*	*$11,872,480*	*$16,109,231*	*$20,355,990*	*$24,731,386*
Cumulative Net Benefits	**$1,655,991**	**$2,461,192**	**$4,917,951**	**$6,307,535**	**$8,421,539**	**$11,333,163**
Breakeven Year:	2008					
Net Present Value:	$11,333,163					
Present Value of Costs:	$13,398,222					
Return on Investment:	14.10%					

Appendix D: OCS Orthoimagery Customers

Federal	
Agencies receiving or have received Orthoimagery	**Delivery Type**
Defense Threat Reduction Agency	Project Specific Orthoimagery
Federal Aviation Administration	Project Specific Orthoimagery
Federal Emergency Management Agency	Project Specific Orthoimagery
Fort Drum	Project Specific Orthoimagery
Mapping and Charting Establishment DND (Canada)	2003 Orthoimagery
Ministère de la Sécurité publique (Canada)	2003 Orthoimagery
National Law Enforcement & Corrections Technology Center Northeast	2003 Orthoimagery of Canada Border Counties
National Oceanic and Atmospheric Administration	2006 Imagery of NYC, Area of Interest, Hudson River Area
US Army Corps of Engineers	Yearly Update
US Army Reserve	Project Specific Orthoimagery
US Census	Yearly Update
US Department of Energy	Project Specific Orthoimagery
US Department of State	New York City
US Environmental Protection Agency	Project Specific Orthoimagery
US Fish and Wildlife Service	Project Specific Orthoimagery
US Navy	Project Specific Orthoimagery
USDA	Yearly Update
USGS/NGA	Yearly Update, LIDAR
State	
Agencies receiving or have received Orthoimagery	**Delivery Type**
Adirondack Park Agency	Raw Imagery
Buffalo State College	Raw Imagery
Development Authority of the North Country	Ft Drum Area
Long Island Railroad (MTA)	New York City and Long Island Orthoimagery
Metropolitan Transportation Authority Police (State)	New York City
NYS Canal Corp	Project Specific Orthoimagery
NYS Department of Criminal Justice Services	Yearly Update
NYS DED	Yearly Update
NYS Department of Environmental Conservation	Yearly Update, TIFFs, Raw Imagery
NYS Department of Health	Yearly Update
NYS Department of Public Service	Project Specific Orthoimagery
NYS Department of State	Yearly Update
NYS Department of Transportation	Yearly Update
NYS DHSES Office of Emergency Management	Yearly Update
NYS Division of Agriculture and Markets	Yearly Update
NYS Division of Criminal Justice Services	Yearly Update
NYS Division of Military and Naval Affairs	Yearly Update
NYS DOT Photogrammetry Section	Multiple Years and Areas of Raw Imagery for Specific Projects
NYS Office of General Services	Yearly Update
NYS Office of the Attorney General	Yearly Update
NYS Office of Information Technology Services	Yearly Update
NYS Office of Parks, Recreation and Historic Preservation	Project Specific Orthoimagery

NYS Office of Real Property Services	Project Specific Orthoimagery
NYS Police	Yearly Update
NYS Power Authority	Yearly Update
NYS Thruway Authority	Yearly Update
NYSERDA	Project Specific Orthoimagery
Paul Smiths College	Project Specific Raw Imagery
SUNY Buffalo	Project Specific Orthoimagery
SUNY College at Plattsburgh	Project Specific Orthoimagery

County

Agencies Receiving or Have Received Orthos for Their County	**Delivery Type**
Albany	Entire County
Albany County Office of Natural Resource Conservation	Pre QA Orthoimagery
Allegany	Entire County
Broome	Entire County
Cattaraugus	Entire County
Cayuga	Entire County
Chautauqua	Entire County
Chemung	Entire County
Chemung Storm Water Control District	Sample of Raw Imagery in AOI
Chenango	Entire County
Clinton	Entire County
Columbia	Entire County
Cortland	Entire County
Delaware	Entire County
Dutchess	Entire County
Erie	Entire County
Essex	Entire County
Franklin	Entire County
Fulton	Entire County
Genesee	Entire County
Greater Buffalo-Niagara Regional Transportation Council	Erie Sensitive Tiles Only
Greene	Entire County
Hamilton	Entire County
Herkimer	Entire County
Herkimer-Oneida Counties Comprehensive Planning Program	Entire Counties
Jefferson	Entire County
Lewis	Entire County
Livingston	Entire County
Madison	Entire County
Monroe	Entire County
Montgomery	Entire County
Nassau	Entire County
New York City	Entire City
Niagara	Entire County
Oneida	Entire County
Onondaga	Entire County
Ontario	Entire County
Orange	Entire County

Orleans	Entire County
Oswego	Entire County
Otsego	Entire County
Putnam	Entire County
Rensselaer	Entire County
Rockland	Entire County
Saratoga	Entire County
Schenectady	Entire County
Schoharie	Entire County
Schuyler	Entire County
Seneca	Entire County
St Lawrence	Entire County
Steuben	Entire County
Suffolk	Entire County
Sullivan	Entire County
Tioga	Entire County
Tompkins	Entire County
Ulster	Entire County, Project Specific Raw Imagery
Warren	Entire County
Washington	Entire County
Wayne	Entire County
Westchester	Entire County, Project Specific Raw Imagery
Wyoming	Entire County
Yates	Entire County

Local

Agencies receiving or have received Orthoimagery	**Delivery Type**
Albany Police	Citywide Orthoimagery (TIFF)
City of Newburgh	Upgrade in Imagery
Department of Environmental Protection (NYC Upstate)	Project Specific, Multi County, NYC Water Supply Watersheds, Spring and Summer Imagery (Funded), LIDAR
Neighborhood Preservation Coalition of New York State, Inc.	New York City
NYC Office of Emergency Management	Sensitive Imagery Only
Poughkeepsie Police Department	Dutchess County Orthoimagery
Syracuse Metropolitan Transportation Authority	Project Specific Orthoimagery
Town of Carmel	Town-Wide Orthoimagery
Town of Islip	Project Specific Orthoimagery
Town of Southampton	Town-Wide Orthoimagery

Not-for-Profits

Requestor	**Delivery Type**
The Nature Conservancy	Hudson Valley Orthoimagery

Appendix E: Web Distribution and Usage Report

Interactive Web Application
NYS Orthos Online (www.orthos.dhses.ny.gov/)
History:
Three versions since 2002. Current version started in March 2011. Ability to view different years of program imagery as well as statewide NAPP coverage from mid-1990's. Users can also download imagery files.

Statistics (from Google Analytics)
These values exclude use from DHSES computers.

Period	Visits	Unique Visitors	Returning Visitors
3/1/11 – 9/30/12	106,386	49,429	56%
4/1/12 – 9/30/12	32,108	15,394	59%

Usage Analysis

- Weekend and holiday usage is typically 1/5 of that during work days
- Specific user source information is limited since more than 60% of the identified sources appear to be internet service providers.
- Of those usage sources which appear to be more specifically identified, State and Federal agency, private sector, and educational institution users show up the most.

Web Services
Information available at http://gis.ny.gov/gateway/mg/webserv/
History:
USGS hosted at EROS Data Center starting in 2005 are single vintage per location. NYS hosted starting in 2011 includes all available years. Also has CIR versions.

Statistics on USGS (last report through July 2009)

Period	Visitors
08/01/07-7/31/09	221,300
02/01/09-7/31/09	74,500

Statistics on NYS (OCS has access to more detailed usage data than from the USGS services.)

Period	Visitors	Hits
3/1/11 – 9/30/12	282,200	150,246,000
4/1/12 – 9/30/12	109,200	50,861,000

Usage Analysis

- Weekend and holiday usage is significantly lower than during work days
- Specific user source information is limited since more than 60 percent of the identified sources appear to be internet service providers.
- Of those usage sources which appear to be more specifically identified, State and Federal agency, private sector, and educational institution users show up the most.

Appendix F: Phone Survey of Counties Not in the Study Sample

	Do one or more of your county agencies use orthoimagery provided by NYS (through OCS)?	Which agencies are the most frequent users?	Are there other frequent users of the orthoimagery in your county but not in the county government? Who are they?	Additional notes
Allegany County	Yes	Real Property Tax Services	Independent surveyors	Simplified deed research, helped with identifying dated property lines and limits need for site visits
Cattaraugus County	Yes	Real Property, GIS, Economic Development Department, DPW, Sheriff's Department, assessors	County residents	Saves need for site visits and allows more effective Public Safety response.
Cayuga County	Yes	Real property services, Health Department, Parks and Recreation, Emergency Management, the Sheriff's Department and the Soil and Water Conservation District.	The City of Auburn's Engineering and Planning Departments.	Useful for background image in mapping applications. Estimated savings are at least $25,000 a year.
Chautauqua County	Yes			
Columbia County	Yes	Real Property Tax Services, Soil and Water Conservation Department, planning Department	Some non-profits, such as Colombia Land Conservancy, as well as college students	They use the Program to provide printouts to various departments, town officials, etc. Facilitates mapping.
Cortland County	Yes	County Planning and Soil and Water Conservation District	Mostly local realtors.	Provides underlying base for maps and lessens need for field visits
Delaware County	Yes	Planning Department, DPW, Emergency Services, Tax Department and Social Services.	Local realtors and surveyors	Saves time on site visits and makes the site plans and visits easier.
Franklin County	No.			Purchased GIS maps in 2009. They also use Google maps.
Fulton County	Yes	Real Property Tax Services, Planning Department and 911 dispatches.		Planning Department needs to provide quality images to the board for better decision-making.
Genesee County	Yes, but relying more on Pictometry 2010 data.	GIS, Sheriff's Dispatching Center and Department of Economics and Development		
Greene County	Yes	Real Property Services, Economic Development and Highway Departments.	Every surveyor doing work in the county as well as the general public.	Mapping in general would be much more difficult without the orthoimages. Cost prohibitive to do imaging themselves.
Hamilton County	Yes	Soil and Water Conservation Trust		Used for mapping snowmobile trails, but relying more on Google maps.
Herkimer County	Yes	Real Property Tax Services, 911 and the Highway Department	The GIS expert in the county uses the Program.	Necessary for 911. It saves hundreds of thousands of dollars.
Lewis County	Yes	Economic Development and Planning, Recreation and Trails Department, and Soil and Water Conservation district.	Engineering and surveying firms	
Livingston County	Yes	Planning, Highway and Real Property Tax Departments	College students	Saves hundreds of thousands of dollars.
Madison County	Yes.	911, Real Property Tax Services, and Planning Department.	College students	Used for local land use reviews, environmental surveys, and as a backdrop for mapping. Use pictometery in addition to orthoimagery.
Monroe County	Yes	Department of environmental services, planning, emergency management, and health services.	All municipalities within Monroe County have availability through the GIS services division.	
Montgomery County	Yes	Real Property Tax Services and the Planning Department.		They use the imagery for tax mapping and property lines.
Niagara County	Yes.	GIS, Department of Economics Development & Planning, and Department of Environmental Health,	Larger towns use the images.	Used daily for base mapping & constant editing.

Orange County	Yes.	Planning, Realty, Public Works, and District Attorney		There is significant evidence of the State Orthoimagery usage. See: http://www.orangecountygov.com/content/124/1362/1460/4314/default.aspx
Ontario County	No			
Orleans County				Unclear of significant evidence. See http://orleansny.com/Portals/0/Departments/Highway/Map%20Information.pdf
Oswego County	Yes.	GIS is the most frequent user.		They use the Program for daily mapping purposes.
Otsego County	Yes.	911 center and Soil & Water Conservation District	Local colleges and universities.	Used for GIS land use planning, background mapping and parcel indirect mapping online
Rensselaer County	Yes	911 agency, Tax Department, and GIS		Cost and time saving is inevitable; orthoimagery saves approximately a month of labor per year.
Saratoga County	Yes.	Planning, 911 and Law Enforcement and Real Property	Local towns private sector agencies, real estate agents and developers	Also use pictommetry
Schoharie County	Yes.	GIS, 911 system and Real Property	Soil & Water Conservation District, NRCS (National Resources), Lamont Engineering, and Surveyors	GIS uses it on a daily basis for background mapping, large scale project as references, and local agencies for decision making.
Schuyler County	Yes.	Watershed Protection Agency , Cooperative Extension and Soil & Water Conservation	Engineering firms	Used for site visits and land assessment. Saves the county at least $100,000 a year
Seneca County				Significant evidence of NYS Orthoimagery. See: http://www.co.seneca.ny.us/newsfiles/Aerials2007.pdf
Steuben County	No			The county pays a lot of money for the Orthoimagery services. See: http://www.pictometry.com
Sullivan County	Yes	Real Property Agency, 911 System, Department of Public Work and Planning and technicians.		Used for parcel and tax mapping and flood zones, as well as identifying broadband networking and towers usage.
Tioga County	Yes	GIS, Department of Planning, Real Property, Soil & Water Conservation, 911 system, and Environmental Health Agency	Realtors and researchers from universities.	The GIS also uses Google Maps for references. Orthoimagery increases the accuracy for identifying the process of properties, and provides enormous cost savings.
Tompkins County				Significant evidence of NYS Orthoimagery use. See: http://www.tompkins-co.org/gis
Ulster County	Yes	Information Services, Planning Board, Emergency Management, Real Property Tax Service Agency, Department of the Environment, Sheriff's department, Planning Board, etc.	Municipalities in the county, several engineering firms, consultants, general public	Orthoimagery used in 3rd party vendor E911 and Sheriff's Department applications, as well as Ulster County Web map and REConnect.
Washington County	Yes	GIS and Real Property	A farm land company in the county	
Wayne County	Yes	Planning Board, Economic Development, Water District and Drainage, Highway Department		Orthoimagery serves as compliment, rather than fundamental element on their regular basis.
Wyoming County	Yes	GIS, 911 system and Environment Planning.		The Orthoimagery is used for general reference purposes.
Yates County	Yes	Real Property, Tax Office, Soil & Water Conservation, Planning and Town's Coal Enforcement	Assessors in the State RPS program and Cornell Cooperative Extension	Orthoimagry saves time; very time consuming to inspect 100 acre farm lands

Appendix G: County Demographic and Economic Indicators

County	Population, July 2010	Land area in sq miles, 2010	Population per sq mile, 2010	Median household income, 2006-10	Per Capita Revenues	Per Capita Expenditures
Albany County	303,889	523	581	56,090	1,884	1,990
Allegany County	48,951	1,029	48	41,305	1,886	1,989
Broome County	200,368	706	284	44,457	2,174	2,221
Cattaraugus County	80,250	1,308	61	42,466	2,411	2,456
Cayuga County	79,997	692	116	48,415	1,883	1,890
Chautauqua County	134,813	1,060	127	40,639	2,066	2,102
Chemung County	88,830	407	218	44,502	2,236	2,181
Chenango County	50,396	894	56	43,943	1,806	1,764
Clinton County	82,143	1,038	79	47,489	1,975	1,938
Columbia County	63,020	635	99	55,546	2,100	2,212
Cortland County	49,324	499	99	45,338	2,249	2,173
Delaware County	47,843	1,442	33	42,967	1,931	1,939
Dutchess County	297,739	796	374	69,838	1,539	1,541
Erie County	918,751	1,043	881	47,372	1,665	1,663
Essex County	39,316	1,794	22	45,216	2,125	2,377
Franklin County	51,609	1,629	32	42,050	1,866	2,002
Fulton County	55,471	495	112	43,240	1,644	1,778
Genesee County	60,080	493	122	49,750	2,153	2,177
Greene County	49,160	647	76	46,235	1,857	1,881
Hamilton County	4,835	1,717	3	49,557	3,484	3,542
Herkimer County	64,481	1,411	46	42,318	1,506	1,483
Jefferson County	116,680	1,269	92	43,410	1,690	1,696
Lewis County	27,101	1,275	21	42,846	4,331	4,450
Livingston County	65,349	632	103	51,690	2,265	2,438
Madison County	73,464	655	112	53,345	1,380	1,477
Monroe County	744,635	657	1,133	51,303	2,053	2,130
Montgomery County	50,260	403	125	42,603	1,650	1,829
Nassau County	1,341,033	285	4,710	93,613	2,186	2,364
Niagara County	216,542	522	415	45,964	1,639	1,603
Oneida County	234,870	1,212	194	46,708	1,571	1,685
Onondaga County	467,253	778	600	50,676	2,208	2,351
Ontario County	108,095	644	168	56,468	1,866	1,864
Orange County	373,551	812	460	69,523	1,963	2,078
Orleans County	42,861	391	110	48,063	1,681	1,650
Oswego County	122,166	952	128	45,333	1,595	1,521
Otsego County	62,227	1,002	62	45,268	1,636	1,714
Putnam County	99,718	230	433	89,218	1,389	1,392
Rensselaer County	159,465	652	244	54,152	1,911	1,955
Rockland County	312,520	174	1,801	82,534	2,013	2,357
Saratoga County	219,988	810	272	65,100	1,175	1,315
Schenectady County	154,932	205	758	55,188	1,816	1,877
Schoharie County	32,692	622	53	50,864	1,854	1,822
Schuyler County	18,338	328	56	47,404	1,986	2,090
Seneca County	35,206	324	109	46,707	1,697	1,679
St Lawrence County	111,917	2,680	42	42,303	1,708	1,694
Steuben County	98,938	1,391	71	43,867	1,801	1,808
Suffolk County	1,494,388	912	1,638	84,506	1,797	2,050
Sullivan County	77,470	968	80	48,103	2,447	2,667
Tioga County	51,095	519	99	51,948	1,666	1,582
Tompkins County	101,654	475	214	48,655	1,648	1,662
Ulster County	182,473	1,124	162	57,584	1,836	1,876
Warren County	65,723	867	76	51,619	2,376	2,383
Washington County	63,322	831	76	48,327	1,765	1,733
Wayne County	93,783	604	155	52,562	1,744	1,870
Westchester County	950,283	431	2,207	79,619	2,582	2,880
Wyoming County	42,138	593	71	50,075	2,643	2,790
Yates County	25,367	338	75	46,822	1,651	1,665

Source: US Census Bureau.

Notes: The grey shaded counties are included in the study sample.

Appendix H: LIDAR Collection in New York State

Collection and dissemination of data from Light Detection and Ranging (LIDAR) technology in New York State is at a stage reminiscent of the status of orthoimagery collection and dissemination around 2000, when development of the NY Statewide Digital Orthoimagery Program began. Many LIDAR datasets have been collected and there is widespread interest in these datasets and in adding to them with new collections. However, there is very limited coordination of the collections and no consistent method for making the LIDAR data and derived products available. An investment in consistent yearly funding and an agency to oversee a statewide LIDAR program similar to the orthoimagery program would be very likely to see returns outstripping the excellent returns measured for the investment in orthoimagery.

LIDAR data has been collected for approximately 35% of the area of New York State. Most of this was collected in projects covering a county or smaller area. Current records indicate approximately 12-25 different projects between 2002 and 2012, depending on how projects are defined. Funding came from combinations of County, State and Federal funds. Most often the projects were in support of efforts to update flood zone mapping. (More information on the datasets is available on the NYS GIS Clearinghouse at http://gis.ny.gov/elevation/.)

Unlike orthoimagery, LIDAR data is typically used in products derived from the original data. The most common derived products are bare earth elevation models, used to describe the surface of the earth. In turn these elevation models are used to model drainage, inundation zones, and many other elevation-related characteristics of an area. In the context of a return on investment discussion, these uses have measurable and strategic benefits far exceeding the amounts invested to collect and process the LIDAR data. New York State has a large amount of population, infrastructure and economic assets in and near flood-prone areas. Up-to-date elevation data is needed to model the flood risks accurately.

The existing statewide elevation data is based on mapping completed by the Federal government between the 1950's and the early 1990's. Obviously many changes to the terrain have been made since these maps were compiled. In addition, the statewide dataset typically provides an elevation every 10-meters, allowing for many critical terrain details to be missed. LIDAR is typically collected to support modeling terrain every 1-2 meters. However, for the LIDAR data collections mentioned above, derived elevation models are not consistently available and available models are not consistent in many properties such as format and detail. In addition, since the LIDAR typically was collected for specific project areas without reference to neighboring or overlapping datasets, there is limited information on how well adjoining datasets match. Thus, a user with an area of interest spanning two or more LIDAR project areas may have complete LIDAR coverage, but they will have to perform additional work to ensure consistent modeling from one LIDAR area to the next. This becomes more important as users attempt to use the full detail available in many of the LIDAR datasets.

Potential benefits from LIDAR datasets will continue to increase as users take advantage of more than the data collected on the bare ground. LIDAR collects data points on all features – at ground level and above. Thus a LIDAR dataset can be used to model buildings and other manmade features as well as tree and vegetation canopies. These types of models can be used in designing communication systems where line-of-sight is critical, placing surveillance sensors for effective monitoring, and accurately predicting dispersal of airborne materials, among many uses. Models of the tree canopies in forested areas are used for predicting timber yields. At this time, generation of such models from existing LIDAR datasets in NY is very limited

A statewide LIDAR program in NY, if properly funded and supported, would be challenged to accomplish the following items.

- Leverage the investment made in existing LIDAR datasets by making the data and derived products more widely available. In support of this effort, the LIDAR program would need to document the quality, format, and other characteristics of the datasets to aid users.

- Identify and prioritize data gaps for collection. These would include areas with no LIDAR coverage and areas where the age or quality of existing LIDAR datasets recommend update or replacement.
- Identify funding partners among County/Local, State, and Federal agencies, similar to the process used with the orthoimagery program.
- Procure a contract with specifications for LIDAR data and derived products meeting the needs identified through review of existing data and discussions with partners.
- Manage collection, processing, and distribution of the new LIDAR data and derived products. As with the orthoimagery program, wide and reliable availability is the path to increasing benefits from the initial investments.
- Develop needs-based goals for maintenance and/or upgrades to datasets.

The current orthoimagery program provides an excellent model for developing a statewide LIDAR program. Overall data costs could be reduced compared to the costs of many smaller projects. A coordinated effort dealing with existing and new LIDAR datasets would unlock the widespread benefits currently being hampered by inconsistent data development and distribution. These benefits would greatly exceed the investments needed for the program.

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About the Office of Cyber Security

The Office of Cyber Security is dedicated to the protection of the State's cyber security infrastructure and is responsible for statewide policies, standards, programs, and services relating to cyber security and geographic information systems (GIS). The NYS GIS Coordinating Body operates under the auspices of the NYS Office of Cyber Security to address GIS issues on a statewide basis. The Body coordinates, promotes and facilitates the development, effective use, and sharing of geographic information. It also removes barriers to implementing geographic information technology to improve the delivery of public services, protect the public and the environment, and enhance the business climate for the benefit of the State, its municipalities, businesses and citizens.

About the Rockefeller Institute

The Nelson A. Rockefeller Institute of Government, the public policy research arm of the University at Albany, State University of New York, was established in 1982 to bring the resources of the 64-campus SUNY system to bear on public policy issues. The Institute is active nationally in research and special projects on the role of state governments in American federalism and the management and finances of both state and local governments in major areas of domestic public affairs.