Sandy Creeks Watersheds
Baseline Conditions Report

TALCOTT FALLS

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Prepared for:

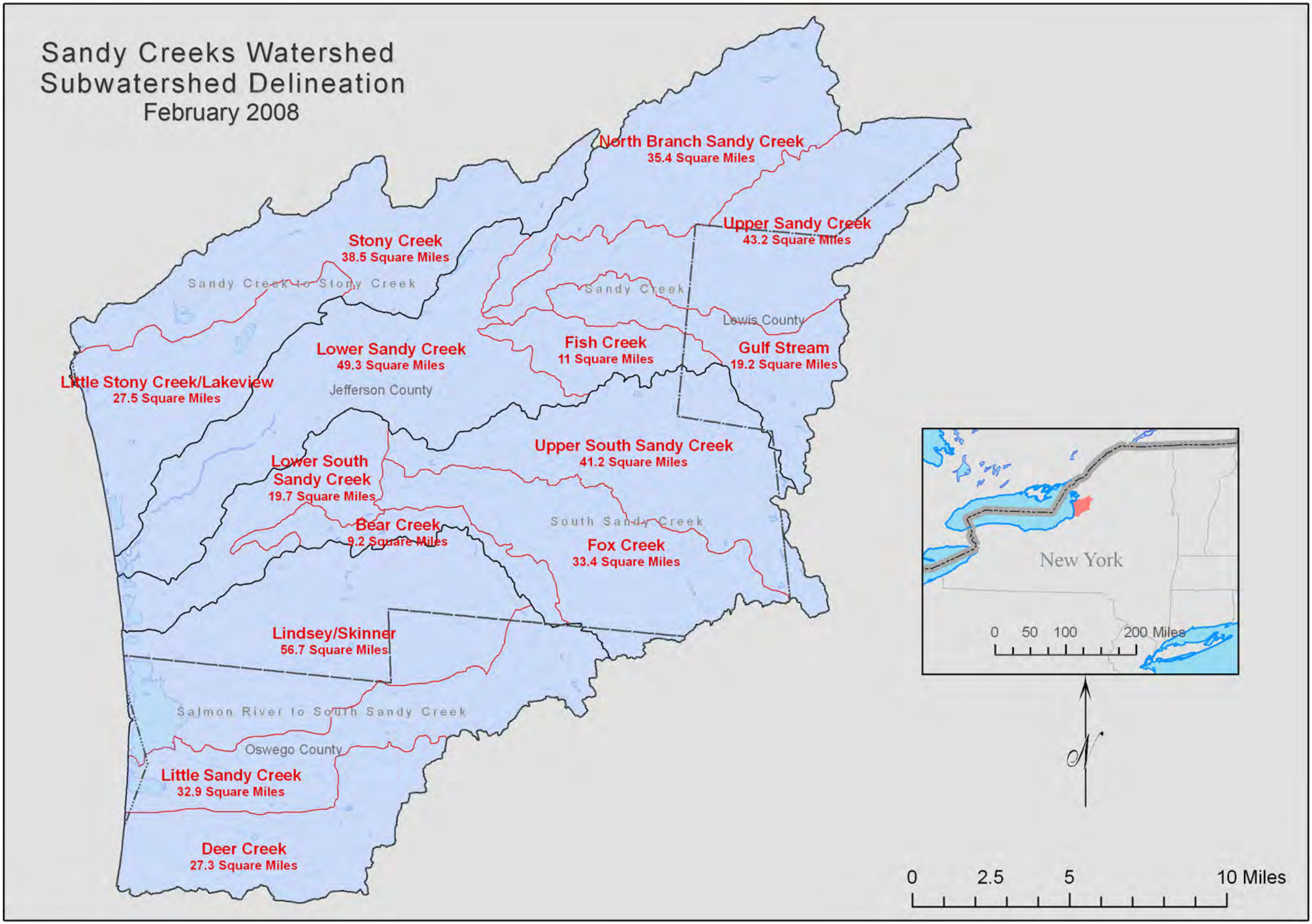
The New York State Department of State with funds provided from the NYS Environmental Protection Fund and under cotnract to The Nature Conservancy.

In support of the Sandy Creeks Watersheds Ecosystem Based Management Strategic Plan

Prepared by:

camoin associates
ECONOMIC DEVELOPMENT

Biohabitats Incorporated



Sandy Creeks Watershed
Subwatershed Delineation
February 2008
North Branch Sandy Creek
35.4 Square Miles
Upper Sandy Creek
43.2 Square Miles
Stony Creek
38.5 Square Miles
Sandy Creek to Stony Creek
Sandy Creek
Lewis County
Lower Sandy Creek
49.3 Square Miles
Fish Creek
11 Square Miles
Gulf Stream
19.2 Square Miles
Little Stony Creek/Lakeview
27.5 Square Miles
Jefferson County
Upper South Sandy Creek
41.2 Square Miles
Lower South
Sandy Creek
19.7 Square Miles
Bear Creek
9.2 Square Miles
South Sandy Creek
Fox Creek
33.4 Square Miles
New York
0 50 100 200 Miles
Lindsey/Skinner
56.7 Square Miles
Salmon River to South Sandy Creek
Oswego County
Little Sandy Creek
32.9 Square Miles
Deer Creek
27.3 Square Miles
0 2.5 5 10 Miles

TABLE OF CONTENTS

List of Tables

List of Figures

List of Appendices

1.0 INTRODUCTION

This Baseline Conditions Report has been prepared as a supporting document for the Sandy Creeks Watersheds Ecosystem-based Management Strategy development project. Ecosystem-based Management (EBM) is a term used to describe an integrated approach to managing the natural resources and socio-economic components that comprise communities or other common boundaries such as watersheds. The primary goal of EBM is to keep the economy of communities healthy by ensuring that the natural resources (arable lands, forests, lakes, rivers, scenic views, etc.), on which many economies directly and indirectly rely, can continue to support local communities. Examples in the Sandy Creeks Watershed that illustrate the important relationship between local economies and healthy natural resources include: working farms that provide both dairy and crops for consumption and open space; forests that provide recreational opportunities, valuable wood resources for paper, lumber and firewood as well as essential habitat to animals; and wetlands, rivers and swamps that provide protection from floods and serve as habitat for fish and other wildlife. EBM recognizes the importance of considering the synergies that exist between human and natural systems and the necessity to manage them as interconnected systems rather than isolating and focusing on single components.

The goal of this project is to develop a baseline conditions report that characterizes the watersheds both ecologically and economically and, can be used by the current project partners (The Nature Conservancy, Tug Hill Commission and New York Departments of State and Environmental Conservation). The baseline conditions will then be used to form a framework strategy that will identify the steps necessary to do a comprehensive Ecosystem-based Management plan that will include collaborative planning with communities, identification of conservation targets, and development of methods to maintain ecological integrity and economic sustainability.

2.0 WATERSHEDS BACKGROUND

The Sandy Creeks Watersheds cover approximately 444 square miles and are comprised of four primary watersheds as defined by the United States Geological Survey (USGS): Sandy Creek to Stony Creek, Sandy Creek, South Sandy Creek and Salmon River to South Sandy (Table 1 and Figure 1). For the purpose of this project and in keeping with common watershed management principles, the four primary watersheds were further delineated into fourteen smaller subwatersheds ranging in area from nine to fifty-seven square miles (Table 2 and Figure 1).

The watersheds are located in the northwest portion of the Tug Hill Region and are generally aligned in an east-west orientation with higher elevations to the east (Figure 2). All flow is westward towards Lake Ontario. The Black River watershed is located to the east and north of the Sandy Creeks Watersheds. The watersheds reside within the jurisdictional boundaries of Jefferson, Lewis and Oswego Counties, and include all or portions of the following towns and villages: Henderson, Hounsfield, Adams, Watertown, Champion, Rodman, Rutland, Denmark, Pinckney, Montague, Worth, Lorraine, Boylston, Redfield, Richland, Sandy Creek, Ellisburg, Mannsville, Lacona, and Pulaski. Forestry, agricultural, and recreational economies in this area are heavily dependent on the natural resource base ranging from the headwater forests and healthy stream ecosystems to large lakeside wetland complexes.

Table 1. Four Watersheds Comprising Sandy Creeks EBM Strategy

USGS Name	Abbreviated Name	Area (acres)	Area (sq. miles)
Sandy Creek to Stony Creek	Stony Creek	42,203	65.9
Sandy Creek	Sandy Creek	101,193	158.1
South Sandy Creek	South Sandy Creek	66,283	103.6
Salmon River to South Sandy Creek	Little Sandy Creek	74,804	116.9
	Total Area	**284,482**	**444.5**

Table 2. Fourteen Subwatershed Delineations

Watershed	Subwatershed	Area (acres)	Area (sq. miles)
Sandy Creek to Stony Creek	Stony Creek	24,618	38.5
	Little Stony Creek/Lakeview	17,585	27.5
Sandy Creek	North Branch Sandy Creek	22,677	35.4
	Upper Sandy Creek	27,652	43.2
	Gulf Stream	12,307	19.2
	Fish Creek	7,029	11.0
	Lower Sandy Creek	31,528	49.3
South Sandy Creek	Upper South Sandy Creek	26,370	41.2
	Fox Creek	21,396	33.4
	Lower South Sandy Creek	12,633	19.7
	Bear Creek	5,883	9.2
Salmon River to South Sandy Creek	Lindsey/Skinner	36,308	56.7
	Little Sandy Creek	21,041	32.9
	Deer Creek	17,455	27.3
	Total Area	**284,482**	**444.5**

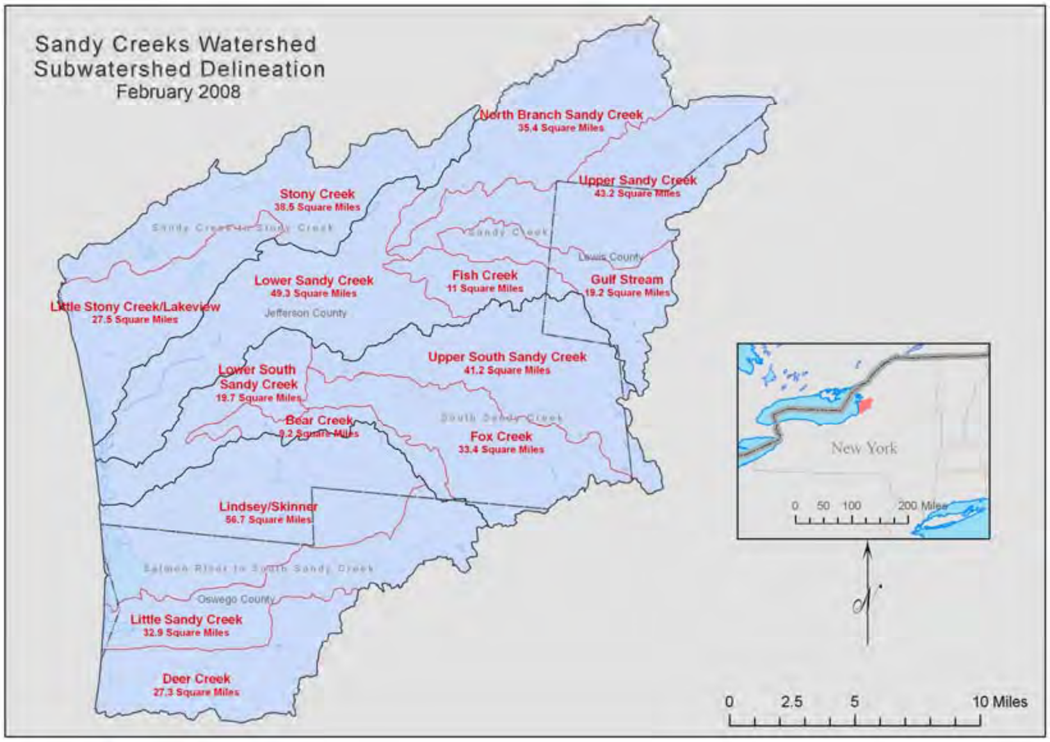


Figure 1. Subwatershed Delineation Map

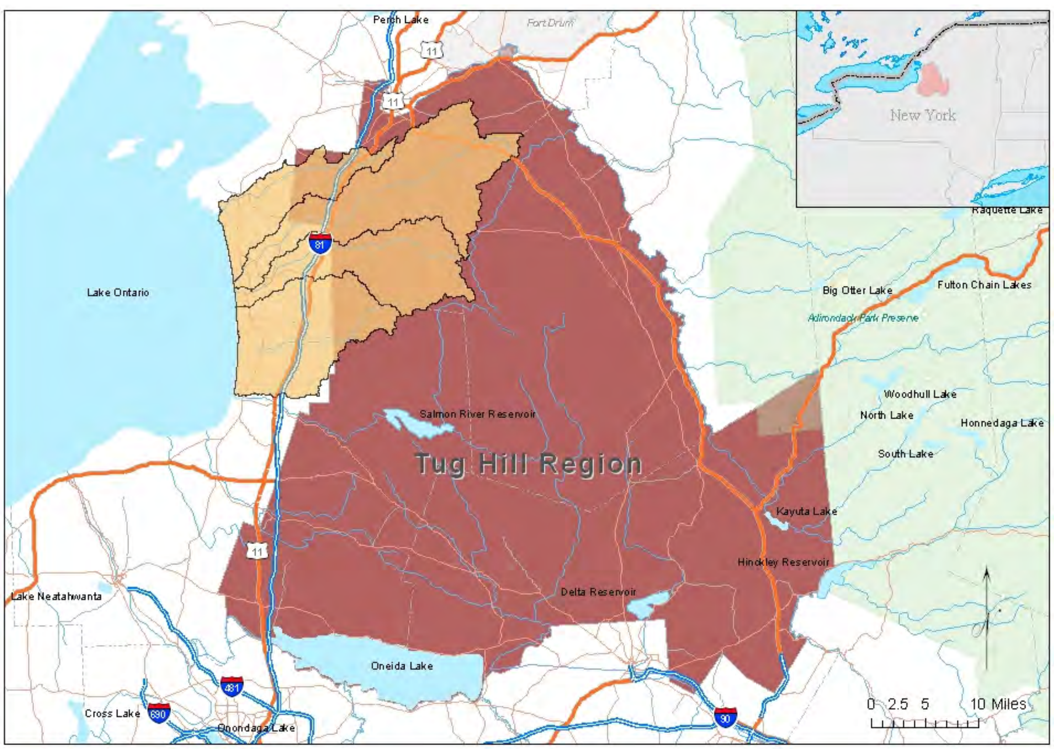


Figure 2. Sandy Creeks Watersheds and Tug Hill Region

3.0 DATA ACQUISITION AND METHODS

The data presented and summarized in this Baseline Conditions Report came from a variety of sources, including: literature reviews, GIS data sets (including socio-economic data resources), United States Geological Survey stream gauge data, and anecdotal information obtained from a subset of interviews and limited field reconnaissance. Existing reports and GIS data sets were largely provided by project partners. These were supplemented with a limited amount of independent internet searches for relevant data. The scope of work and associated budget neither allowed for a comprehensive data search nor any extensive quantitative field assessments. Thus, while some data may not exist, other data may be available but was not included in this effort due to the limited scope. A summary of the various data sources is provided below.

3.1 LITERATURE REVIEW

Biohabitats performed a literature review of articles provided by Tug Hill Commission, The Nature Conservancy and Stone Environmental Inc. The technical articles pertained to the Sandy Creeks region and represented a range of topics including: stream monitoring, biological assessment, endangered species documentation, economic impacts, and shoreline evolution. A total of 15 technical documents were reviewed and documented in an annotated bibliography (See Appendix 1). Camoin Associates also conducted a limited level of literature review to support their socio-economic analysis (see Section 3.3 and 4.0).

In general, the studies and reports were consulted provided isolated and localized information for various subwatersheds in the region. While the information and findings contained in many of the documents are informative and well presented, collectively they do not provide a complete picture of ecological or economical conditions found throughout the watershed. Consequently the lack of comprehensive data made it difficult to assess watershed conditions or perform trend analyses based on common metrics that exist for all of the 14 subwatersheds.

3.2 GEOGRAPHIC INFORMATION SYSTEM (GIS) DATA

Biohabitats acquired GIS data for the Sandy Creek Watersheds from three primary sources: Tug Hill Commission, The Nature Conservancy and Cornell University Geospatial Information Repository (CUGIR). These sources provided a variety of information including watershed boundaries, hydrology, geology, soils, tax parcels, municipal boundaries, species documentation, managed and conservation lands, etc. Biohabitats downloaded additional GIS information from USDA-NRCS Geospatial Data Gateway and USDA-NRCS Soil Data Mart. Both USDA-NRCS sites were used to obtain topographic, aerial photography, and other base layers beneficial for watershed analysis.

The Tug Hill Commission and The Nature Conservancy provided Biohabitats with CDs, while data from CUGIR and the USDA-NRCS were downloaded directly from internet websites. After each dataset was downloaded, each data file name and supporting information was catalogued in an excel spreadsheet. Refer to Appendix 2 for a catalogue of GIS data layers collected for this project.

Using the GIS data provided, the Biohabitats Team, working with THC, delineated the four watersheds into fourteen subwatersheds (see Figure 1). Drainage area was calculated for each subwatershed. Each subwatershed was also described based on the percent of drainage area within the larger watershed areas. GIS analysis was then used to review natural resource and ecological characteristics for each subwatershed. Original datasets were not manipulated spatially and attributes were not changed during analysis. Data sets were clipped to the project area and all existing attributes were carried forward and kept in tact to support new layers created for project specific analysis. The following representative analyses were conducted to assist in understanding subwatershed conditions:

- **County and municipal boundaries** were overlaid with the subwatersheds to determine which boundaries were located partially or entirely within the subwatersheds.
- The **urban influence of the transportation system** was evaluated based on road density (miles/ square mile) within each subwatershed. The road/stream crossings and the

road/stream crossing density (count/ square mile) were also quantified to represent the influence of the road network on the stream systems.

- **Subwatershed hydrography** was analyzed by looking at both stream length (miles) per subwatershed and drainage density (stream miles/ square mile).
- **Average annual precipitation** was presented by subwatershed as percent of subwatershed area per inches of precipitation.
- The **land cover[1] composition** for each subwatershed was determined from a raster layer, which is a layer comprised of cells, where each cell value stands for the presence of a type of vegetation, structure, or other feature that covers the land. The cells were totaled by cover type and then multiplied by the cell surface area. The distribution of land area by *land cover* is not the same as the *land use* distribution that is used in socio-economic analysis. The latter, *land use*, is based on the economic use the land is put under.
- **Soils per subwatershed** were described by general soils map units and their corresponding hydrologic soil groups based on a general soils map. These characteristics were quantified by acreage and percent of subwatershed area for both soil map units and hydrologic soil groups.
- **GIS wetland coverage** based on official New York State Freshwater Wetlands Maps as described in Article 24-0301 of the Environmental Conservation Law was used to calculate the total wetland area and the percent total area of each subwatershed. To better represent the benefit provided by the existing wetlands, wetland area and percent of subwatershed area was further analyzed based on wetland classification (Class I, II, III, IV, no wetland class designated and non-wetland features). Wetland classifications were expressed in acres and percent of subwatershed area.

[1]The terms *Land Use* and *Land Cover* are often used interchangeably. However, there are in fact significant and important differences between the two. Land use refers to how land is used by humans and the corresponding economic use to which land is put (e.g., residential, commercial, agricultural, industrial, recreation, etc.). Land cover refers to the vegetation, structures, or other features that cover the land (e.g., forest, water, wetlands, urban, etc.).

Two land parcels may have similar land cover, but different land use. For instance, an industrial plant that assembles electronic components may look, from the outside, very much like an office building with a distribution warehouse. The first is an example of industrial use, the latter an example of commercial use.

Two land parcels that have similar land use may have different land cover. A golf course and an office building are both commercial land uses. The former would have a land cover of grass, while the latter would be considered built up. (http://www.cara.psu.edu/land/lu-primer/luprimer01.asp).

- **Managed land** GIS data was utilized to represent parcels of land in each subwatershed that have some level of protection and management already existing. This information was presented as total acres per subwatershed, percent of subwatershed area and acres by managing entity.

More detailed analysis results are documented in the subwatershed profiles found in Section 6.0.

The Biohabitats Team used the data provided to the maximum extent possible; however, it was beyond the scope of this project to create new GIS datasets or to reconcile existing datasets and ensure consistency with other data. As a result, there were some limitations on how the data could be used to assist in the understanding of watershed and subwatershed conditions. Specific GIS data gaps that were observed during the analysis are described in more detail in Section 7.2 and are consistent with findings from the March 2007 report by Stone Environmental Inc. entitled *Task 10: Ocean and Great Lakes GIS Data Catalog, Data Gaps, and Mapping Strategies.*

3.3 SOCIO-ECONOMIC DATA

Camoin Associates conducted an assessment of socio-economic conditions in the Sandy Creeks Watershed. As part of its research, Camoin Associates reviewed literature and market information and interviewed a number of local stakeholders in order to identify potential socio-economic data sources. Results of their efforts are included in this Baseline Conditions Report and will be used in the development of the EBM Strategy (see Appendix 3 for Camoin's full Socio-Economic Analysis Report for the Sandy Creeks Watersheds).

One of the overarching objectives of Ecosystem-based Management is to characterize the interrelationships between the local economic and natural systems; identify resource management issues and threats to ecological integrity and human well-being; and explain the links between economics and ecosystems in the Sandy Creeks Watersheds. This preliminary effort to identify and analyze readily available socio-economic data for the Sandy Creeks Watersheds should be viewed as the first step in a much more long-term process to enhance local, state and federal data collection methods to facilitate analysis of socio-economic data on the basis of ecosystem boundaries.

The biggest challenge in collecting and analyzing socio-economic data for this project is that most data of this kind is collected on the basis of political boundaries. Because the Sandy Creeks Watersheds cross the boundaries of numerous towns and three counties, it was not possible to locate existing data that exclusively covered just the Sandy Creeks Watershed. Furthermore, from an economic perspective, it is reasonable to assume that the natural resource value of the Watershed (agricultural output, tourism business, forestry-related production, economic stimulus from second home ownership, etc.) affects both the Watersheds and the immediately adjacent areas.

Therefore, for much of the analysis included in this Baseline Conditions Report, Camoin Associates relied on tax parcel data provided by the New York State Office of Real Property Services and on demographic and employment data from ESRI, a leading national provider of social and economic statistics derived from Census data. ESRI is commonly used by economic developers, site selectors and others in the fields of planning and economic development. For the purpose of obtaining data from ESRI, Camoin Associates defined a Sandy Creeks Trade Area (or simply “Trade Area”) (Figure 3) by creating a circle with 16.5 mile radius, whose center is located near the centroid of the Sandy Creeks Watersheds study area (the intersection of Routes 189 and 97).

Figure 3. Sandy Creeks Trade Area

3.4 FIELD RECONNAISSANCE

The scope of work for this project did not contain a field assessment component that allowed for the collection of detailed and quantitative data. The Biohabitats Team, however, felt that it would be beneficial to conduct a rapid windshield survey of as much of the subwatershed areas as possible to develop a qualitative sense of watershed conditions. To facilitate this survey and to be most efficient with a limited amount of time in the field, road crossings of streams were targeted as locations to record observations. Over fifty locations were visited in the field, photo-documented and recorded on a field form. Each subwatershed had at least two observation points.

Few scientifically-based findings result from such an effort; however, the anecdotal information is nevertheless valuable in terms of substantiating and loosely calibrating some of the GIS analysis that was conducted. A much more robust and quantitative field assessment effort is recommended across all fourteen subwatersheds in order to better inform the EBM planning process.

Field reconnaissance was conducted from April 9 to 11, 2007. A visual observation survey characterizing the existing land use, forest cover, invasive vegetation, and stream crossing was completed. Tug Hill Commission staff joined Biohabitats in the field over the three day period. Appendices 4 and 5 contain the photo documentation and qualitative field assessment sheets that were recorded over the three day effort. Specific observations about individual subwatershed characteristics and conditions are provided in the subwatershed profiles contained in Section 6.0.

3.5 USGS GAUGING STATION

United States Geological Survey (USGS) stream gauge network databases were reviewed for potential gauge station locations in the study area. Only one gauge location was identified, Sandy Creek near Adams, NY (gauge ID 04250750). This gauge is located in the Lower Sandy Creek subwatershed and had a drainage area of 137 square miles. The gauge has annual data available for forty-eight years (1957-2005). Refer to Appendix 6 for surface-water annual statistics, surface-water monthly statistics, and peak flow for this USGS gauge station. Stream gauge data can be a valuable source of information to assess watershed responses to land use changes and implementation changes. The lack of a gauging network throughout the Sandy Creeks Watersheds places a significant limitation on the ability to accurately model hydrologic conditions and to predict watershed responses to policy and other implementation initiatives targeting flood control, runoff volume reduction and other common watershed management strategies. Gauges can be an expensive undertaking to maintain and service at the high level that the USGS typically requires; however, the value of having a more robust and distributed network of gauges should be explored in more detail during the EBM strategy development.

3.6 STAKEHOLDER PROCESS

EcoLogic, Inc., a New York-based environmental consulting firm, facilitated a series of stakeholder focus group meetings between June and October 2007. The purpose of the meetings was to introduce the concept of Ecosystem-based Management and to solicit local ideas and concerns about local natural resources and socioeconomic sectors. Outreach techniques included a series of meetings (two open-invitation forums and seven focus group gatherings) and individual interviews. The solicitation of comments was guided by a series of questions. During the initial open-invitation meeting the following questions were posed:

- What aspects of the ecosystem are most important—of greatest value—to you, with an emphasis on natural resources and social, economic sustainability?
- What are the issues and challenges facing the Sandy Creeks ecosystem over the next five to ten years?
- What are some tools (educational, scientific, regulatory, etc.) that might help stakeholders face these challenges and protect this area for future generations?

Focus groups consisted of representatives from the following sectors; agriculture, business, conservation, foresters and large landowners, municipalities and recreation. All of the focus groups were asked to respond to following questions:

1. What is your background and interest in the Sandy Creeks watershed? (What brought you to this meeting tonight?)
2. Think back about fifteen years. How would you compare the state of this region at that time to what it is now? Consider this in natural resource terms, recreational terms, social terms, however you'd like.
3. Think ahead about fifteen years. Given the current trends in population, land use, economic development; will this be an area where your family wants to settle?
4. Why or why not? What factors will change the Sandy Creeks region?
5. Which of these can be controlled?
6. Identify one or two priority projects that you believe can effectively improve the future of the Sandy Creeks ecosystem.

The open-invitation wrap-up meeting was designed to ensure that what was heard by EcoLogic staff adequately captured local interests and concerns. Furthermore, participants had the opportunity to consider comments collected from all of the meetings. This initial stakeholder outreach effort can be expanded upon for the EBM planning process. Results from the stakeholder process are explained in more detail along with recommendations for future stakeholder involvement are outlined in section 7.3 of this report.

4.0 SOCIO-ECONOMIC ANALYSIS

As described in Section 3.3, a Trade Area was defined by creating a circle using a 16.5 mile radius centered on the Sandy Creeks Watershed (Figure 3). The Trade Area extends beyond the Watersheds to accommodate current socio-economic datasets. Thus, the socio-economic analysis includes data from outside the watersheds. For example, part of Watertown falls within the Watersheds boundary with most of it falling outside of the Watersheds but within the Trade Area. As a result, socio-economic data associated with Watertown is included in the Sandy Creeks Watersheds socio-economic analysis. The full socio-economic report written by Camoin Associates is contained in Appendix 3. Key summary components are presented in the following sections.

4.1 POPULATION

There are an estimated 63,747 persons living in the Sandy Creeks Trade Area (Table 3). The population in the study area grew at a faster rate than the population statewide between 2000 and 2006, but is projected to grow at a slower rate than the population statewide between 2006 and 2011. Consistent with national population trends as the Baby Boom generation ages, the largest increase for the 2000 to 2011 period is projected for the 55-64 year old age group (see Table 3).

Table 3. Population by Age – Sandy Creeks Trade Area

Population by Age - Sandy Creeks Trade Area					
Population	**2000**	**2006**	**2011**	**Change 2000-2006**	**Change 2006-2011**
Total Population	61,843	63,746	64,420	1,903	674
Under Age 25	21,499	21,565	20,714	66	-851
25 - 34	8,600	8,129	8,652	-471	523
35 - 44	10,116	9,401	8,092	-715	-1,309
45 - 54	8,058	9,260	9,948	1,202	688
55 - 64	5,205	6,820	8,107	1,615	1,287
65 - 74	4,155	4,038	4,385	-117	347
75 - 84	3,023	3,111	2,914	88	-197
85+	1,187	1,422	1,608	235	186

Source: ESRI, Camoin Associates

4.2 INCOME BY AGE

Figure 4 below shows the income distribution of the Trade Area population by age of the head of household. Overall, the Trade Area has a lower median income than both the State of New York and the U.S. As reflected in the graph, young and old age groups tend to have the largest number of low-income households. In five out of the seven age groups, most households have annual income of less than $25,000 and between $25,000 and $50,000.

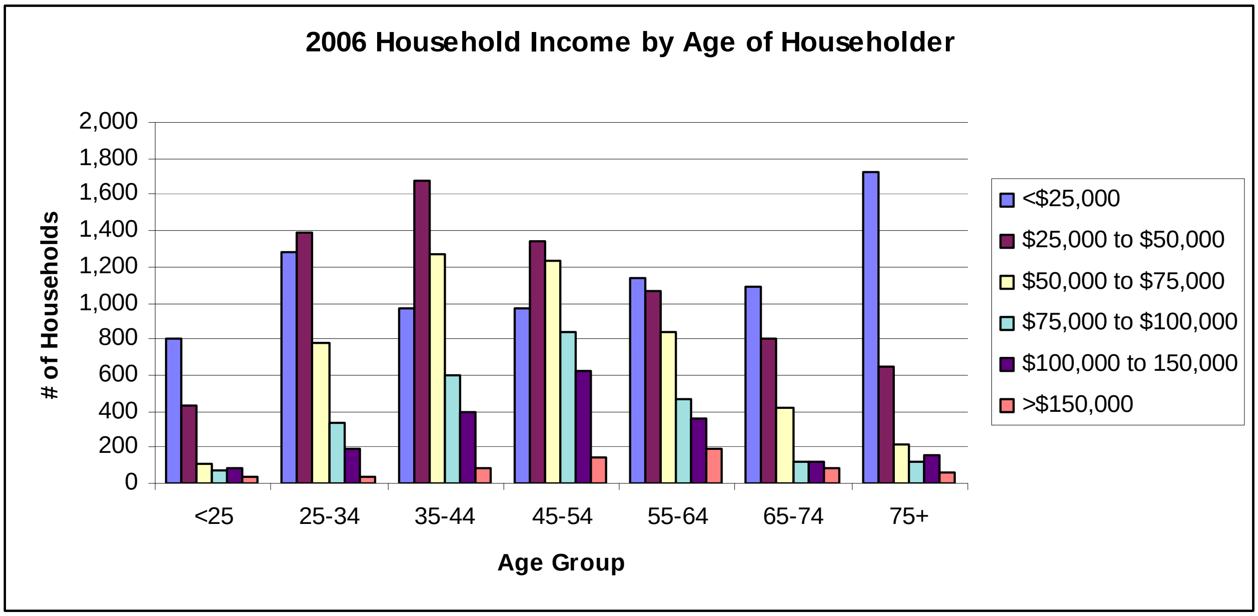


Figure 4. Household Income by Age

4.3 EMPLOYMENT

Employment by major industry sector according to the North American Industrial Classification System (NAICS) for the Trade Area in 2006 is illustrated in Table 4 below.[2] There are a total of approximately 29,644 persons employed in the Watershed Trade Area. Note that this figure includes only the *jobs* that are located within the Trade Area boundary, not all working residents. According to ESRI, in the year 2000, there were approximately 26,405 Watershed residents aged sixteen or older who worked. Of those workers, approximately 9,634 of them (36%) commute

[2] The NAICS replaced the U.S. Standard Industrial Classification (SIC) system. NAICS was developed jointly by the U.S., Canada, and Mexico to provide new comparability in statistics about business activity across North America.

twenty or more minutes daily to work, which means a significant number of Trade Area residents leave the Trade Area boundary to get to work.

Table 4 shows the number of employees in each industry division, as well as the percentage of total employment each division comprises. It is important to note that the employment data below includes only those individuals employed by businesses and *does not include self-employed individuals*, such as family farmers that have no employees. Additionally, some agricultural-based employment may be counted under "Wholesale Trade," "Transportation and Warehousing," or "Other Services" categories. For this reason, the data will appear to undercount the agriculture sector in particular.

Table 4. Employment Distribution across Industry Sectors

Employment Distribution Across Selected Industry Sectors				
	United States		Trade Area	
	Number	Percent	Number	Percent
Retail Trade	**16,616,004**	**13.5%**	**5,481**	**18.5%**
Health Care and Social Assistance	16,403,212	13.4%	3,935	13.3%
Manufacturing	**13,000,725**	**10.6%**	**1,558**	**5.3%**
Accommodation and Food Services	10,713,674	8.7%	2,611	8.8%
Educational Services	**9,994,096**	**8.1%**	**3,006**	**10.1%**
Food Services and Drinking Places	8,507,607	6.9%	2,303	7.8%
Public Administration	**8,221,255**	**6.7%**	**3,077**	**10.4%**
Professional, Scientific, and Technical Services	**7,233,671**	**5.9%**	**726**	**2.4%**
Other Services (except Public Administration)	**6,859,577**	**5.6%**	**3,466**	**11.7%**
Wholesale Trade	6,194,850	5.0%	1,225	4.1%
Construction	**6,034,744**	**4.9%**	**916**	**3.1%**
Finance and Insurance	**5,042,035**	**4.1%**	**698**	**2.4%**
Food and Beverage Stores	3,360,135	2.7%	952	3.2%
Administrative and Support and Waste Management and Reme	3,296,874	2.7%	480	1.6%
Transportation and Warehousing	3,223,074	2.6%	597	2.0%
Real Estate and Rental and Leasing	3,068,291	2.5%	532	1.8%
General Merchandise Stores	2,564,093	2.1%	996	3.4%
Information	2,564,343	2.1%	503	1.7%
Motor Vehicle and Parts Dealers	**2,351,153**	**1.9%**	**1,222**	**4.1%**

Source: ESRI

Note: Differences of more than 1.5 percentage points highlighted in bold, with blue denoting a lower concentration in the Trade Area and green denoting a higher concentration in the Trade Area.

Although reliable data on the actual number of farms in the Sandy Creeks Watershed only is not currently available, according to the U.S. Department of Agriculture's *2002 Census of Agriculture*, Jefferson County has 1,028 farms. This estimate is down 1% from the *1997 Census of Agriculture*. The average farm size is 322 acres, which is up from 286 acres in 1997. By far, the top two commodities by sales are "Milk and other dairy products from cows" and "Cattle and calves."

Based on the employment data that is available for the Trade Area, which is illustrated in Table 4, the largest employment sector in the Trade Area is Retail, followed by Health Care, Other Services (such as & maintenance and personal care services), Public Administration (government), and Educational Services. Although agriculture and forestry are considered major industries in the Watershed, outside of sole proprietorships they actually directly employ few people according to the ESRI data.

Table 4 also compares employment concentrations in the Trade Area against those in the United States for selected industries. The data shows that the Trade Area, when compared to the larger US, has a relatively high concentration of employment in Retail Trade, Education Services, Public Administration, Other Services and Motor Vehicle and Parts Dealers. It has a relatively low concentration in Manufacturing, Professional, Scientific and Technical Services, Construction, and Finance and Insurance.

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4.4 LOCATION QUOTIENT ANALYSIS

A *location quotient* (LQ) is a quantitative tool that uses employment data to determine which industries have a larger or smaller presence in the local economy relative to a larger reference area, such as the state or the nation. It identifies how local industries compare with national averages, providing insight into understanding local economic strengths and competitive advantages. The location quotient method is often used to identify industry clusters and potential development prospects.

An LQ *less* than 1.00 indicates that the industry's share of local employment is less than that industry's share of national employment. As a rule of thumb, location quotients of between 0.80 and 1.20 are not considered significantly different from 1.00, so in identifying employment concentrations, one looks for LQs higher than 1.20.

Table 5 shows location quotients for major industry divisions in the Sandy Creeks Trade Area, relative to the nation and the state.

Table 5. Location Quotients for Sandy Creeks Trade Area, 2006

LQs, All 2-Digit NAICS, Sandy Creeks Trade Area, 2006			
NAICS Code	**Description**	**Relative to Nation**	**Relative to State**
11	Agriculture, Forestry, Fishing and Hunting	0.75	**3.00**
21	Mining	0.00	0.00
22	Utilities	0.75	1.00
23	Construction	0.63	0.94
31-33	Manufacturing	0.50	0.68
42	Wholesale Trade	0.82	0.93
44-45	Retail Trade	**1.37**	**1.57**
48-49	Transportation and Warehousing	0.77	0.74
51	Information	0.81	0.57
52	Finance and Insurance	0.59	0.42
53	Real Estate and Rental and Leasing	0.72	0.69
54	Professional, Scientific, and Technical Services	0.41	0.32
55	Management of Companies and Enterprises	0.50	0.50
56	Administrative and Support and Waste Management and Remediation Services	0.59	0.67
61	Educational Services	**1.25**	1.06
62	Health Care and Social Assistance	0.99	0.86
71	Arts, Entertainment, and Recreation	0.89	0.94
72	Accommodation and Food Services	1.01	**1.22**
81	Other Services (except Public Administration)	**2.09**	**1.95**
92	Public Administration	**1.55**	**1.51**
	Unclassified Establishments	0.80	0.36

Source: ESRI, Camoin Associates

Note: LQs in excess of 1.2 highlighted in yellow, those below .80 in blue.

As the table illustrates, three sectors have a strong presence in the trade area relative to *both* the State of New York and the U.S. These are:

- Retail
- Other Services (e.g., motor vehicle and parts dealers, building material and garden equipment and supplies dealers, general merchandise stores)
- Public Administration

Sectors with a relatively strong concentration compared to the state, but not the nation are:

- Agriculture, Forestry, Fishing & Hunting
- Accommodation and Food Services

In addition, the Watershed has a strong concentration of employees in educational services compared to the nation, but not compared to the state.

4.5 TAX PARCEL DATA ANALYSIS

Tax parcel data for the entire Sandy Creeks Watershed area and its fourteen sub-watersheds were analyzed to gain an understanding of the various major land uses and the value of land by use type. The tax parcel data analyzed here is 2006 data provided by the NYS Office of Real Property Services. The data set includes a field that classifies each parcel by land use type. The various land use categories follow the New York State property classification system. Camoin Associates aggregated the tax parcel data by land use type in order to analyze land use by acreage and land value by use type in the overall Sandy Creeks Watershed and its 14 sub-watersheds. Subwatershed tax parcel data is presented later in this report. See Appendix 7 for a series of composite maps of the overall Sandy Creeks Watershed showing:

- All tax parcels by land use type (note that the tax parcel data set contains a significant number of parcels that do not have a centroid and therefore could not be mapped according to land use type)
- Entertainment and recreational facilities
- Lodging and dining establishments
- Seasonal residences
- Wild and forested land (including commercial timber tracts)[3] by ownership.

Each municipality assesses property differently – while one town may assess at 100% of market value, another may assess at only 60% of market value. In order to facilitate the comparison of land values by use type throughout the Watershed, Camoin Associates converted assessed values to market values by applying the state equalization rate for each municipality to the assessed values provided in the data set.

[3] Land belonging to timber companies falls under the 900-999 classification as defined by the Office of Real Property Services. More specifically, classification #910 and includes all private lands which are associated with forest land areas that do not conform to any other property type classification, plus plantations and timber tracts having merchantable timber.

Table 6 shows total acreage for each type of land use present in the Watershed, as well as the total market value and the average market value per acre for each land use type.

Table 6. Sandy Creeks Watershed Area Market Value by Land Use

Total Sandy Creeks Watershed Area					
Land Use	Acreage	% of Total	Total MV	% of Total MV	Per Acre Market Value
Agricultural	108,715	36.23%	$90,062,749	8.45%	$828
Residential	65,372	21.78%	$692,566,980	64.95%	$10,594
Vacant	42,540	14.18%	$33,645,511	3.16%	$791
Commercial	2,159	0.72%	$53,917,692	5.06%	$24,972
Recreation and Entertainment	1,794	0.60%	$17,392,822	1.63%	$9,695
Community Service	721	0.24%	$105,259,139	9.87%	$145,997
Industrial	2,025	0.67%	$3,075,381	0.29%	$1,519
Public Service	2,769	0.92%	$15,149,008	1.42%	$5,470
Public Parks, Wild, Forest	73,984	24.65%	$55,174,305	5.17%	$746
Totals	300,080	100.00%	$1,066,243,587	100.00%	$24,983

Community services land accounts for the smallest percentage of land acreage in the Watershed (less than 1%), but has the highest market value per acre ($145,997). Since these types of property are not subject to the real property tax (and thus receive little scrutiny) and because the non-taxable value of property can sometimes be part of formulas regarding the distribution of state aid, the extremely high value-per-acre amount is suspect.

A subwatershed breakout of total market value by percent of land use is provided in Table 7 on the following page.

Table 7. Subwatershed Percent of Total Market Value by Land Use

Percent of Total Market Value by Land Use									
	Agricultural	Residential	Vacant	Commercial	Recreation and Entertainment	Community Service	Industrial	Public Service	Public Parks, Wild, Forest
Deer Creek	4.9%	68.9%	4.5%	6.8%	6.5%	4.2%	0.2%	2.8%	1.3%
Little Sandy Creek	1.9%	74.5%	3.7%	8.2%	2.3%	3.7%	0.1%	2.7%	2.9%
Little Stony Creek	15.0%	59.3%	3.8%	1.4%	7.4%	0.2%	0.3%	0.2%	12.3%
Fox Creek	8.3%	56.2%	3.2%	0.2%	0.0%	1.7%	0.0%	0.0%	30.4%
Fish Creek	12.8%	51.6%	3.4%	0.0%	0.0%	0.6%	0.0%	28.5%	3.1%
Gulf Stream	9.2%	57.6%	10.0%	0.0%	2.2%	0.8%	0.0%	0.8%	19.4%
Lindsey Skinner	4.4%	63.9%	4.3%	5.2%	1.2%	17.6%	0.4%	0.8%	2.3%
Lower Sandy Creek	14.3%	46.4%	1.4%	8.3%	1.5%	25.1%	0.0%	1.9%	1.0%
Lower South Sandy	20.9%	36.2%	1.7%	0.7%	0.0%	3.6%	0.0%	0.8%	36.1%
North Branch Sandy Creek	14.5%	74.0%	3.1%	3.0%	0.1%	2.2%	0.3%	2.5%	0.2%
Upper Sandy Creek	17.4%	68.6%	3.3%	0.3%	0.2%	4.9%	0.1%	0.1%	5.2%
Upper South Sandy Creek	15.0%	56.7%	4.4%	0.4%	0.1%	0.6%	0.1%	0.3%	22.3%
Stony Creek	5.3%	78.4%	1.5%	6.0%	0.1%	6.7%	0.6%	0.5%	1.0%
Bear Creek	5.1%	63.5%	4.4%	5.3%	1.1%	17.2%	0.4%	0.9%	2.1%
Total Watershed	**8.4%**	**65.0%**	**3.2%**	**5.1%**	**1.6%**	**9.9%**	**0.3%**	**1.4%**	**5.2%**

Note: Significant differences in market value by land use type between the Watershed and Subwatershed are show in green (higher) and yellow (lower).

4.6 SOCIO-ECONOMIC DATA GAPS & TRENDS TO TRACK

The various analyses conducted by Camoin Associates each have their own limitations. In general, however, they will provide a useful starting point to continue looking at trends into the future, as they are relatively simple to reproduce and the core data sets are readily available. Updating the analyses on a five-year interval should be sufficient to provide basic trend information for the various indicators. Specific opportunities to take advantage of include:

- *Demographic data* – As time goes by and new policies are instituted, local officials can track what happens to the demographic data points as a result. Key indicators of the economic effects of changes to the watershed could be observed in the age distribution and especially income distribution data tables.
- *Employment data* – It may be helpful to obtain from NYS Department of Labor a special run of aggregated Quarterly Census of Employment and Wages (QCEW) data at the 3-digit NAICS level for all the towns in the Watershed. That way, trends in employment

and an associated LQ analysis at a more detailed level could be tracked over time. This would be useful in identifying key industries that should be targeted for retention efforts or potential growth industries that should be targeted for attraction to the area.

- *Tax parcel data* – Beginning a trend line measuring changes in land use and land values over time for the overall Sandy Creeks Watershed, as well as for each sub-watershed, would be useful to help understand the impact that environmental or other policies have on the economy. It should be noted that land uses and values are assigned by local assessors and can be highly subjective in some cases. As explained earlier, it should also be noted that land use does not necessarily reflect land cover and vice versa.
- *Agricultural sector data* – Data on agricultural sector employment and annual production within the Sandy Creeks Watershed alone is not currently available, but would be beneficial in the context of the EBM Strategy. This may require periodic surveying (every five years, for example) of local producers to gather the data that would allow the Commission to begin measuring changes in agricultural employment, annual production (measured in tons of product or dollars of sales) and changes in the proportion of goods produced in the Watershed that are exported out of the area. Potential data sources include Cornell Cooperative Extension Service, Northern NY Agriculture Development Program and the NY State Department of Agriculture and Markets.
- *Forestry sector data* – Data on employment and annual production in the forestry sector within the Sandy Creeks Watershed alone is not currently available, but would also be useful in the context of the EBM Strategy. This may require periodic surveying (every five years, for example) of local loggers and timber producers to gather the data that would allow state and local decision makers to begin measuring changes in forestry employment, annual production (measured in tons of product or dollars of sales), and changes in the proportion of logs harvested and timber produced in the Watershed that is exported out of the area. Potential data sources include the Empire State Forest Products Association and the NY State Department of Agriculture and Markets.
- *Tourism sector data* – Although there is a good deal of data available at the county and broader regional level to measure changes in the tourism industry over time, it is not possible to separate out data for the municipalities in the Sandy Creeks Watershed. It may

be worthwhile to work with state and county entities that currently collect tourism-related data to explore the possibility of separating these data out for the Sandy Creeks Watershed. In addition, the number of hunting and fishing licenses, as well as snowmobile registrations, would be other data points that would illustrate changes in tourism and recreation over time. It could be helpful to request that people applying for these licenses and registration fill out a very short questionnaire regarding their typical spending habits and other types of activity they engage in while in the Watershed.

5.0 REGIONAL ENVIRONMENTAL PROFILE

Analysis of available geographic and environmental datasets allows a characterization of the physical, biological, and ecological conditions of the Sandy Creeks Watersheds at a regional scale. This is valuable both to "set the stage" for more detailed subwatershed profiles which follow in Section 6 and to recognize connectivity across the landscape, particularly with respect to the interface with Lake Ontario.

In general, the landscape is dominated by rural conditions, with mixes of agricultural and forested areas interspersed with relatively small urban centers. The region has low human population densities: the average density is approximately fifty people per square mile. Good water quality conditions, large areas of connected woodland, shrubland, riparian, and wetland habitats, and low amounts of impervious area throughout the Sandy Creeks Watersheds suggest that the region is ecologically-vital, and remains relatively unimpacted by human disturbances. Ecological stressors tend to be associated with urban stormwater runoff including inadequate stream buffers, areas of excess nutrient loading, and localized erosion; habitat fragmentation associated with agriculture, resource extraction, and infrastructure; and erosion / disturbances associated with recreational uses.

The following sections present an overview of the regional topography, geology, soils, climate, hydrology, land cover, and infrastructure. It should be noted that limited data restricts the ability to provide trend analyses for such parameters as land cover and water quality, although variability through the subwatersheds is captured.

5.1 GEOLOGY AND TOPOGRAPHY

Two bedrock geologic regions lie within the watershed area; the Ontario Lowlands and Tug Hill Plateau. The Ontario Lowlands region extends from Lake Ontario east until the land elevation increases to form the Tug Hill Plateau. Both of these regions are formed from sedimentary rock including sandstone, shale, limestone, etc.

The Lowlands are formed on the more easily erodible materials and include remnants of large lakes scoured by glaciers and filled with glacial meltwater as the continental ice sheet advanced and retreated over the Northeast. The Tug Hill Plateau, which is actually a part of the Allegheny Plateau, consists of erosion-resistant sandstone of the Ordovician age. This deposit tilts westward and rests on limestone, siltstone, and a series of sandy shales. It has been isolated through erosion by meltwater escaping through the present Mohawk Valley from former Lake Iroquois. As the glacial lakes shrank, or altogether disappeared, characteristic glacial lake deposits were left behind: sand, silt and clay, and other evidence of ancient shorelines. Many striking glacial features are evident, including thousands of drumlins (elongated hills of glacial drift) in the Ontario Lowlands and abundant gorges in the Tug Hill Plateau region carved by rapidly flowing glacial runoff. Many of these gorges, locally referred to as “gulfs,” reach depths up to 300 feet.

The regional topography of the watersheds is comprised of higher elevation regions along the eastern edge of the watershed (with maximum elevation of about 1,738 feet) in the plateau region with steady fall along the escarpment to the shores of Lake Ontario on the western edge where elevations are approximately 262 feet above mean sea level (Figure 5). This translates into an average regional slope of 1.92%; individual subwatershed slopes are shown in Table 8.

Table 8. Topography by Subwatershed

Subwatershed	Maximum Elevation (Feet)	Minimum Elevation (Feet)	Percent Slope
Fish Creek	1476	656	2.0
Fox Creek	1706	558	1.9
Bear Creek	1312	295	1.6
Gulf Stream	1706	722	1.6
Lindsey/Skinner	1214	262	1.4
Little Sandy Creek	1410	262	1.4
Deer Creek	1082	262	1.4
Upper South Sandy Creek	1738	558	1.3
Upper Sandy Creek	1574	656	1.0
Lower Sandy Creek	1181	262	0.9
Lower South Sandy Creek	689	262	0.8
North Branch	1214	656	0.7
Stony Creek	951	262	0.7
Little Stony/ Lakeview	558	262	0.6

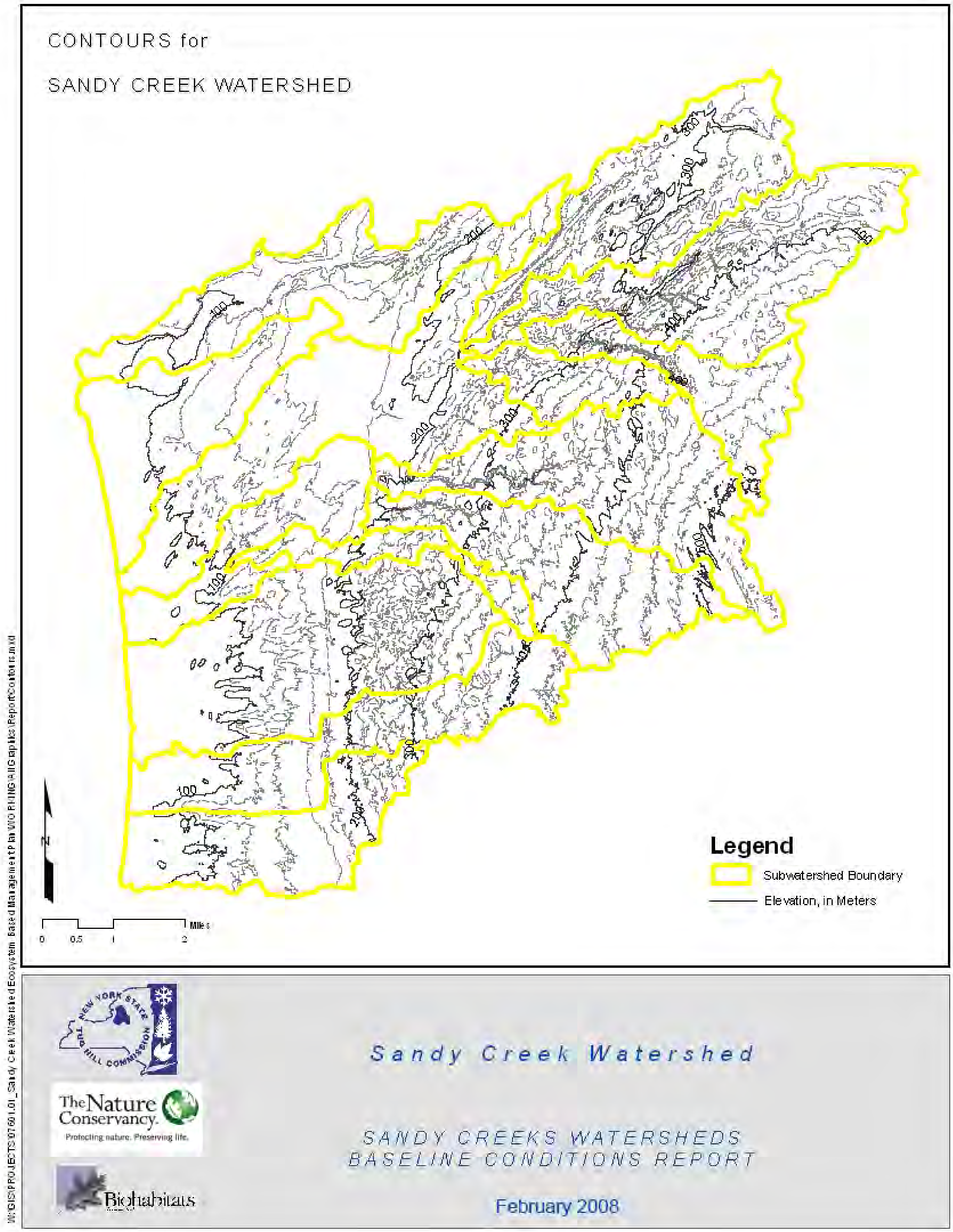

Figure 5. Contours for Sandy Creek Watershed

5.2 SOILS

Soils within the watershed are generally classified in four of the twelve soil taxonomy orders, the highest level of classification for soils. The most commonly mapped soil orders within the watershed according to the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey are Alfisols, Inceptisols, Entisols and Histosols, in no particular order. Alfisols are relatively more developed with moderate leaching and clay accumulations within the subsurface, while Inceptisols are weakly developed and Entisols have little to no morphological development. Histosols are classified as organic soils with high accumulations of organic matter and detritus. These soils groups are generally composed of compacted fine to moderately coarse materials with moderate to slow infiltration rates (hydrologic soils groups B and C).

Soils in the region are considered to be young, geologically speaking, having formed over glacial deposits after their retreat. As a result, they display little morphological development. Despite this, fertile soils can be found on river valley floodplain terraces which have progressively formed from alluvial deposits. The Tug Hill uplands are characterized by strongly acidic soils, which are not ideal for agriculture but support the development of woodland communities.

The fertility of soils in the lowland floodplains and the lack of arable lands in the plateau region explain the patterns of agricultural development throughout the region.

5.3 CLIMATE

The region has a continental climate characterized by warm, dry summers and cold, snowy winters with a growing season approximately eighteen to twenty weeks long. Tug Hill is renowned for its extreme precipitation, especially in the form of winter snowfall, which is some of the heaviest that occurs in the US east of the Rocky Mountains. The combination of winter winds blowing over some 150 miles of Lake Ontario waters and the 2,000-foot rise of Tug Hill creates these heavy snows, often over 200 inches annually. But "lake effect" snows can be very local, so snowfall amounts around the Tug Hill Region vary considerably.

Average annual precipitation in the region generally increases from west (thirty-eight inches) to east (fifty inches). Mean monthly temperatures tend to be below 20^{o} F in January, warming to above 70^{o} F in the summer months.

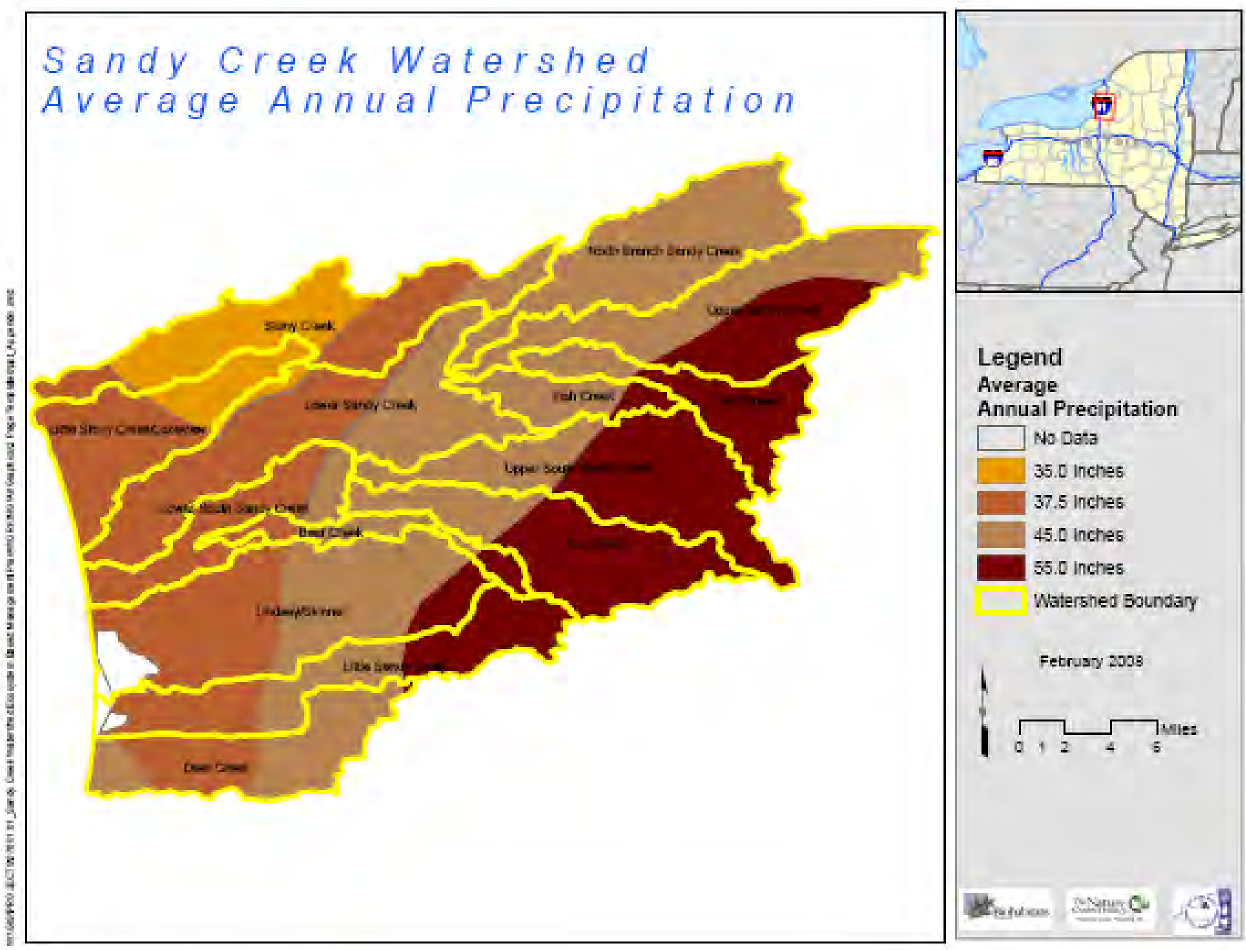

Figure 6. Sandy Creeks Watershed Annual Average Precipitation

5.4 HYDROLOGY, STREAM CHANNEL CONDITIONS, AND WATER QUALITY

As indicated in Section 3.5, only one USGS stream gauge is located within the study area, on Sandy Creek near Adams, NY (see Appendix 6). Mean monthly discharges at this station are displayed in Figure 7 below. Peak discharge for Sandy Creek at this station for the period of record is recorded as 7,700 cfs on Jan 19, 1996.

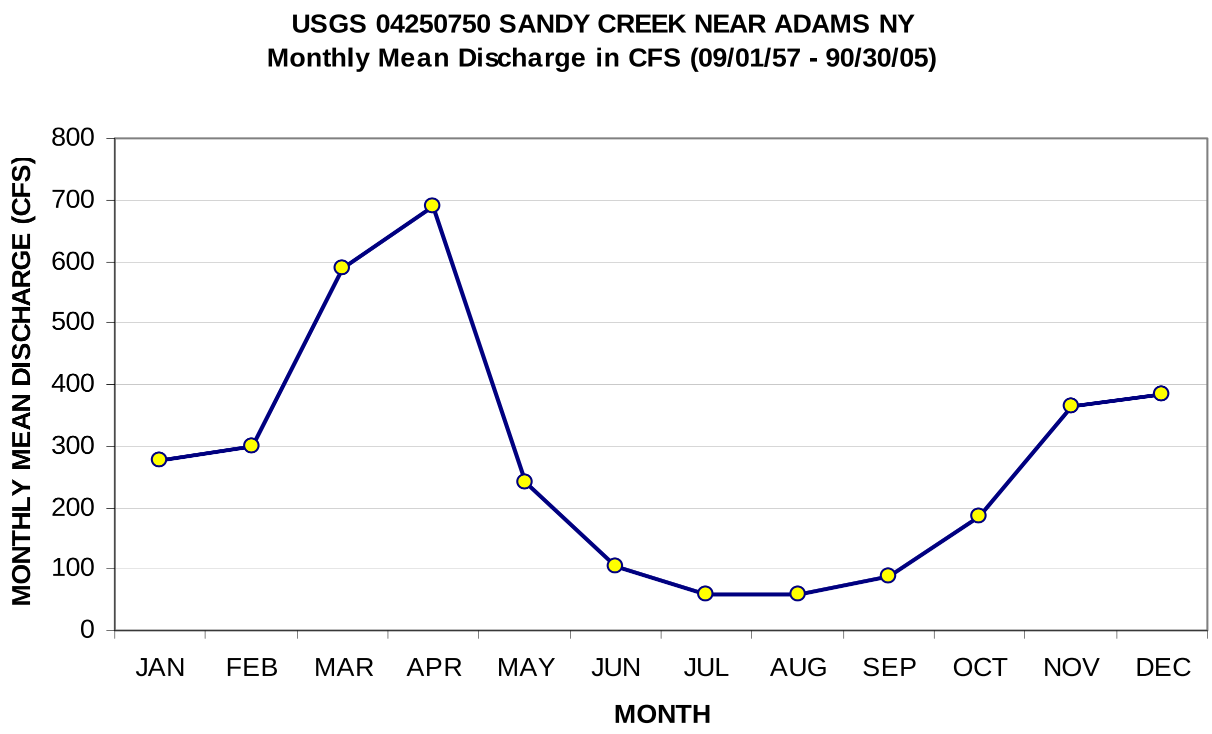

Figure 7. Sandy Creek Mean Monthly Discharge in Cubic Feet per Second (CFS)

Channel and riparian conditions for each subwatershed are noted in the subwatershed profiles, but are generally considered to be slightly impacted to un-impacted based on visual observations at the small sample of field reconnaissance sites (Appendices 4 and 5). Impacts typically were associated with more urbanized areas where land development has encroached on stream corridors and increased stormwater runoff rates and volumes as well as agricultural areas where stream buffers were absent or impacted by livestock access.

A limited data set of water quality exists for the region as a whole. New York State Department of Environmental Conservation (NYSDEC) has conducted isolated sampling as part of its Rotating Integrated Basin Studies (RIBS) initiative. For the reporting period ending in 2005, seven water quality sampling stations were established and monitored in the region (see Figure 8), with six of the seven being one-time macro invertebrate and field parameter (e.g., dissolved oxygen, pH, conductivity, and water temperature) collection efforts. The seventh station involved more extensive data collection, including a water column chemistry analysis with over ten discrete sampling events spanning a seven month time frame.

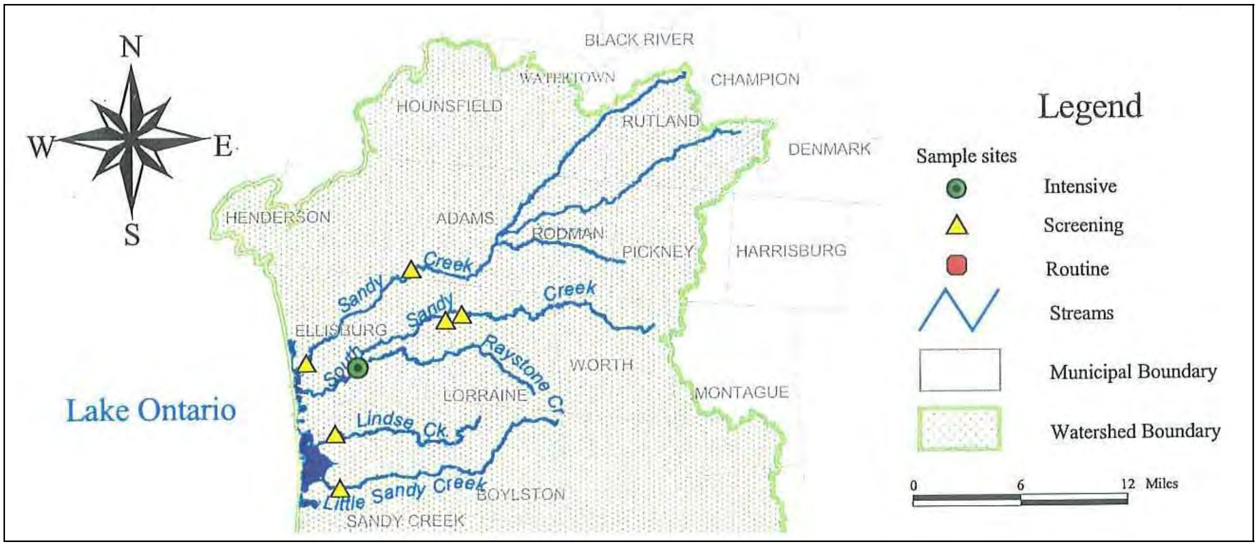

Figure 8. RIBS sampling stations in the Sandy Creeks Watersheds (source: NYSDEC, 2005).

The sampling locations were located in the western portion of the watershed region, with three of the locations in close proximity to Sandy Ponds and Lake Ontario. Of the seven sampling locations, four were reported as being slightly impacted and three were reported as non-impacted based on macro invertebrate indices. These conditions are consistent with the NYSDEC 2004 Lake Ontario Basin Waterbody Inventory and Priority Waterbodies List, which provides an assessment of water quality conditions for segments of tributaries to Lake Ontario. According to this study, the Lower Sandy Creek subwatershed (from confluence with Lake Ontario to Adams) is identified as having minor impacts to aquatic life from nutrients, organic loads and siltation from agricultural activities in the watershed, based on macro invertebrate and fish sampling. The upstream tributaries are listed as being in good condition.

These water quality data points support the general finding that surface water quality conditions are good; however, the lack of a continuous time series record and the relatively thin distribution of sampling locations across the full region (particularly the eastern portion of the watersheds, which comprise the headwater basins) makes extrapolating results with any confidence or scientific backing challenging. A more frequent (e.g., annual) and geographically broader sampling effort comparable to the RIBS protocol would bring more certainty to the understanding of the health of the region's receiving waters. Further, it would help with demonstrating ecosystem response to concerted conservation efforts or economic development efforts that are pursued with an eye towards minimizing environmental impacts (such as residential development using low impact development techniques to minimize stormwater runoff impacts).

5.5 TUG HILL AQUIFER

The Tug Hill Aquifer, a pronounced subsurface hydrologic feature within the Sandy Creeks Watersheds, is composed of an underground rock and soil formation of glacial outwash and stratified sands and gravels deposited by retreating glaciers. The 47 mile-long crescent shaped aquifer extends around the western and southwestern side of the Tug Hill region (Figure 9). Portions of the aquifer are either unconfined or confined (capped or in between impermeable material such as clay or glacial till) or under both conditions at different depths. The major river systems in the Sandy Creeks Watersheds feed the Tug Hill aquifer, which is a source of drinking water for municipalities and drinking water wells. The aquifer also supplies water for manufacturing, industrial, and agricultural purposes. The northern portion of the aquifer has been designated as an EPA Sole Source: The Safe Drinking Water Act authorizes EPA to designate aquifers which are the sole or principal source of drinking water for an area. To meet the criteria for designation, a sole source aquifer must supply at least 50 percent of the drinking water to persons living over the aquifer and there can be no feasible alternate source of drinking water. Once designated, EPA can review proposed projects that are to receive federal funds and which have the potential to contaminate the aquifer.

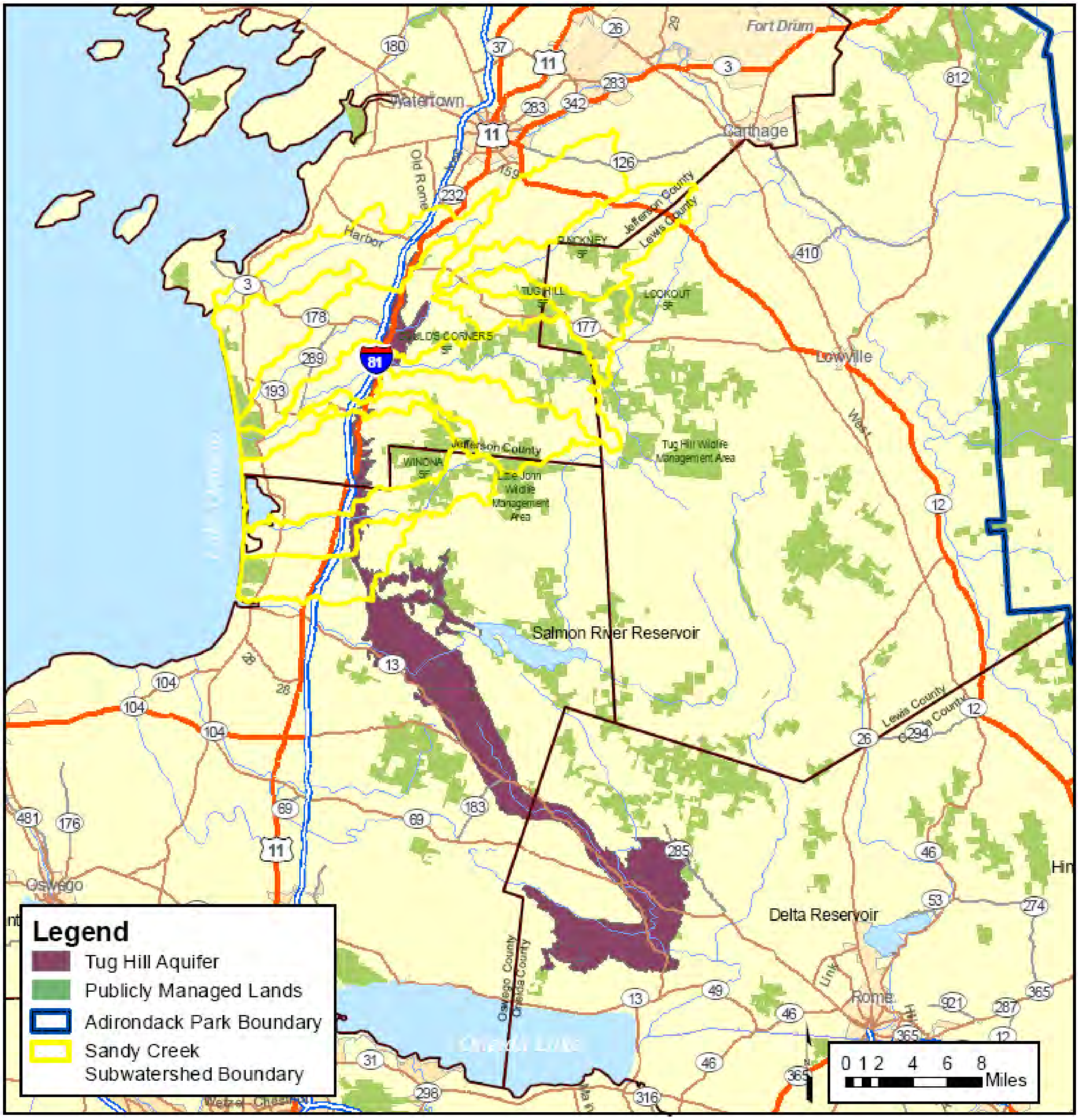

Figure 9. Tug Hill Aquifer (indicated by area colored in purple). Source: NYS Tug Hill Commission.

5.6 LAND COVER

Tug Hill is the third largest intact forested region in New York State. Tug Hill's forests are an important resource of the timber industry and are a valuable component of the New York State economy. Total forested land cover in the Sandy Creeks Watersheds (including deciduous, evergreen, and mixed forests, as well as palustrine forested wetland) is approximately 48% of the total land area. Deciduous forests alone cover 77,978 acres or 27% of the watershed area. The remaining major land cover types include scrub/shrub (50,046 acres or 17.6% of the watershed) and grassland (43,067 acres or 15.1% of the watershed). Land cover acreages for the entire Sandy Creeks Watersheds region as well as each subwatershed are shown in Table 9 below.

The majority of deciduous forest, evergreen forest, and mixed forest are located in the eastern portion of the Sandy Creek Watersheds within the plateau and escarpment regions. Forest fragmentation is prevalent in northwest and western portions of the Sandy Creek Watersheds, while larger, contiguous patches of deciduous, evergreen, and mixed forest land covers are found in the southeast near and within the Tug Hill State Forest boundary.

The majority of scrub/shrub habitats are found along the western portions of the Sandy Creeks Watersheds (to the north and northeast). Grassland habitats are located in western and northeast areas of the Sandy Creek Watersheds; the largest fields of grassland are concentrated in the northwest portions of the Ontario Lowlands. Cultivated land is primarily located in the northwest portions of the Ontario Lowlands where lacustrine silt and clay deposits (deposited under lake conditions) have formed soils suitable for agriculture. Large patches of palustrine scrub/shrub wetland and palustrine emergent wetland occur along the shoreline of Lake Ontario and extend inland along the riparian areas, while palustrine forested wetland is primarily located within the plateau and escarpment region along with the other forested land covers. Approximately 16.7% of the land area is covered by wetlands habitats (Figure 10).

Table 9. Subwatershed Land Cover Comparison

(Percent of Subwatershed Land Cover Acreage per Watershed Land Cover Acreage)

Subwatershed	High Intensity Developed	Low Intensity Developed	Cultivated Land	Grassland	Deciduous Forest	Evergreen Forest	Mixed Forest	Scrub/ Shrub	Palustrine Forested Wetland	Palustrine Scrub/Shrub Wetland	Palustrine Emergent Wetland (Persistent)	Bare Land	Water
Stony Creek	31.8	12.7	11.1	11.6	4.9	2.3	5.7	13.4	8.2	9.8	6.5	1.2	3.5
Little Stony Creek/Lakeview	0.0	7.8	14.2	9.7	1.8	1.8	2.2	7.2	4.5	7.5	12.0	40.7	9.3
North Branch Sandy Creek	2.8	12.2	9.1	14.0	5.9	0.6	1.4	10.2	5.9	7.2	9.1	0.7	2.5
Upper Sandy Creek	1.3	9.5	7.4	10.8	9.6	11.1	10.6	10.1	10.9	10.3	6.1	0.6	2.0
Gulf Stream	0.0	2.1	1.1	1.9	5.4	8.9	5.9	2.5	7.7	7.2	3.1	0.4	2.1
Fish Creek	0.0	1.8	1.4	1.6	3.4	4.5	4.6	2.0	2.7	1.9	0.8	0.0	0.3
Lower Sandy Creek	36.1	14.0	29.1	17.2	4.7	6.7	4.8	9.6	9.2	9.4	16.0	9.2	5.9
Upper South Sandy Creek	0.6	3.1	1.7	3.1	15.1	16.9	14.4	4.8	13.3	10.8	7.9	1.4	6.4
Fox Creek	0.2	2.1	0.6	3.5	13.6	8.2	10.8	4.4	10.3	8.1	4.4	0.0	3.7
Bear Creek	0.7	2.4	0.8	1.5	3.0	2.6	2.4	1.7	2.2	1.9	0.7	0.0	0.6
Lower South Sandy Creek	1.8	6.8	9.6	6.2	2.5	1.7	2.2	4.3	3.2	3.8	10.5	17.9	5.4
Lindsey/Skinner	6.0	12.8	7.7	7.7	13.1	22.0	18.0	14.4	9.9	9.6	8.5	21.8	48.4
Little Sandy Creek	14.0	7.2	2.7	4.8	10.7	7.7	9.4	7.4	6.8	5.8	5.1	5.2	7.8
Deer Creek	4.6	5.4	3.4	6.6	6.4	4.9	7.7	7.9	5.2	6.9	9.6	0.8	2.2
Percent of Land Cover per Total Watershed Acreage	0.2	3.4	9.1	15.1	27.4	6.7	1.6	17.6	11.9	3.3	1.5	0.3	1.8
Note:	3 Highest Values							3 Lowest Values					

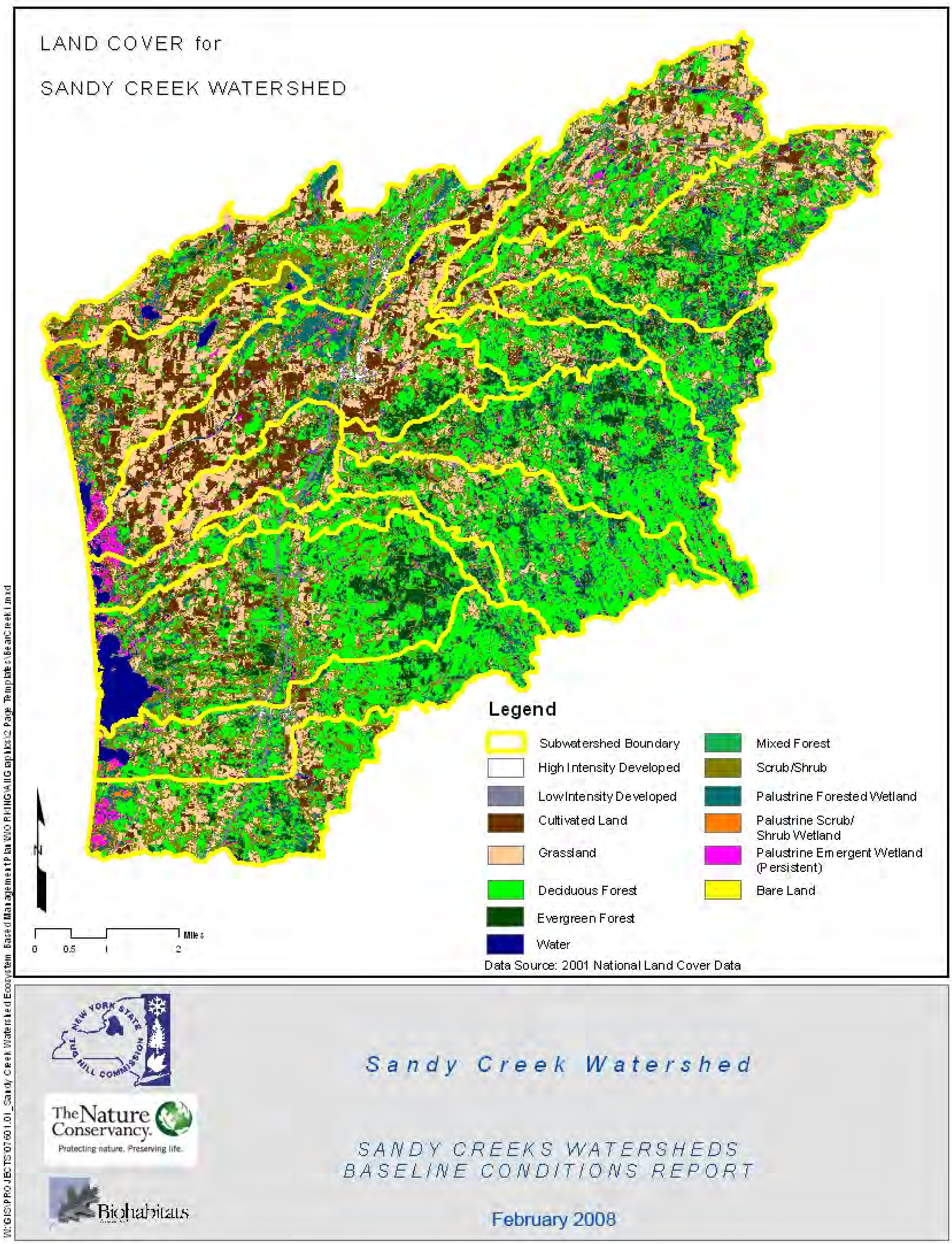

Figure 10. Land Cover for Sandy Creeks Watershed

High and low intensity developed land is situated along Interstate 81, which intersects the subwatersheds from north to south. The remaining transportation corridors are widely distributed like a spider web across the region and tend not to support high density urban development. These transportation corridors are potential barriers to the migration of aquatic and terrestrial organisms, and fragment habitat corridors. The degree to which they impact natural habitats is unquantified, but can be used as an initial metric of ecological disturbance (see Section 6).

A total of 53,339 acres, approximately 19%, of the Sandy Creeks Watersheds land area is protected from future development actions, with parcels in public ownership, land trusts, or designated for conservation status (Figure 11).

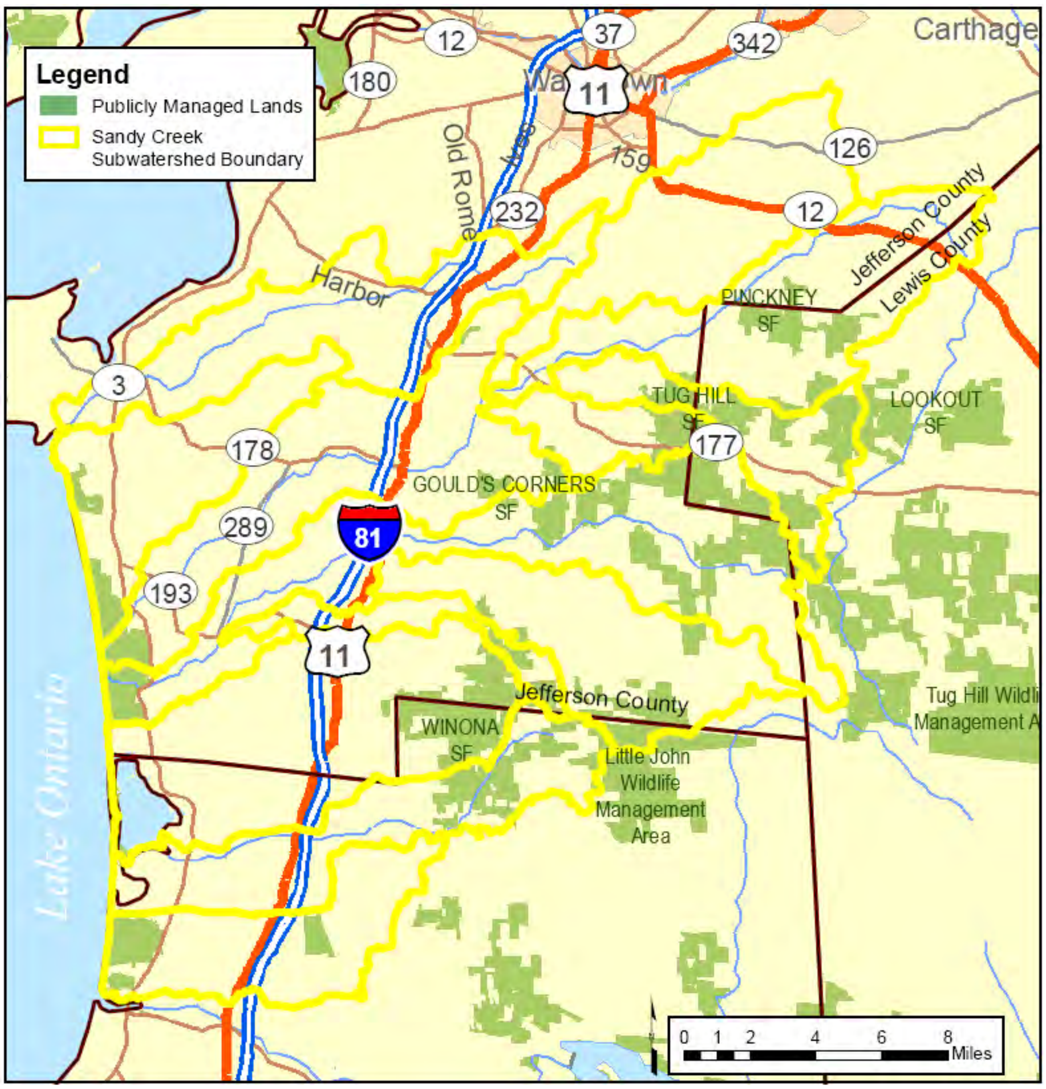

Figure 11. Publicly-owned lands in the Sandy Creeks Watersheds

In New York State, special protections are granted to coastal habitats that are determined to be Significant Coastal Fish and Wildlife Habitats (SCFWH) by NYSDEC, and designated by New York State Department of State (NYSDOS). Within the Sandy Creeks Watershed, there are five complexes of SCFWH, comprising the coastal areas adjacent to Lake Ontario and extending into the floodplain, wetland, and riparian habitats of the major tributaries (Figure 12). Each of these areas has a “Significance Value” rating, based upon the following metrics: ecosystem rarity, species vulnerability, human use, population level, and replaceability. These metrics are scored by NYSDEC staff, the total “Significance Value” provides a relative measure of the ecological value of the site.

From north to south, these areas and their “Significance Values” (in parentheses) are:

- *El Dorado Beach and Black Pond Wetlands (71)*
- *Lakeview Marsh (157)*
- *North and South Sandy Ponds (125)*
- *Sandy Pond Tributaries (44)*
- *Deer Creek Marsh (92)*

Specific habitats associated with each SCFWH complex are included in Appendix 8. Figure 13 below, depicts wetland features over the entire watershed.

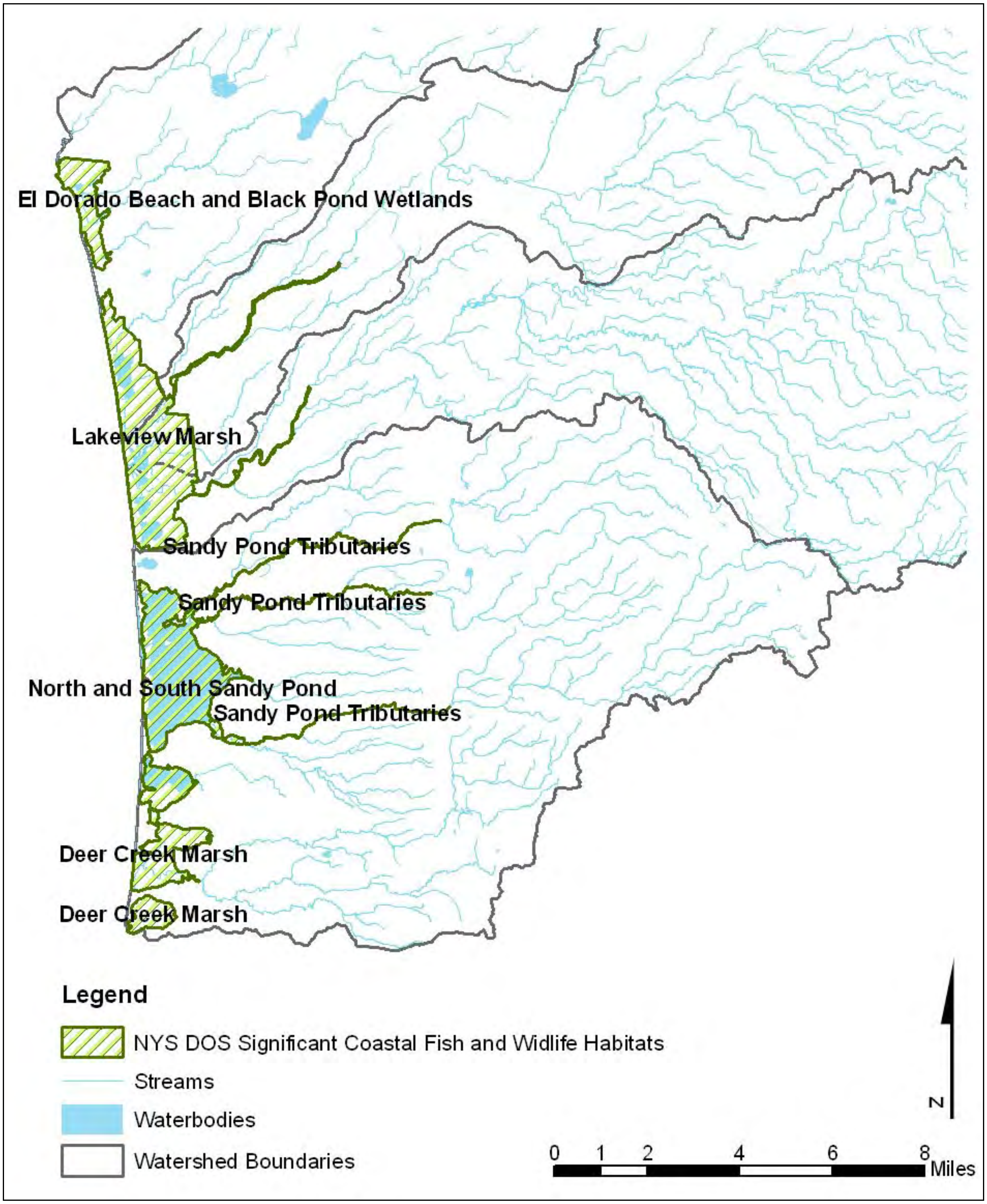

Figure 12. NYS DOS designated Significant Coastal Fish and Wildlife Habitats

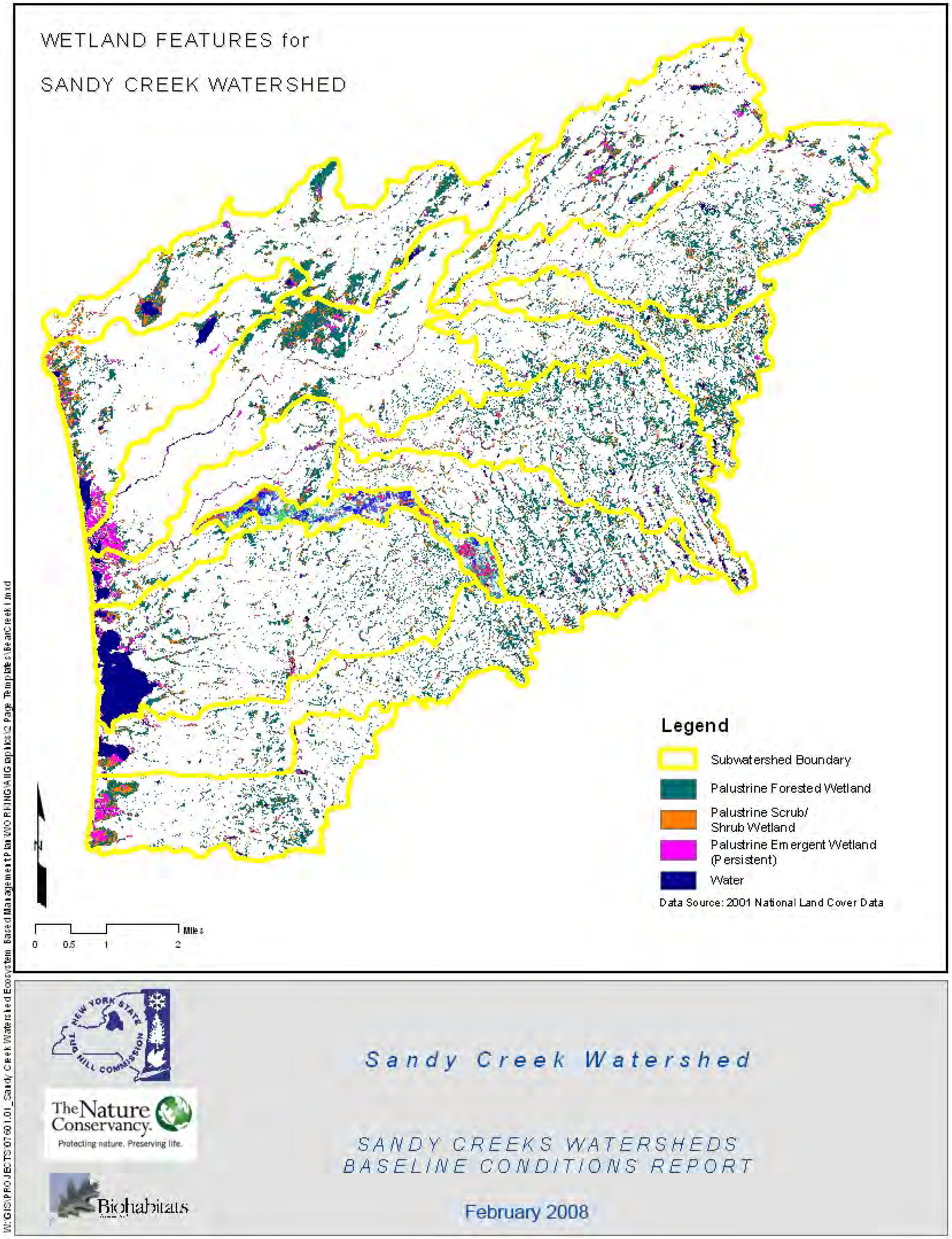

Figure 13. Wetlands in the Sandy Creeks Watershed and Subwatersheds

The following tables provide a comparison across all of the Sandy Creeks subwatersheds of select land cover features. The top and bottom values associated with each data set and metric have been shaded to facilitate review. The data are presented in two basic formats – raw data (Table 10) and normalized data based on subwatershed area (Table 11).

Table 10. Raw Data of Land Cover Features for Sandy Creeks Watershed

Subwatershed	Area (square miles)	Stream (miles)	Classified Wetland Area (acres)	Managed Lands (acres)
Stony Creek	38.5	36.1	1990	124
Little Stony Creek/Lakeview	27.5	30.2	1939	2380
North Branch Sandy Creek	35.4	40.4	997	0
Upper Sandy Creek	43.2	60.0	687	3849
Gulf Stream	19.2	25.0	947	4829
Fish Creek	11.0	17.3	49	1995
Lower Sandy Creek	49.3	60.3	2697	2482
Upper South Sandy Creek	41.2	81.0	934	10216
Fox Creek	33.4	68.7	852	5110
Bear Creek	9.2	16.2	27	1322
Lower South Sandy Creek	19.7	35.8	866	2482
Lindsey/Skinner	56.7	96.2	1789	6326
Little Sandy Creek	32.9	63.8	1807	4302
Deer Creek	27.3	40.4	2165	1861
Note:	Highest Values		Lowest Values	

Table 11. Normalized Data for Sandy Creeks Watersheds Land Cover

Subwatershed	Road Density (miles of road per square mile)	Drainage Density (miles of stream per square mile)	Managed Land (acres per square mile)
Stony Creek	2.40	0.9	3.2
Little Stony Creek/Lakeview	2.20	1.1	86.6
North Branch Sandy Creek	1.80	1.1	0.0
Upper Sandy Creek	1.84	1.4	89.1
Gulf Stream	1.43	1.3	251.1
Fish Creek	1.84	1.6	181.6
Lower Sandy Creek	2.23	1.2	50.4
Upper South Sandy Creek	1.58	2.0	247.9
Fox Creek	1.40	2.1	152.8
Bear Creek	2.40	1.8	143.8
Lower South Sandy Creek	2.62	1.8	125.7
Lindsey/Skinner	2.38	1.7	111.5
Little Sandy Creek	2.65	1.9	130.9
Deer Creek	2.13	1.5	68.2
Note:	Highest Values		Lowest Values

5.7 VEGETATION AND WILDLIFE

Formal documentation on the plant and animal communities specific to the Sandy Creeks Watersheds is sparse; however, the natural communities of the greater Tug Hill region have been well-documented. The following descriptions are excerpted from the *Oneida Lake State of the Lake and Watershed Report*, 2003, and the *Tug Hill Tomorrow Land Trust Strategic Land Conservation Plan*, 2006; providing an overview of natural communities in the greater Tug Hill region (of which Sandy Creeks Watersheds comprises the northwestern portion), modified in some instances to reflect conditions specific to the Sandy Creeks Watersheds.

The Tug Hill Plateau supports an upland core forest dominated by sugar and red maple, American beech, and yellow birch, mixed with spruce-fir and hemlock. Outside of the core forest, conifer plantations exist, as well as abandoned agricultural fields and cutover areas in various stages of succession that will ultimately result in a mixed hardwood forest. Coniferous species include red spruce, balsam fir, hemlock, and white-pine. Naturally occurring coniferous forests exist around the rims of deep gorges and ravines, in the higher elevations of the upland core area, and in swampy woods. Much of the state-owned land in the Tug Hill region has been reforested as coniferous plantations consisting mostly of white pine, red pine, Austrian pine, jack pine, Scotch pine, Norway spruce, white spruce, and European larch.

Big game animals such as white-tailed deer use the deciduous forests during the warmer months while moving into the coniferous stands to find winter refuge. Fur-bearing animals such as the beaver, mink, muskrat, otter, and fisher occupy the wetlands and forested waterways. Low-lying wetlands also support significant populations of waterfowl, snowshoe hare, and many species of amphibians and reptiles. Forest fringe areas provide excellent habitat for numerous songbird species, woodcocks, ruffed grouse, and many other small mammals. Trout and other cool water fishery species abound in the waters that flow from Tug Hill. Several species of rare plants and animals have been documented by the New York Natural Heritage Program including bird’s-eye primrose, large-leaf aster, soft fox sedge, rock cress, Jacob’s ladder, and the raven.

American elm and red maple are the dominant species found in the moist forest lands of the Lake Plain, while sugar maple and beach are the dominant species characterizing the forest canopy in areas of well-drained soils. Scattered patches of aspen, pitch pine, black, red and white oak, black gum, and yellow-poplar are also present throughout the Lake Plain region.

The active farm and pasturelands in the watershed serve an important role for wildlife by providing fringe habitats, open areas and food. Pastures are often the first areas free of snow and the first to green up in the spring, replenishing the food source. Cultivated croplands provide corn and other food for wildlife. Deer, squirrel, Canada goose, and crow are among the many wildlife species that take advantage of farm fields.

Shrublands are areas of dense thickets comprised of shrubs, saplings, grasses and flowering plants and are common in the fringe areas between the active farmlands and forestlands. The converging habitat types (open/sheltered) and variety of food sources (seeds, fruits, grasses) available in shrubland areas attract wildlife species and contribute to the diversity of the overall landscape. Field-side shrubland is characterized by tall grasses and provide ideal habitat for birds, such as woodcock, and small mammals, such as mice and voles. Not surprising, aerial predators, such as hawks and owls are also attracted to open shrubland areas.

An analysis of biodiversity and species richness was performed by Cornell University in the Tug Hill Region. The New York GAP analysis program determined that woodlands comprised by sugar maple mesic, successional hardwoods, and evergreen-northern hardwood, as well as deciduous wetlands, ranked extremely high in species richness. Areas of marginal biodiversity are located within the agricultural and pastoral areas in northern and northeast regions (including parts of the Sandy Creeks Watersheds). This is associated with disturbance and fragmentation of native old-growth woodland habitats, and replacement with land cover types that support less diversity (such as agricultural fields) (Cornell University, 2006).

Rare, Threatened, and Endangered Species

Several rare, threatened, and endangered species occur in the Sandy Creeks region. Piping plover (*Charadrius melodus)* is listed as federally endangered bird, with nesting and foraging habitat occurring along the shoreline of Lake Ontario in from the Salmon River (Oswego County) to Stony Point (Jefferson County). The bog turtle (*Clemmys muhlenbergii*) is listed as threatened in Oswego County. The New York State endangered short-eared owl (*Asio flammeus*) occurs in Jefferson County, preferring large, open sites that support rodent populations (such as agricultural plots). The federally-threatened bald eagle (*Haliaeetus leucocephalus*) and federally-endangered Indiana bat (*Myotis sodalist*) occur across the entire state of New York. The New York State endangered Bog Buckmoth (*Hemileuca* spp.) moth occurs in Oswego County; it occurs in palustrine peatlands or wetlands along the Lake Ontario shoreline.

The Nature Conservancy lists the bobcat, red spruce, blackburnian warbler, eastern pearlshell mussel, moose, fisher, goshawk, marten, and brook trout as species of note in the Tug Hill region.

Invasive Species

Invasive plants in the Sandy Creeks watersheds include black and pale Swallow-wort (*Cynanchum louiseae* & *C. rossicum*), giant hogweed (*Heracleum mantegazziamum*), purple loosestrife (*Lythrum salicaria*), European frogbit (*Hydrocharis morsus-ranae*), and Japanese knotweed (*Polygonum cuspidatum*) (Cornell University Cooperative Extension, 2007). Their distribution and degree of infestation in the watershed is unreported, except for a limited field surveys from 2004-2006 documenting Swallow-wort infestation in the Stony Creek and Little Stony/Lakeview subwatersheds.

The St. Lawrence Eastern Lake Ontario Weed Management Area (SLELO WMA) was formed in January 2006 to create a cooperative and coordinated approach in the prevention and management of invasive plants. SLELO is a cooperative effort among the following agencies: Cornell Cooperative Extension of Jefferson, Lewis, & St. Lawrence counties; NYS Dept. of Environmental Conservation, Region 6; NYS Office of Parks, Recreation & Historic Preservation, 1000 Islands Region; The Nature Conservancy; USDA Natural Resources Conservation Service; NYS Dept. of Transportation, Region 7.

6.0 SUBWATERSHED PROFILES

A series of subwatershed profiles were developed using the available data. Each profile should be viewed as an initial understanding of key characteristics of the subwatershed, which can be updated and expanded on as new and more detailed data are collected and developed for a given subwatershed. The profiles also enable a reviewer to recognize the lack of comprehensive ecological data sets for all 14 subwatersheds. Finally, breaking out the available data sets by the 14 subwatersheds provides an opportunity to conduct types of comparative analyses that can be used to inform a prioritization process for collecting additional data and developing management strategies for conservation and restoration.

For each subwatershed the following core data are summarized: municipal boundaries/urban influences, hydrology, precipitation, land cover, soils, wetlands, managed lands (as defined by the TNC GIS data layer, see Appendix 2), field reconnaissance, socio-economic conditions, and related studies. Where available, subwatershed profiles were supplemented with unique data to that specific subwatershed such as: invasive species, biological assessments, stream gaging record, and water quality information. Subwatershed maps have been prepared that show selected data elements (Appendix 9). Each subwatershed is accompanied by a four panel sequence that includes: topography, land cover, hydrography (wetlands and streams), and managed lands.

Each of the following subwatershed reports is written so that it can stand alone and serve as a watershed-specific handout for public meetings or other stakeholder engagement purposes. As a result, readers will notice that some of the information presented in profiles becomes redundant (e.g., explanation of soil groups and relevant existing studies). Again, the repetition is intentional so that these descriptions may best serve individual subwatersheds' needs.

For readers wishing to bypass the individual subwatershed descriptions, please turn to Section 7: Findings and Recommendations.

6.1 STONY CREEK

Located in the Sandy Creek to Stony Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Stony Creek subwatershed is located entirely within Jefferson County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Watertown, Hounsfield, Henderson, Rodman, and Adams. The transportation system has a road density of 2.4 miles of road per square mile. There are a total of 91 road/stream crossings with a density of 2.4 crossings per square mile within the subwatershed.

Hydrology

The Stony Creek subwatershed comprises approximately 58% of the total drainage area in the northern section of the Sandy Creek to Stony Creek Watershed. Stony Creek subwatershed has a drainage area of 24,618 acres (38.5 square miles) with a drainage density of 0.9 stream miles per square mile. The total stream length within the subwatershed is 36.1 miles. There is one significant tributary identified in the subwatershed: Stony Creek.

Precipitation

Table 12 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 12. Stony Creek Average Annual Precipitation From East to West, in general.

% of Subwatershed Area	Precipitation (inches)
12	45
37	37.5
51	35

Land Cover

The major land cover consists of scrub/shrub and grassland. Refer to Figure 14 for a graphic representation of the land cover composition for the entire subwatershed.

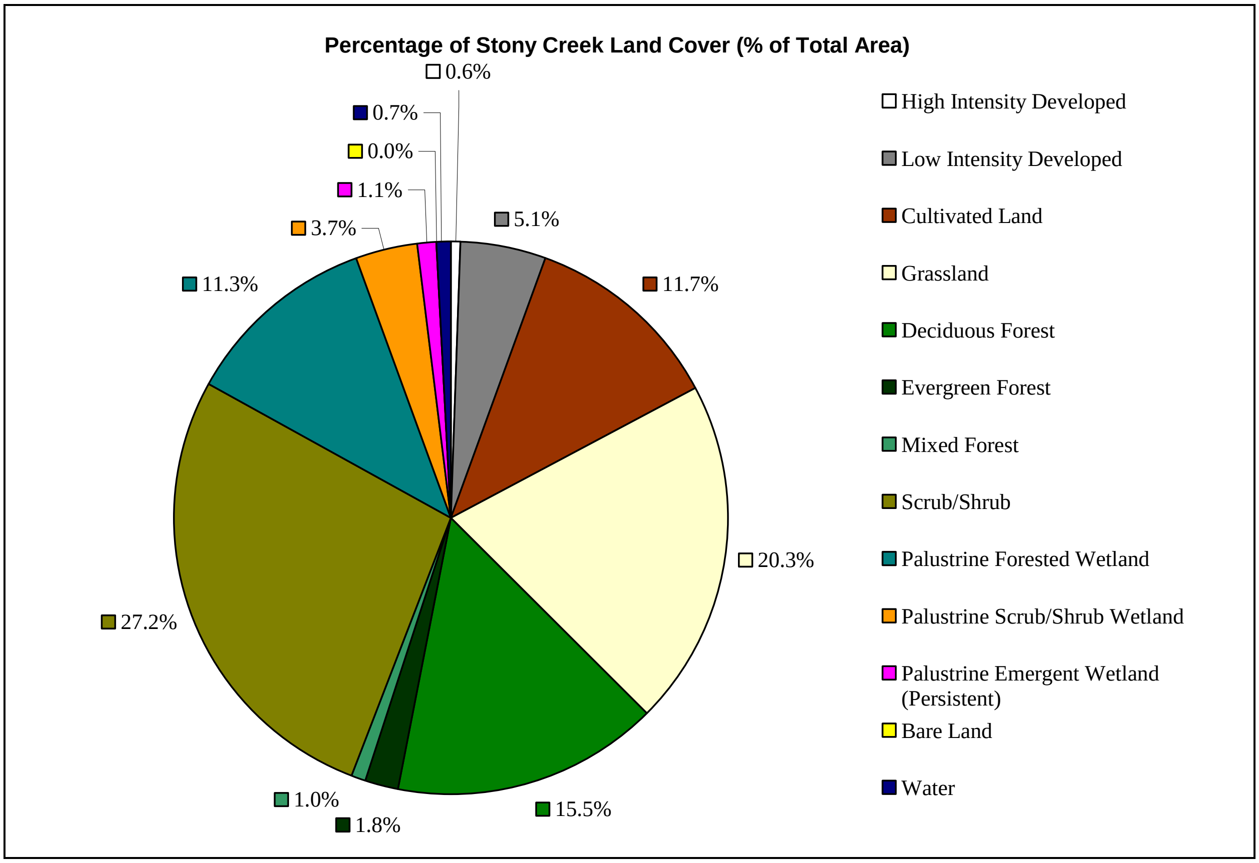

Figure 14. Stony Creek Land Cover Composition

Soils

The general soils map for New York, developed by USDA NRCS, was used to determine the soils delineated within the subwatershed. A general soils map is created by combining delineations of an existing soil survey, such as a county soil survey, to form broader map units no smaller than 2,500 acres with a 1:250,000 scale. The smallest delineation allowed for a county soil survey map unit ranges from approximately 1 to 10 acres depending on mapping scale. Therefore, a general soil map can be used to reveal geographic relationships and to compare the suitability of large areas for general land uses. Due to the larger, generalized map units of a general soils map, it is not suitable for planning the management of a particular field or selecting a site for development. A county soil survey or a professional soil scientist should be consulted for a more detailed interpretation of existing soil map unit composition. For more precise management decisions and interpretations, a soil scientist can survey and describe the soil series in smaller delineations for a specific area of interest.

Table 13 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under similar storm and cover conditions. Refer to Table 14 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 13. General Soil Map Units in Stony Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5888	Ontario-Madrid-Bombay	2306	9.4
s5930	Wilpoint-Guffin-Galoo-Chaumont	1061	4.3
s5942	Oakville-Elnora-Colonie	111	0.5
s5950	Palmyra-Howard-Alton	3720	15.1
s5987	Rhinebeck-Niagara-Hudson-Dunkirk-Collamer	4932	20.0
s5988	Niagara-Canandaigua	6087	24.7
s5989	Minoa-Lamson-Galen-Arkport	1496	6.1
s5990	Palms-Edwards-Carlisle	389	1.6
s6007	Stockbridge-Galway-Farmington	2129	8.6

Table 14. Stony Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	111	0.5
B	6026	24.5
C	17031	69.2
D	1061	4.3
A/D	389	1.6

Notes: HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.

U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

Wetlands

There are 1,990 acres of classified wetlands, approximately 8% of the total area, within Stony Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 15 for the acres of wetland by classification within the subwatershed and Appendix 12 for a detailed description of each classification.

Table 15. Stony Creek Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	841.3	3.4
Class II	707.2	2.9
Class III	441.5	1.8
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	NA	NA

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes
II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

Managed Lands

Stony Creek subwatershed contains 124 acres (0.5% of subwatershed area) of managed land. All 124 acres of managed land within Stony Creek is managed by New York State.

Invasive Species

There are documented locations of Swallow-wort infestation (an invasive non-native vine) along the northern boundary and throughout Stony Creek subwatershed and within Little Stony Creek/Lakeview subwatershed. The majority of known infestation locations extend beyond the northern boundary of Stony Creek. The Swallow-wort locations represent all locations of infestation visited during the 2006 field season.

Field Reconnaissance

A field reconnaissance was conducted by Biohabitats from April 9 to 11, 2007. Observations were based on a visual and qualitative overview of each subwatershed. Photographs and a visual observation survey characterizing the existing land use, forest cover, invasive vegetation, and stream crossing were completed at pre-selected road and stream crossings.

The field observations within the subwatershed concluded: A sampling point in the upper portion of the subwatershed is situated in a deciduous forest/residential area. The stream channel is bedrock dominated with little to no erosion. Lower in the subwatershed, agriculture becomes the dominate land use with forests limited to narrow strips along the streams. Impacted buffers due to the agricultural land use are causing some stream bank erosion. Overall the water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 16. Market Value per Acre by Land Use in Stony Creek

Stony Creek							
Land Use	Est. Acreage in Upper Stony Creek	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Stony Creek	% of Total MV in Stony Creek	Per Acre MV in Stony Creek	Per Acre MV in Sandy Creeks Watershed
Agricultural	10,707	45.43%	36.23%	$10,969,315	5.30%	$1,025	$828
Residential	5,654	23.99%	21.78%	$162,254,455	78.43%	$28,696	$10,594
Vacant	4,021	17.06%	14.18%	$3,026,048	1.46%	$753	$791
Commercial	311	1.32%	0.72%	$12,328,308	5.96%	$39,641	$24,972
Recreation and Entertainment	47	0.20%	0.60%	$199,032	0.10%	$4,211	$9,695
Community Service	81	0.35%	0.24%	$13,922,956	6.73%	$170,897	$145,997
Industrial	538	2.28%	0.67%	$1,160,148	0.56%	$2,156	$1,519
Public Service	154	0.65%	0.92%	$1,033,041	0.50%	$6,706	$5,470
Public Parks, Wild, Forest	2,057	8.73%	24.65%	$1,978,277	0.96%	$962	$746
Totals	23,571	100.00%	100.00%	$206,871,580	100.00%	$28,338	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.
MV – Market Value

- Stony Creek has a smaller percentage of land used for public park and forested land (9%) than on average for the Watershed (25%).
- The market value of land per acre in Stony Creek is higher than the Watershed averages for all land categories, except recreation and entertainment and vacant land.

Existing Studies

Few existing studies associated with Stony Creek subwatershed were found as part of this project effort. However, one broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario (Brown & Connelly, 2002). This study has limited applicability to the rest of the subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University (CRP, 2006). The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of the articles' content, and the references for these documents are detailed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006

6.2 LITTLE STONY CREEK/LAKEVIEW

Located in the Sandy Creek to Stony Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Little Stony Creek/Lakeview subwatershed is located entirely within Jefferson County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Henderson, Ellisburg, and Adams. The transportation system has a road density of 2.2 miles of road per square mile. There are a total of 42 road/stream crossings with a density of 1.5 crossings per square mile within the subwatershed.

Hydrology

Little Stony Creek/Lakeview subwatershed comprises approximately 42% of the total drainage area in the northern section of the Sandy Creek to Stony Creek Watershed. Little Stony Creek subwatershed has a drainage area of 17,585 acres (27.5 square miles) with a drainage density of 1.1 stream miles per square mile. The total stream length within the subwatershed is 30.2 miles. There is one significant tributary identified in the subwatershed: Little Stony Creek.

Precipitation

Table 17displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 17. Little Stony Creek/Lakeview Average Annual Precipitation from East to West, in general.

% of Subwatershed Area	Precipitation (inches)
31	35
69	37.5

Land Cover

The major land cover is grassland followed closely by cultivated land and scrub/shrub. Refer to Figure 15 for a graphic representation of the land cover composition for the entire subwatershed.

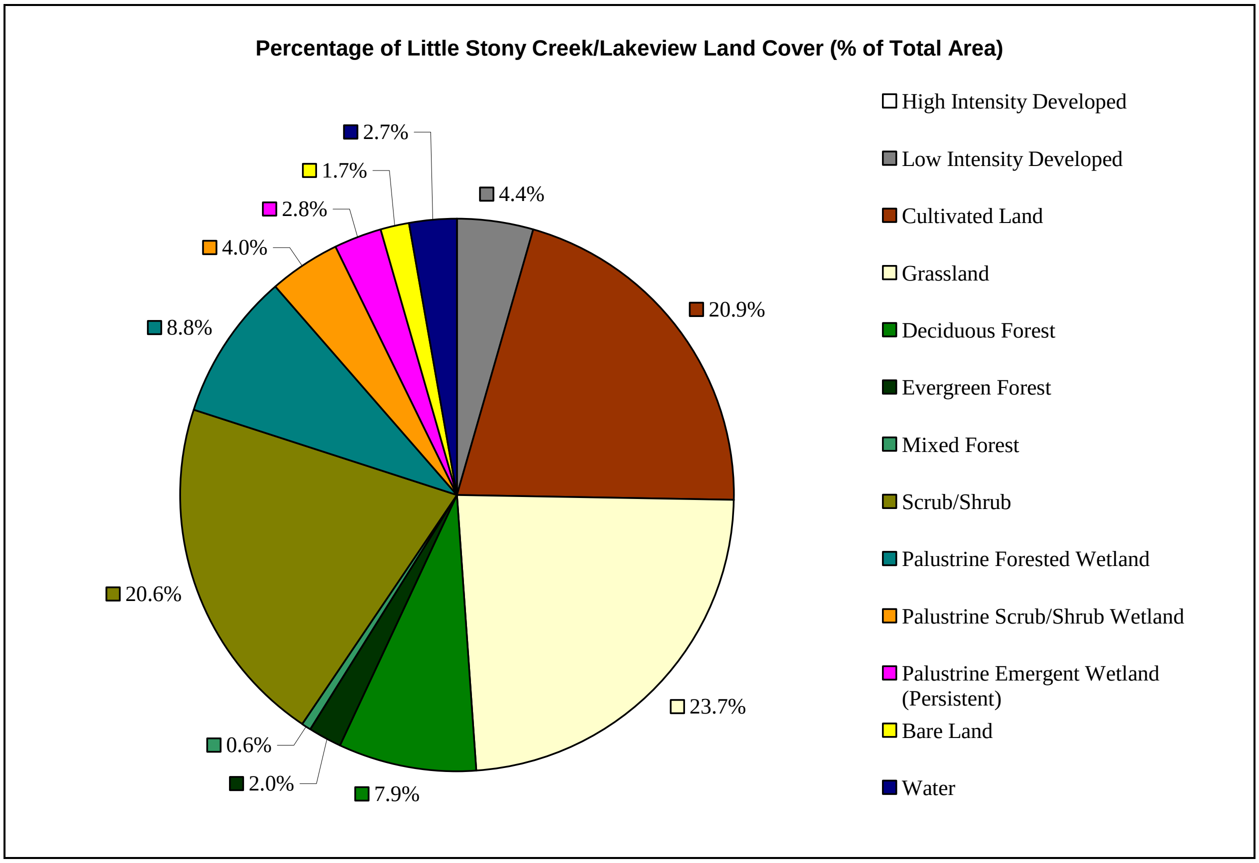

Figure 15. Little Stony Creek/Lakeview Land Cover Composition

Soils

Table 18 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under storm and cover conditions. Refer to Table 19 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 18. General Soil Map Units in Little Stony Creek/Lakeview

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5930	Wilpoint-Guffin-Galoo-Chaumont	635	3.6
s5942	Oakville-Elnora-Colonie	6512	37.0
s5969	Wayland-Saprists-Fluvaquents-Aquents	1344	7.6
s5987	Rhinebeck-Niagara-Hudson-Dunkirk-Collamer	1631	9.3
s5988	Niagara-Canandaigua	4217	24.0
s5989	Minoa-Lamson-Galen-Arkport	216	1.2
s5991	Wassaic-Lairdsville-Farmington	1508	8.6
s6007	Stockbridge-Galway-Farmington	1509	8.6

Table 19. Little Stony Creek/Lakeview Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	905	5.1
B	1935	11.0
C	13499	76.8
D	2	0.01

Notes:
HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

<u>Wetlands</u>

There are 1,939 acres of wetlands, approximately 11% of total area, of wetlands within Stony Creek subwatershed. A wetland classification system was developed to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 20 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 20. Little Stony Creek/Lakeview Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	1291.2	7.3
Class II	406.7	2.3
Class III	240.7	1.4
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	NA	NA
Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV. *New York State Department of Environmental Conservation May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.*		

<u>Managed Lands</u>

Little Stony Creek/Lakeview subwatershed contains 2,380 acres (13.5% of subwatershed area) of managed land. The total managed land within Little Stony Creek/Lakeview is managed by the following: 2,118 acres by New York State and 261 acres by The Nature Conservancy.

<u>Invasive Species</u>

There are documented locations of Swallow-wort infestation (an invasive non-native vine) along the northern boundary and throughout Stony Creek subwatershed and within Little Stony Creek/Lakeview subwatershed. The majority of the infestation locations during 2006 extend beyond the northern boundary of Stony Creek. These sample points were taken in 2006 and represent all known locations of Swallow-wort infestation sites visited during that field season. There are also a limited number of known Swallow-wort locations based on one 2004-2005 sample effort. These sample locations are mostly contained within Little Sandy Creek/Lakeview subwatershed.

<u>Field Reconnaissance</u>

The field observations within the subwatershed concluded: The majority of land use in Little Stony Creek/Lakeview subwatershed is agricultural, primarily dairy farms, with a smaller portion as rural residential. In the lower part of the watershed closer to Lake Ontario, forested wetlands appears to make up the rest of the land. Some bank erosion is occurring in residential areas with impacted buffer zones lower in the subwatershed. Overall water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 21. Market Value per Acre by Land use in Little Stony Creek

Little Stony Creek							
Land Use	Est. Acreage in Little Stony Creek	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Little Stony Creek	% of Total MV in Little Stony Creek	Per Acre MV in Little Stony Creek	Per Acre MV in Sandy Creeks Watershed
Agricultural	10,178	64.43%	36.23%	$10,723,113	14.98%	$1,054	$828
Residential	1,842	11.66%	21.78%	$42,458,116	59.32%	$23,048	$10,594
Vacant	1,571	9.94%	14.18%	$2,709,251	3.79%	$1,725	$791
Commercial	131	0.83%	0.72%	$1,033,476	1.44%	$7,916	$24,972
Recreation and Entertainment	532	3.37%	0.60%	$5,305,647	7.41%	$9,978	$9,695
Community Service	19	0.12%	0.24%	$152,671	0.21%	$8,086	$145,997
Industrial	150	0.95%	0.67%	$239,106	0.33%	$1,598	$1,519
Public Service	1	0.01%	0.92%	$139,812	0.20%	$121,575	$5,470
Public Parks, Wild, Forest	1,374	8.70%	24.65%	$8,814,644	12.32%	$6,416	$746
Totals	15,797	100.00%	100.00%	$71,575,835	100.00%	$20,155	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- A very small percentage of land is residential in Little Stony Creek compared to the overall Watershed. On the other hand, more land is used for agriculture (64%) than in any other sub-watershed.
- Little Stony Creek also has a much lower percentage of public park and forest land than in the overall Watershed and it is much more highly valued in Little Stony Creek.

Existing Studies

Few existing studies associated with Little Stony Creek/Lakeview subwatershed were found as part of this project effort. However, one broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario (Brown & Connelly, 2002). This study has limited applicability to the rest of the subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University (CRP, 2006). The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix

1 provides a summary of the article's content, and the references for these documents are listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006

6.3 NORTH BRANCH SANDY CREEK

Located in the Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

North Branch Sandy Creek subwatershed is located entirely within Jefferson County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Watertown, Champion, Rodham, Adams, and Rutlands. The transportation system has a road density of 1.8 miles of road per square mile. There are a total of 58 road/stream crossings with a density of 1.6 crossings per square mile within the subwatershed.

Hydrology

North Branch Sandy Creek comprises approximately 23% of the total drainage area in far northern section of the Sandy Creek Watershed. North Branch Sandy Creek subwatershed has a drainage area of 22,677 acres (35.4 square miles) with a drainage density of 1.1 stream miles per square mile. The total stream length within the subwatershed is 40.4 miles. The significant tributaries identified in the subwatershed include: Boynton Creek, Freeman Creek, Jacobs Creek, North Branch Sandy Creek, and Staplin Creek.

Precipitation

Table 22 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 22. North Branch Sandy Creek Average Annual Precipitation from East to West, in general.

% of Subwatershed Area	Precipitation (inches)
100	45

Land Cover

The major land cover consists of grassland, scrub/shrub, and deciduous forest. Refer to Figure 16 for a graphic representation of the land cover composition for the entire subwatershed.

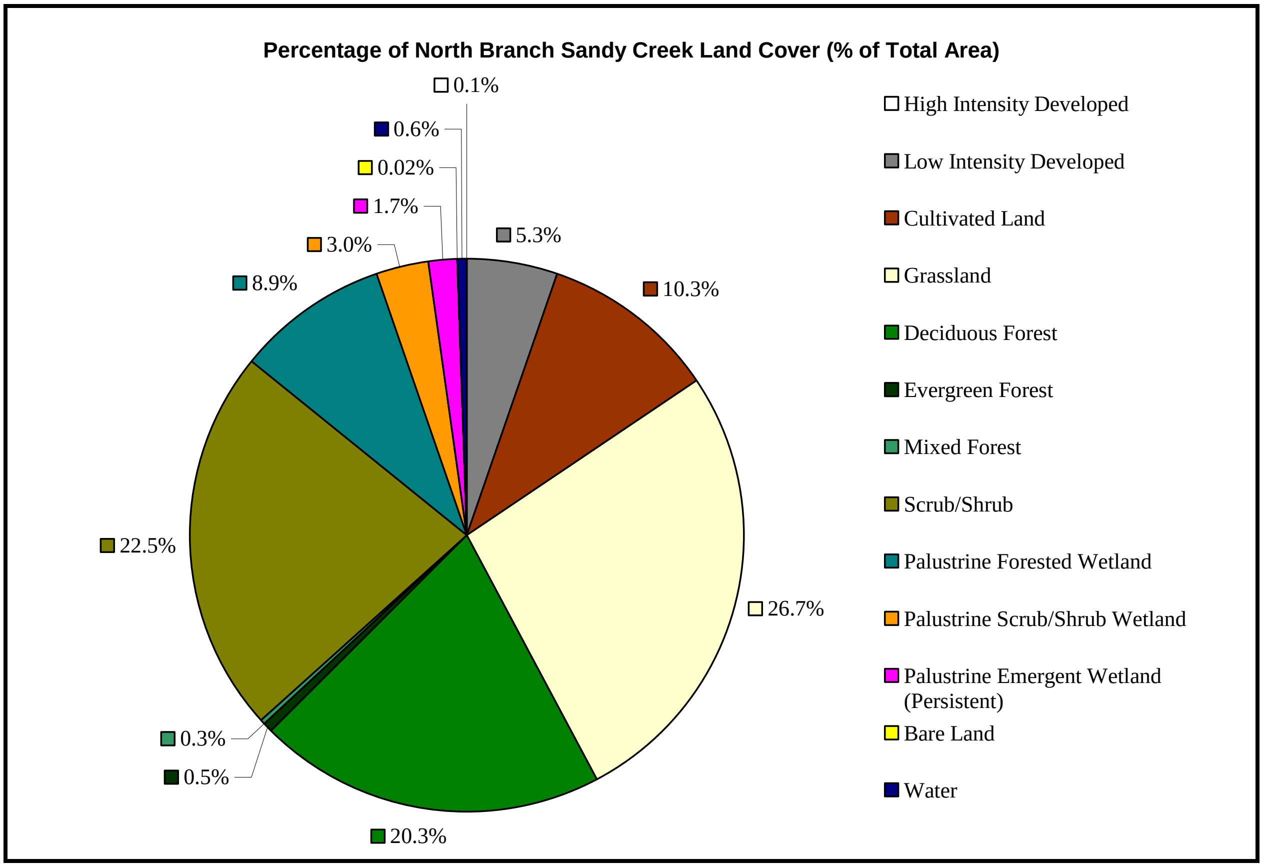

Figure 16. North Branch Sandy Creek Land Cover Composition

Soils

Table 23 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under storm and cover conditions. Refer to Table 24 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 23. General Soil Map Units in North Branch Sandy Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5888	Ontario-Madrid-Bombay	9972	44.0
s5950	Palmyra-Howard-Alton	153	0.7
s5991	Wassaic-Lairdsville-Farmington	8377	36.9
s5999	Pyrities-Malone-Kalurah	260	1.1
s6003	Tunbridge-Schroon-Bice-Berkshire	14	0.1
s6007	Stockbridge-Galway-Farmington	3900	17.2

Table 24. North Branch Sandy Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	-	-
B	18777	82.8
C	3900	17.2
D	-	-
Notes: HSG classes are defined as follows: A – High infiltration rate even when thoroughly wetted and low runoff potential. B – Moderate infiltration rate when thoroughly wetted. C – Slow infiltration rate when thoroughly wetted. D – Very slow infiltration rate when thoroughly wetted or high runoff potential. *U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.*		

Wetlands

There are 997 acres of wetlands, approximately 4.4% of the total area, within North Branch Sandy Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 25 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 25. North Branch Sandy Creek Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	NA	NA
Class II	791.1	3.5
Class III	205.8	0.9
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	NA	NA
Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV. *New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York*		

Managed Land

There is no managed land within the subwatershed's boundary.

Eroded Streambank and Current Condition Assessment

A stream assessment and inventory were conducted along 20 miles of Sandy Creek and North Sandy Creek documenting 28 eroding stream sites, 13 on Sandy Creek and 15 on North Sandy Creek. Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) methods along with observed soil erodability characteristics were used to estimate sediment load for each site. The results concluded North Sandy Creek is 4% eroding, a higher percentage of erosion than Sandy Creek at 2.5% eroding based on a ratio of length of eroding site to total length of stream bank documented. Field observation and documentation can be referred to in "*An Assessment of Sandy Creek and North Sandy Creek Jefferson County, NY*" prepared by Upper Susquehanna Coalition.

Biological Assessment

A biological assessment was conducted on Sandy Creek on August 19-20, 1997 with the purpose of assessing general water quality and establishing invertebrate data. All sites sampled in Sandy Creek from the village of Rodmand to North Landing were evaluated as slightly impacted based on nutrient enrichment, organic loading, and siltation results. The stream supported high levels of algae growth on substrate rocks. Fish Creek, a tributary of Sandy Creek, was assessed as non to slightly impacted with no adverse effects from the regional landfill. Sandy Creek and Fish

Creek were assessed as having good water quality based on the sampled fish communities (Stream Biomonitoring Unit, May 1998).

<u>Field Reconnaissance</u>

The field observations within the subwatershed concluded: A majority of the land use is agricultural, primarily dairy farms, with a scattering of residential. Forest fragmentation is occurring throughout the subwatershed. The streams have varying levels of buffer cover. Overall, the water clarity is clear. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

<u>Socioeconomic Analysis</u>

Table 26. Market Value per Acre by Land Use in North Branch Sandy Creek

North Branch Sandy Creek							
Land Use	Est. Acreage in North Branch	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in North Branch	% of Total MV in North Branch	Per Acre MV in North Branch	Per Acre MV in Sandy Creeks Watershed
Agricultural	12,871	60.56%	36.23%	$8,928,908	14.51%	$694	$828
Residential	4,130	19.43%	21.78%	$45,558,750	74.05%	$11,031	$10,594
Vacant	3,782	17.80%	14.18%	$1,896,378	3.08%	$501	$791
Commercial	83	0.39%	0.72%	$1,871,242	3.04%	$22,572	$24,972
Recreation and Entertainment	0	0.00%	0.60%	$70,000	0.11%		$9,695
Community Service	39	0.18%	0.24%	$1,367,809	2.22%	$35,280	$145,997
Industrial	48	0.22%	0.67%	$213,726	0.35%	$4,475	$1,519
Public Service	27	0.13%	0.92%	$1,512,489	2.46%	$55,241	$5,470
Public Parks, Wild, Forest	274	1.29%	24.65%	$108,321	0.18%	$395	$746
Totals	21,255	100.00%	100.00%	$61,527,623	100.00%	$16,274	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- Agricultural land makes up a much larger share of total acreage in North Branch Sandy Creek than in the overall Watershed.
- There is no land in the sub-watershed that is used for recreation or entertainment and much less land is dedicated to public parks and forest than in the overall Watershed.
- In terms of land value per acre, public service lands and industrial lands are more highly valued than in the overall Watershed.

Existing Studies

Few existing studies associated with North Branch Sandy Creek subwatershed were found as part of this project effort. However, one broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario (Brown & Connelly, 2002). This study has limited applicability to the rest of the subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University (CRP, 2006). The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of the articles' content, and the references for these documents are listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006

6.4 UPPER SANDY CREEK

Located in the Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Upper Sandy Creek subwatershed is located 58% with Jefferson County and 42% within Lewis County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Chamion, Rodham, Denmark, Pinckney, Adams, and Rutland. The transportation system has a road density of 1.84 miles of road per square mile. There are a total of 87 road/stream crossings with a density of 2.0 crossings per square mile within the subwatershed.

Hydrology

The Upper Sandy Creek subwatershed comprises approximately 27% of the total drainage area in the Sandy Creek Watershed. The subwatershed has a drainage area of 27,652 acres (43.2 square miles) with a drainage density of 1.4 stream miles per square mile. The total stream length within the subwatershed is 60 miles. The significant tributaries identified in the subwatershed include: Gulf Stream, Sandy Creek, South Branch Sandy Creek, Shingle Gulf, and Stebbins Creek.

Precipitation

Table 27 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 27. Upper Sandy Creek Average Annual Precipitation from East to West, in general.

% of Subwatershed Area	Precipitation (inches)
38	55
62	45

Land Cover

The major land cover consists of deciduous forest followed by scrub/shrub. Refer to Figure 17 for a graphic representation of the land cover composition for the entire subwatershed.

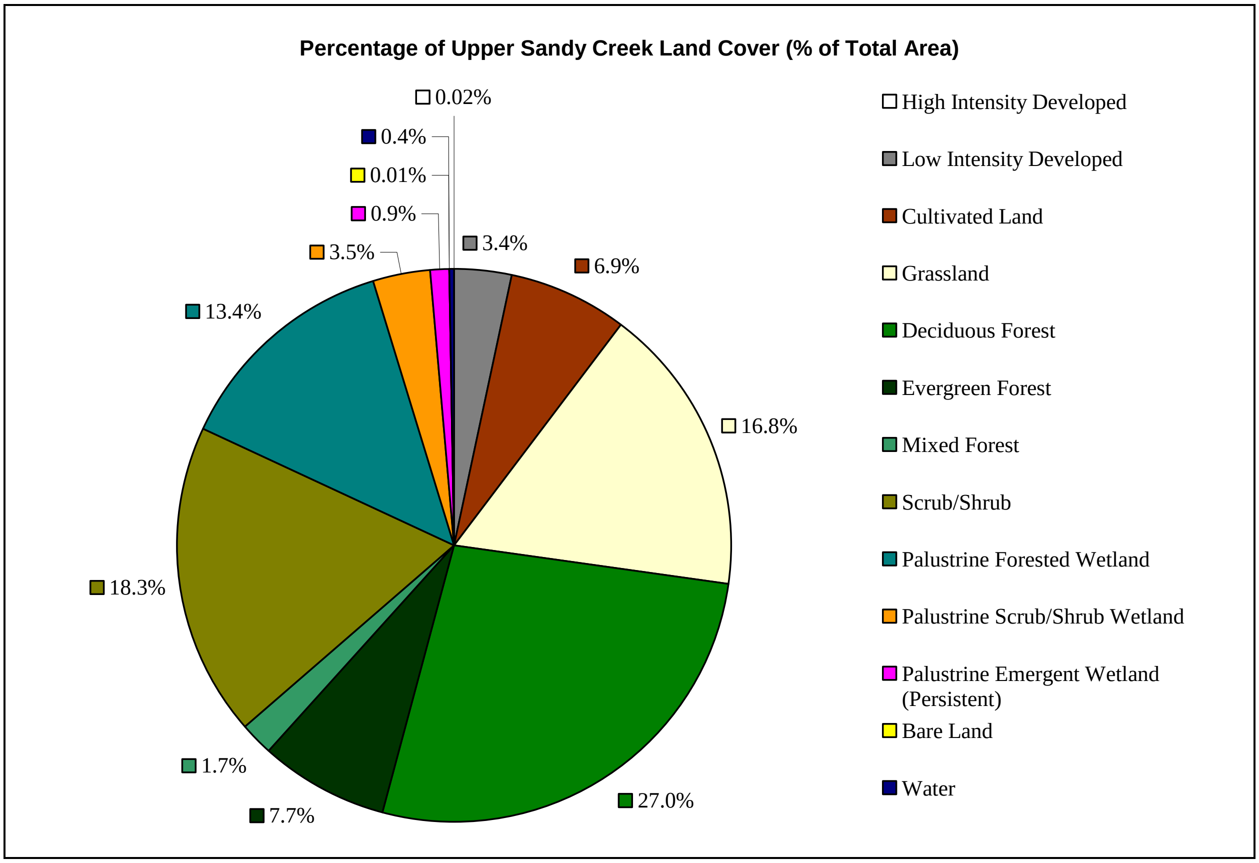

Figure 17. Upper Sandy Creek Land Cover Composition

Soils

Table 28 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under storm and cover conditions. Refer to Table 29 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 28. General Soil Map Units in Upper Sandy Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5888	Ontario-Madrid-Bombay	6363	23.0
s5896	Nellis-Galway-Amenia	2255	8.2
s5915	Pinckney-Camroden-Bice	7500	27.1
s5952	Farnham-Blasdell-Alton	374	1.4
s5991	Wassaic-Lairdsville-Farmington	669	2.4
s5999	Pyrities-Malone-Kalurah	6313	22.8
s6003	Tunbridge-Schroon-Bice-Berkshire	4173	15.1
s6007	Stockbridge-Galway-Farmington	5	0.02

Table 29. Upper Sandy Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	374	1.4
B	19773	71.5
C	7505	27.1
D	-	-
Notes: HSG classes are defined as follows: A – High infiltration rate even when thoroughly wetted and low runoff potential. B – Moderate infiltration rate when thoroughly wetted. C – Slow infiltration rate when thoroughly wetted. D – Very slow infiltration rate when thoroughly wetted or high runoff potential. *U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.*		

Wetlands

There are 687 acres of wetlands, approximately 2.5% of the total area, within Upper Sandy Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 30 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 30. Upper Sandy Creek Wetlands By Classification

Classification	Acres	% of Subwatershed Area
Class I	NA	NA
Class II	237.1	0.9
Class III	449.9	1.6
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	NA	NA

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

Managed Lands

Upper Sandy Creek subwatershed contains 3,849 acres (13.9% of subwatershed area) of managed land. The total acreage of managed land is divided among three managing entities as follows: 356 acres by the County, 2,865 acres by New York State, and 628 acres by an individual in an easement.

Eroded Streambank and Current Condition Assessment

A stream assessment and inventory was conducted along 20 miles of Sandy Creek and North Sandy Creek documenting 28 eroding stream sites, 13 on Sandy Creek and 15 on North Sandy Creek. Bank Erosion Hazard Index (BEHI) and Near Bank Stress (NBS) methods along with observed soil erodability characteristics were used to estimate sediment load for each site. The results concluded North Sandy Creek is 4% eroding, a higher percentage of erosion than Sandy Creek at 2.5% eroding based on a ratio of length of eroding site to total length of stream bank documented. Field observation and documentation can be referred to in *An Assessment of Sandy Creek and North Sandy Creek Jefferson County, NY* prepared by Upper Susquehanna Coalition.

Biological Assessment

A biological assessment was conducted on Sandy Creek on August 19-20, 1997 with the purpose of assessing general water quality and establishing invertebrate data. All sites sampled in Sandy Creek from the village of Rodmand to North Landing were evaluated as slightly impacted based on nutrient enrichment, organic loading, and siltation results. The stream supported high levels of algae growth on substrate rocks. Fish Creek, a tributary of Sandy Creek, was assessed as non impacted to slightly impacted with no adverse effects from the regional landfill. Sandy Creek and Fish Creek were assessed as having good water quality based on the sampled fish communities (Stream Biomonitoring Unit, May 1998).

Analysis of Existing Water Quality Database from 1997 to 2005

The Jefferson County Water Quality Coordinating Committee collected water samples from six sites on both Sandy Creek and South Sandy Creek. Overall, the water quality of on the two creeks is quite good with relatively low levels of nutrients, high dissolved oxygen concentrations, and the ability to support a desirable and healthy aquatic ecosystem. Chemical methodology limits the analysis and interpretation of the existing data. There is no way to show if an improvement in water quality has occurred. However, it can be concluded there has been no major degradation in the water quality for either creek (Makarewicz and Lewis, 2006).

Field Reconnaissance

The field observations within the subwatershed concluded: The surrounding area is highly agricultural with dairy farms, concentrated animal feeding operations (CAFO), and manure storage facilities. There are also residential areas interspersed throughout the subwatershed. In the agricultural areas, deciduous forests appear as narrow bands along stream channels. Minimal and impacted forested buffers in the agricultural areas are causing bank erosion. Some channelization occurs where several small villages border the stream. Adequate stream buffers are located on steep slopes in stream corridors and along non-agricultural lands. Overall water quality appears to be excellent and water clarity is clear. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 31. Market Value per Acre by Land Use in Upper Sandy Creek

Upper Sandy Creek							
Land Use	Est. Acreage in Upper Sandy	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Upper Sandy	% of Total MV in Upper Sandy	Per Acre MV in Upper Sandy	Per Acre MV in Sandy Creeks Watershed
Agricultural	12,215	45.28%	36.23%	$7,077,520	17.35%	$579	$828
Residential	5,627	20.86%	21.78%	$27,969,039	68.57%	$4,971	$10,594
Vacant	3,375	12.51%	14.18%	$1,346,529	3.30%	$399	$791
Commercial	2	0.01%	0.72%	$105,804	0.26%	$62,238	$24,972
Recreation and Entertainment	0	0.00%	0.60%	$84,741	0.21%		$9,695
Community Service	22	0.08%	0.24%	$1,996,963	4.90%	$89,430	$145,997
Industrial	1	0.00%	0.67%	$37,778	0.09%	$34,034	$1,519
Public Service	5	0.02%	0.92%	$32,228	0.08%	$7,006	$5,470
Public Parks, Wild, Forest	5,729	21.24%	24.65%	$2,139,517	5.25%	$373	$746
Totals	26,975	100.00%	100.00%	$40,790,117	100.00%	$24,879	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- Upper Sandy Creek only has one acre of industrial land, but the value of that one acre is much higher than average for the overall Watershed area.
- Agriculture makes up a larger share of total acreage in Upper Sandy Creek than the average for the overall Watershed.

Existing Studies

Few existing studies associated with Upper Sandy Creek subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. This study has limited applicability to the rest of the subwatershed. Another technical report documented a multi-year project conducted by the NY Natural Heritage Program surveying and documenting significant stream systems and communities within the highest quality watersheds of Tug Hill. Due to partial coverage of surveying and documentation within the Upper Sandy subwatershed, limited conclusions could be made for the entire subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of each article. The references for these studies are listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

Hunt, D.M, et al. *Tug Hill Stream Inventory & Watershed Integrity Analysis*. New York Natural Heritage Program. January 7, 2005.

6.5 GULF STREAM

Located in the Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Gulf Stream subwatershed is located 28% within Jefferson County and 72% within Lewis County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Worth, Montague, Rodman, and Pinckney. The transportation system has a road density of 1.43 miles of road per square mile. There are a total of 29 road/stream crossings with a density of 1.5 crossings per square mile within the subwatershed.

Hydrology

Gulf Stream subwatershed comprises approximately 12% of the total drainage area in the Sandy Creek Watershed. Gulf Stream subwatershed has a drainage area of 12,307 acres (19.2 square miles) with a drainage density of 1.3 stream miles per square mile. The total stream length within the subwatershed is 25 miles. The significant tributaries identified in the subwatershed include: Denning Creek, Gulf Stream, and North Branch Sandy Creek.

Precipitation

Table 32 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 32. Gulf Stream Average Annual Precipitation from East to West, in general.

% of Subwatershed Area	Precipitation (inches)
75	55
25	45

Land Cover

The major land cover within the subwatershed consists of deciduous forest followed by palustrine forested wetlands. Refer to Figure 18 for a graphic representation of the land cover composition for the entire subwatershed.

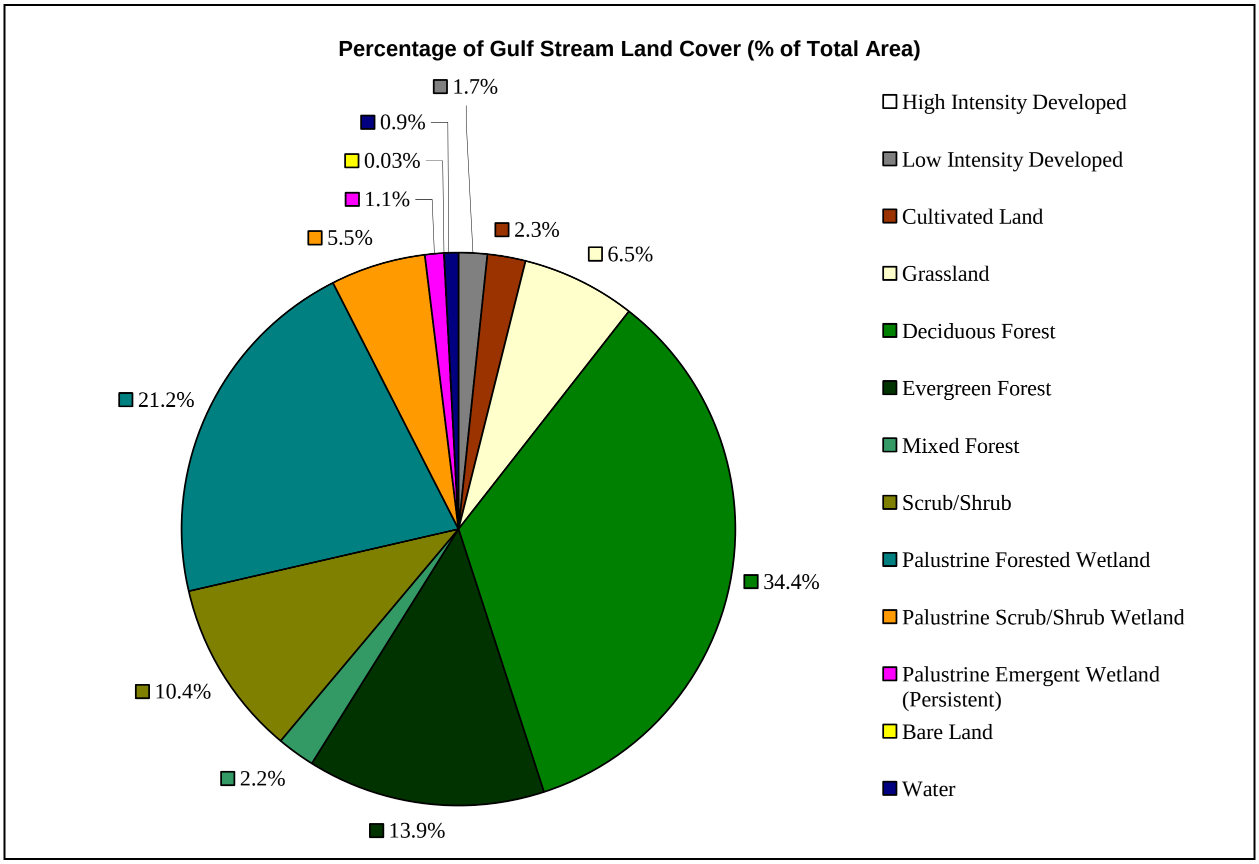

Figure 18. Gulf Stream Land Cover Composition

Soils

Table 33 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under storm and cover conditions. Refer to Table 34 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 33. General Soil Map Units in Gulf Stream

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5952	Farnham-Blasdell-Alton	56	0.5
s5932	Insula-Bice	6	0.1
s6003	Tunbridge-Schroon-Bice-Berkshire	9715	78.9
s5912	Worth-Empeyville-Bice	485	3.9
s5915	Pinckney-Camroden-Bice	2045	16.6

Table 34. Gulf Stream Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	56	0.5
B	9721	79.0
C	2530	20.6
D	-	-
Notes: HSG classes are defined as follows: A – High infiltration rate even when thoroughly wetted and low runoff potential. B – Moderate infiltration rate when thoroughly wetted. C – Slow infiltration rate when thoroughly wetted. D – Very slow infiltration rate when thoroughly wetted or high runoff potential. *U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.*		

Wetlands

There are 947 acres of wetlands, approximately 7.7% of the total area, within Gulf Stream subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 35 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 35. Gulf Stream Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	NA	NA
Class II	445.3	3.6
Class III	501.9	4.1
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	NA	NA

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

Managed Land

The subwatershed contains 4,829 acres (39.2% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 188 acres by the County and 4,541 acres by New York State.

Biological Assessment

A biological assessment was conducted on Sandy Creek on August 19-20, 1997 with the purpose of assessing general water quality and establishing invertebrate data. All sites sampled in Sandy Creek from the village of Rodmand to North Landing were evaluated as slightly impacted based on nutrient enrichment, organic loading, and siltation results. The stream supported high levels of algae growth on substrate rocks. Fish Creek, a tributary of Sandy Creek, was assessed as non-impacted to slightly impacted with no adverse effects from the regional landfill. Sandy Creek and Fish Creek were assessed as having good water quality based on the sampled fish communities (Stream Biomonitoring Unit, May 1998).

Field Reconnaissance

The field observations within the subwatershed concluded: The majority of land use in Gulf Stream subwatershed is agricultural and forest. The stream corridor is characterized by steep slopes. The stream appears to have clear water and is encased by steep forested banks. There is also some evidence of ATV abuse in the stream bed. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 36. Market Value per Acre by Land Use in Gulf Stream

Gulf Stream							
Land Use	Est. Acreage in Gulf Stream	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Gulf Stream	% of Total MV in Gulf Stream	Per Acre MV in Gulf Stream	Per Acre MV in Sandy Creeks Watershed
Agricultural	1,235	11.22%	36.23%	$901,422	9.19%	$730	$828
Residential	2,863	26.01%	21.78%	$5,647,124	57.57%	$1,972	$10,594
Vacant	1,996	18.14%	14.18%	$982,763	10.02%	$492	$791
Commercial		0.00%	0.72%				$24,972
Recreation and Entertainment	40	0.36%	0.60%	$220,182	2.24%		$9,695
Community Service	4	0.03%	0.24%	$74,545	0.76%	$19,617	$145,997
Industrial		0.00%	0.67%				$1,519
Public Service	5	0.04%	0.92%	$82,792	0.84%	$18,398	$5,470
Public Parks, Wild, Forest	4,864	44.19%	24.65%	$1,900,558	19.37%	$391	$746
Totals	11,007	100.00%	100.00%	$9,809,386	100.00%	$6,933	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- Public parks land comprises a much larger percentage of total land use in Gulf Stream than in the overall Watershed and agriculture comprises a much smaller percentage.
- Residential land in Gulf Stream has a much lower per acre value than in the overall Watershed.

Existing Studies

Few existing studies associated with Gulf Stream subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. This study has limited applicability to the rest of the subwatershed. Another technical report documented a multi-year project conducted by the NY Natural Heritage Program surveying and documenting significant stream systems and communities within the highest quality watersheds of Tug Hill. Due to partial coverage of surveying and documentation within the Gulf Stream subwatershed, limited conclusions could be made for on the entire subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of each article. The references for these studies are listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

Hunt, D.M, et al. *Tug Hill Stream Inventory & Watershed Integrity Analysis*. New York Natural Heritage Program. January 7, 2005.

6.6 FISH CREEK

Located in the Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Fish Creek subwatershed is located 92% within Jefferson County and 8% within Lewis County, New York. Several municipalities located entirely or partially within the subwatershed boundary including: Rodham, Pinckney, and Adams. The transportation system has a road density of 1.84 miles of road per square mile. There are a total of 17 road/stream crossings with a density of 1.5 crossings per square mile within the subwatershed.

Hydrology

Fish Creek subwatershed comprises approximately 7% of the total drainage area in the Sand Creek Watershed. Gulf Stream subwatershed has a drainage area of 7,029 acres (11.0 square miles) with a drainage density of 1.6 stream miles per square mile. The total stream length within the subwatershed is 17.3 miles. The significant tributaries identified in the subwatershed include: Fish Creek and Sandy Creek.

Precipitation

Table 37 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 37. Fish Creek Average Annual Precipitation From East to West, in general.

% of Subwatershed Area	Precipitation (inches)
21	55
79	45

Land Cover

The major land cover within the subwatershed consists of deciduous forest followed by scrub/shrub and palustrine forested wetlands. Refer to Figure 19 for a graphic representation of the land cover composition for the entire subwatershed.

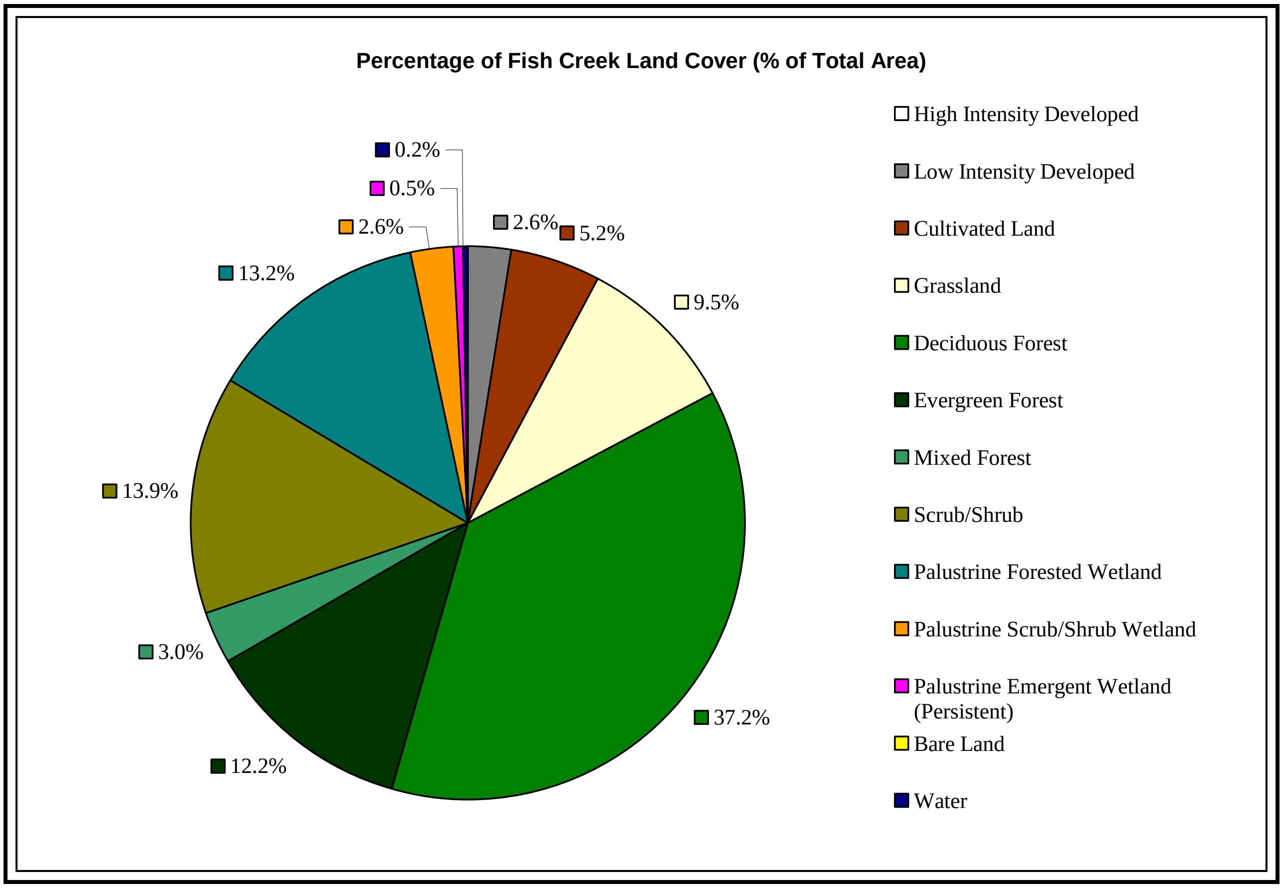

Figure 19. Fish Creek Land Cover Composition

Soils

Table 38 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under storm and cover conditions. Refer to Table 39 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 38. General Soil Map Units in Fish Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5952	Farnham-Blasdell-Alton	406	5.8
s6003	Tunbridge-Schroon-Bice-Berkshire	6095	86.7
s5912	Worth-Empeyville-Bice	527	7.5

Table 39. Fish Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	406	5.8
B	6095	86.7
C	527	7.5
D	-	-

Notes:
HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

Wetlands

There are 49 acres of wetlands, approximately 0.7% of the total area, within Fish Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 40 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 40. Fish Creek Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	NA	NA
Class II	48.5	0.7
Class III	NA	NA
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	NA	NA

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

<u>Managed Lands</u>

The subwatershed contains 1,995 acres (22.5% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 151 acres by the County and 1,843 acres by New York State.

<u>Biological Assessment</u>

A biological assessment was conducted on Sandy Creek on August 19-20, 1997 with the purpose of assessing general water quality and establishing invertebrate data. All sites sampled in Sandy Creek from the village of Rodmand to North Landing were evaluated as slightly impacted based on nutrient enrichment, organic loading, and siltation results. The stream supported high levels of algae growth on substrate rocks. Fish Creek, a tributary of Sandy Creek, was assessed as non impacted to slightly impacted with no adverse effects from the regional landfill. Sandy Creek and Fish Creek were assessed as having good water quality based on the sampled fish communities (Stream Biomonitoring Unit, May 1998).

<u>Field Reconnaissance</u>

The field observations within the subwatershed concluded: The headwaters are heavily forested, whereas the lower sections of the subwatershed are in agriculture with residential interspersed. Deciduous forests appear as narrow bands along stream channels in the agricultural areas and as patches on steeper slopes. However, a majority of the subwatershed has moderately forested buffers. There is little to no erosion throughout the subwatershed. Some bank erosion was observed along impacted buffers in the agricultural areas. Overall, water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 41. Market Value per Acre by Land Use in Fish Creek

Fish Creek							
Land Use	Est. Acreage in Fish Creek	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Fish Creek	% of Total MV in Fish Creek	Per Acre MV in Fish Creek	Per Acre MV in Sandy Creeks Watershed
Agricultural	1,897	33.39%	36.23%	$1,191,102	12.80%	$628	$828
Residential	943	16.59%	21.78%	$4,801,417	51.60%	$5,093	$10,594
Vacant	409	7.20%	14.18%	$317,197	3.41%	$775	$791
Commercial		0.00%	0.72%				$24,972
Recreation and Entertainment		0.00%	0.60%				$9,695
Community Service	9	0.16%	0.24%	$53,165	0.57%	$5,960	$145,997
Industrial		0.00%	0.67%				$1,519
Public Service	1,545	27.19%	0.92%	$2,651,818	28.50%	$1,716	$5,470
Public Parks, Wild, Forest	880	15.48%	24.65%	$290,470	3.12%	$330	$746
Totals	5,683	100.00%	100.00%	$9,305,168	100.00%	$2,417	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- Fish Creek has *less vacant land* and *more public service land* as a percentage of total acreage than any of the other sub-watersheds.
- The value of public service land represents a large share of the total market value of land in Fish Creek.
- Land values in Fish Creek are lower than in the overall Watershed for every land use category.

Existing Studies

Few existing studies associated with Fish Creek subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. This study has limited applicability to the rest of the subwatershed. Another technical report documented a multi-year project conducted by the NY Natural Heritage Program surveying and documenting significant stream systems and communities within the highest quality watersheds of Tug Hill. Due to partial coverage of surveying and documentation within the Fish Creek subwatershed, limited conclusions could be made for on the entire subwatershed. Makarewicz and Lewis analyzed the existing water quality database for Sandy

Creek and South Sandy Creek (2006). Statements about Fish Creek subwatershed based on this analysis is restricted to generalizations, since only a small portion of Sandy Creek is contained within the subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of each article, and the references for these studies are listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

Hunt, D.M, et al. *Tug Hill Stream Inventory & Watershed Integrity Analysis*. New York Natural Heritage Program. January 7, 2005.

Makarewicz, J.C., and Lewis T.L. *Analysis of the Existing Water Quality Database for the Sandy Creek and South Sandy Watershed – 1997 to 2005.* Jefferson County Soil and Water Conservation District, October 2006.

6.7 LOWER SANDY CREEK

Located in the Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Lower Sandy Creek is located entirely within Jefferson County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Henderson, Ellisburg, Rodham, Adams, and Lorraine. The transportation system has a road density of 2.23 miles of road per square mile. There are a total of 71 road/stream crossings with a density of 1.4 crossings per square mile within the subwatershed.

Hydrology

Lower Sandy Creek subwatershed comprises approximately 31% of the total drainage area in the Sandy Creek Watershed. Lower Sandy Creek subwatershed has a drainage area of 31,528 acres (49.3 square miles) with a drainage density of 1.2 stream mile per square mile. The total stream length within the subwatershed is 60.3 miles. The significant tributaries identified in the subwatershed include: Fish Creek, Mud Brook, North Branch Sandy Creek, and Sandy Creek.

Precipitation

Table 42 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 42. Lower Sandy Creek Average Annual Precipitation from East to West, in general.

% of Subwatershed Area	Precipitation (inches)
39	45
57	37.5
4	35

Land Cover

The major land cover within the subwatershed consists of cultivated land and grassland followed by scrub/shrub. Refer to Figure 20 for a graphic representation of the land cover composition for the entire subwatershed.

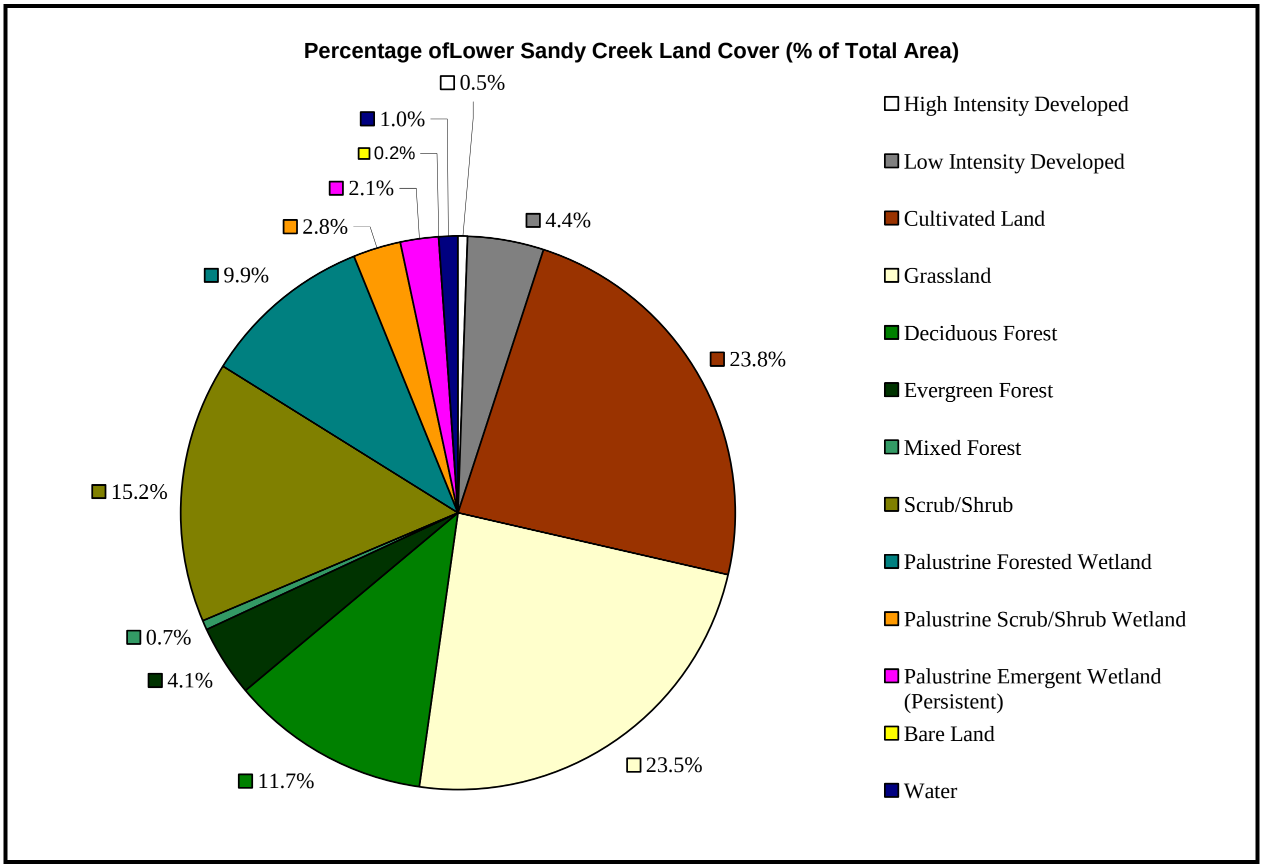

Figure 20. Lower Sandy Creek Land Cover Composition

Soils

Table 43 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under storm and cover conditions. Refer to Table 44 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 43. General Soil Map Units in Lower Sandy Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5888	Ontario-Madrid-Bombay	4110	13.0
s5912	Worth-Empeyville-Bice	3752	11.9
s5942	Oakville-Elnora-Colonie	2172	6.9
s5950	Palmyra-Howard-Alton	3252	10.3
s5952	Farnham-Blasdell-Alton	2320	7.4
s5969	Wayland-Saprists-Fluvaquents-Aquents	768	2.4
s5987	Rhinebeck-Niagara-Hudson-Dunkirk-Collamer	6735	21.4
s5989	Minoa-Lamson-Galen-Arkport	1343	4.3
s5991	Wassaic-Lairdsville-Farmington	6525	20.7
s6003	Tunbridge-Schroon-Bice-Berkshire	537	1.7

Table 44. Lower Sandy Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	4491	14.2
B	14425	45.8
C	11830	37.5
D	768	2.4

Notes:
HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

<u>Wetlands</u>

There are 2697 acres of wetlands, approximately 8.6% of the total area, within Lower Sandy Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 45 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 45. Lower Sandy Creek Wetlands By Classification

Classification	Acres	% of Subwatershed Area
Class I	797.2	3.8
Class II	1720.9	8.2
Class III	165.5	0.8
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	13.3	NA

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

Managed Lands

The subwatershed contains 2,482 acres (7.9% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 486 acres by the County and 1,996 acres by New York State.

Biological Assessment

A biological assessment was conducted on Sandy Creek on August 19-20, 1997 with the purpose of assessing general water quality and establishing invertebrate data. All sites sampled in Sandy Creek from the village of Rodmand to North Landing were evaluated as slightly impacted based on nutrient enrichment, organic loading, and siltation results. The stream supported high levels of algae growth on substrate rocks. Fish Creek, a tributary of Sandy Creek, was assessed as non-impacted to slightly impacted with no adverse effects from the regional landfill. Sandy Creek and Fish Creek were assessed as having good water quality based on the sampled fish communities (Stream Biomonitoring Unit, May 1998).

Habitat and Macroinvertebrate Community Assessment

Rivers and streams within the Lake Ontario basin were monitored based on a verbal habitat assessment and a macroinvertebrate community assessment as part of the Rotating Integrated Basin Studies portion (RIBS) of the Statewide Waters Monitoring Program. The verbal habitat assessment described the stream banks of Sandy Creek in North Landing as moderately stable with small areas of erosion and vegetation or rock cover on the bank area. The macroinvertebrate monitoring yielded an assessment of slightly impacted for Sandy Creek in North Landing; this finding is indicative of non-point source nutrient enrichment. Sandy Creek may be additionally impacted due to siltation. Sandy Creek in Adams was assessed as non-impacted based on macroinvertebrate community assessment results (Statewide Waters Monitoring Section, 2005).

Analysis of Existing Water Quality Database from 1997 to 2005

The Jefferson County Water Quality Coordinating Committee collected water samples from six sites on both Sandy Creek and South Sandy Creek. Overall, the water quality of on the two creeks is quite good with relatively low levels of nutrients, high dissolved oxygen concentrations, and the ability to support a desirable and healthy aquatic ecosystem. Chemical methodology limits the analysis and interpretation of the existing data. There is no way to show if an improvement in water quality has occurred. However, it can be concluded there has been no major degradation in the water quality for either creek (Makarewicz and Lewis, 2006).

USGS Gauging Station

Within the Lower Sandy Creek subwatershed, there is a USGS gauging station (#04250750) located near Adams, NY, actively recording annual statistics, monthly statistics, and peak flow for Sandy Creek. See Appendix 6 for information gathered from the USGS gauging station.

Field Reconnaissance

The field observations within the subwatershed concluded: The sample point in the upper portion of the subwatershed is located in the center of the town of Adams and is predominately commercial and residential. The land use in the lower portion of the subwatershed becomes dominated by agriculture with forests limited to narrow strips along the streams.

The stream channel in the upper subwatershed has some bedrock within the channel. There is little to no bank erosion due to reinforced banks with stone retaining walls. Some bank erosion is present in the lower subwatershed where land adjacent to the stream is agricultural with impacted buffers. Overall the water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 46. Market Value per Acre by Land Use in Lower Sandy Creek

Lower Sandy Creek							
Land Use	Est. Acreage in Lower Sandy	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Lower Sandy	% of Total MV in Lower Sandy	Per Acre MV in Lower Sandy	Per Acre MV in Sandy Creeks Watershed
Agricultural	17,369	61.54%	36.23%	$17,200,351	14.28%	$990	$828
Residential	5,096	18.05%	21.78%	$55,897,351	46.40%	$10,969	$10,594
Vacant	2,916	10.33%	14.18%	$1,739,674	1.44%	$597	$791
Commercial	134	0.48%	0.72%	$10,012,579	8.31%	$74,609	$24,972
Recreation and Entertainment	64	0.23%	0.60%	$1,821,045	1.51%	$28,264	$9,695
Community Service	129	0.46%	0.24%	$30,259,242	25.12%	$233,951	$145,997
Industrial	46	0.16%	0.67%	$21,176	0.02%	$457	$1,519
Public Service	157	0.56%	0.92%	$2,324,012	1.93%	$14,762	$5,470
Public Parks, Wild, Forest	2,313	8.20%	24.65%	$1,189,683	0.99%	$514	$746
Totals	28,226	100.00%	100.00%	$120,465,113	100.00%	$40,568	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- Lower Sandy Creek has a relatively large percentage of agricultural land (62%) and a relatively small percentage of public parks land compared to the overall Watershed.
- Although only 129 acres are classified as community service land, as shown above, it attributes to 25% of the total market value of land in Lower Sandy Creek.

Existing Studies

Few existing studies associated with Lower Sandy Creek subwatershed were found as part of this project effort. However, one broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. This study has limited applicability to the rest of the subwatershed. The NYSDEC Lake Ontario Drainage Basin *Rotating Integrated Basin Studies* (RIBS) report provides an assessment of channel condition and water quality based on macroinvertebrate indices at two stations in lower Sandy Creek. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of the article's content. The reference for this study is listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

New York State Department of Environmental Conservation. 2005. *The Lake Ontario Drainage Basin: Sampling Years 1999-2003 Rotating Integrated Basin Studies Data Report*. Division of Water. Bureau of Watershed Assessment and Research.

6.8 UPPER SOUTH SANDY CREEK

Located in the South Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Upper South Sandy Creek subwatershed is located 86% within Jefferson County and 14% within Lewis County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Worth, Montague, Ellisburg, Rodman, Pinckney, and Lorraine. The transportation system has a road density of 1.58 miles of road per square mile. There are a total of 78 road/stream crossings with a density of 1.9 crossings per square mile within the subwatershed.

Hydrology

Upper South Sandy Creek subwatershed comprises approximately 40% of the total drainage area in the South Sandy Creek Watershed. Upper South Sandy Creek subwatershed has a drainage area of 26,370 acres (41.2 square miles) with a drainage density of 2.0 stream miles per square mile. The total stream length within the subwatershed is 81 miles. The significant tributaries identified in the subwatershed include: Abijah Creek, Clora Creek, Fox Creek, Grunley Creek, Pigeon Creek, and South Sandy Creek.

Precipitation

Table 47 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 47. Upper South Sandy Creek Average Annual Precipitation from East to West, in general

% of Subwatershed Area	Precipitation (inches)
70	55
30	45

Land Cover

The major land cover consists of deciduous forest followed by palustrine forested wetlands at a significantly lower percentage of total area. Refer to Figure 21 for a graphic representation of the land cover composition for the entire subwatershed.

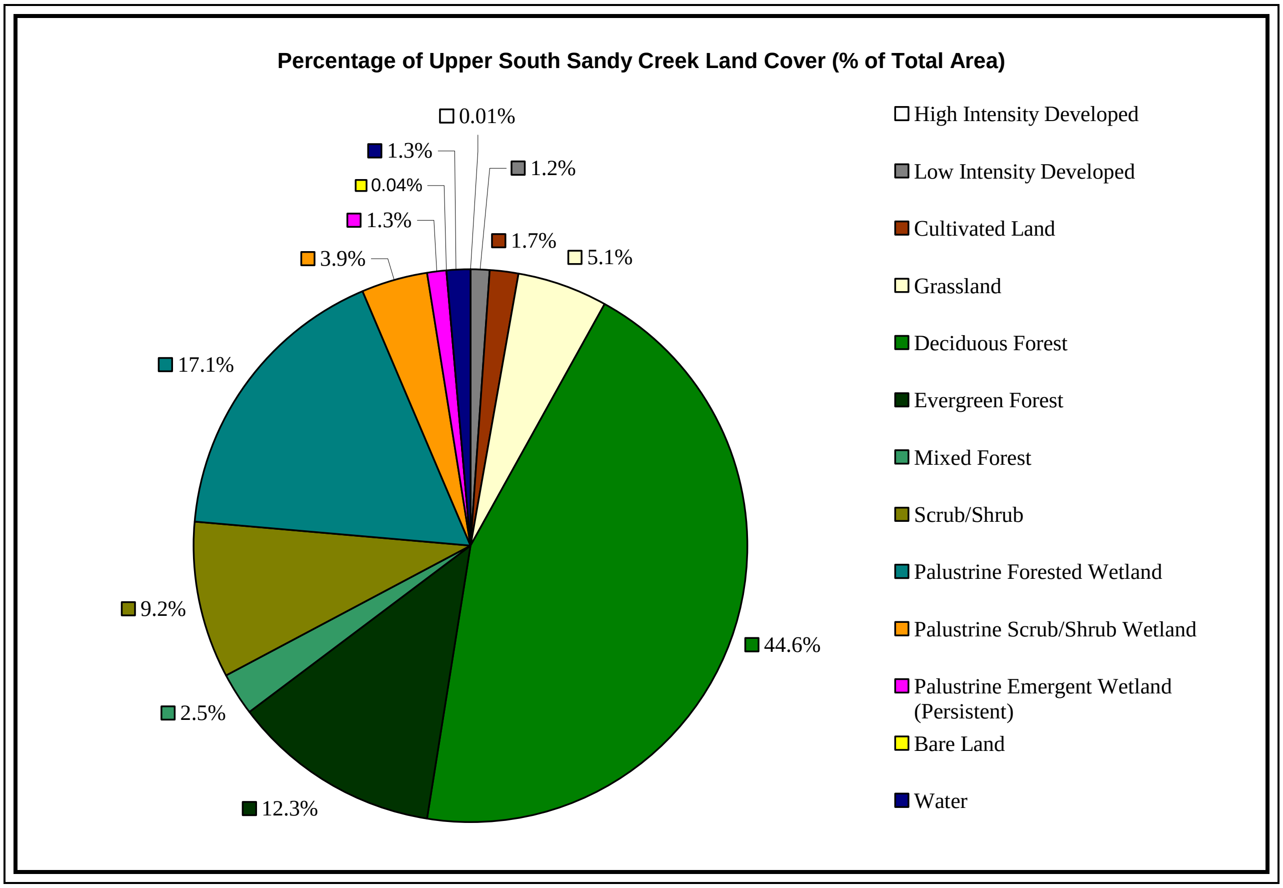

Figure 21. Upper South Sandy Creek Land Cover Composition

Soils

Table 48 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under similar storm and cover conditions. Refer to Table 49 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 48. General Soil Map Units in Upper South Sandy Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5912	Worth-Empeyville-Bice	14238	54.0
s5950	Palmyra-Howard-Alton	2	0.0
s5952	Farnham-Blasdell-Alton	1339	5.1
s6003	Tunbridge-Schroon-Bice-Berkshire	2313	8.8
s6004	Worth-Westbury-Empeyville	8479	32.2

Table 49. Upper South Sandy Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	1339	5.1
B	2315	8.8
C	22717	86.1
D	-	-

Notes:
HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

Wetlands

There are 934 acres of wetlands, approximately 3.54% of the total area, within Upper South Sandy Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 50 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 50. Upper South Sandy Creek Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	NA	NA
Class II	680.7	2.6
Class III	241.4	0.9
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	11.8	0.04

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

Managed Lands

Upper South Sandy Creek subwatershed contains 10,216 acres (38.7% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 1,360 acres by the County and 8,856 acres by New York State.

Habitat and Macroinvertebrate Community Assessment

Rivers and streams within the Lake Ontario basin were monitored based on a verbal habitat assessment and a macroinvertebrate community assessment as part of the Rotating Integrated Basin Studies portion (RIBS) of the Statewide Waters Monitoring Program. The verbal habitat assessment described the stream banks of Little Sandy Creek in Sandy Ponds, Lindsey Creek at The Elms, South Sandy Creek in Ellisburg, South Sandy Creek in Allendale, and Sandy Creek in North Landing as moderately stable with small areas of erosion and vegetation or rock cover on the bank area. The streams banks of Raystone Creek in Giddingsville were assessed as largely unstable with erosion occurring on half the bank area and no vegetative or rock cover. The macroinvertebrate monitoring yielded an assessment of slightly impacted for Little Sandy Creek in Sandy Ponds, Lindsey Creek at The Elms, and Sandy Creek in North Landing. All are indicative of non-point source nutrient enrichment while Sandy Creek may be additionally impacted due to siltation. South Sandy Creek in Ellisburg, South Sandy Creek in Allendale, Raystone Creek in Giddingsville, and Sandy Creek in Adams were all assessed as non-impacted based on macroinvertebrate community assessment results.

Analysis of Existing Water Quality Database from 1997 to 2005

The Jefferson County Water Quality Coordinating Committee collected water samples from six sites on both Sandy Creek and South Sandy Creek. Overall, the water quality of on the two creeks is quite good with relatively low levels of nutrients, high dissolved oxygen concentrations, and the ability to support a desirable and healthy aquatic ecosystem. Chemical methodology limits the analysis and interpretation of the existing data. There is no way to show if an improvement in water quality has occurred. However, it can be concluded there has been no major degradation in the water quality for either creek (Makarewicz and Lewis, 2006).

Field Reconnaissance

The field observations within the subwatershed concluded: The subwatershed originates from wetlands in a predominately deciduous forest. Further downstream in the subwatershed, the dominate land use is agriculture with forests limited to narrow strips along the stream. The upper stream channel has a low gradient, flowing through scrub shrub wetlands with little to no erosion. The stream then flows through a narrow, steep-walled section with bedrock controlling much of the erosion. Lower in the subwatershed, the stream reconnects to the floodplain in the agricultural areas. Overall, the water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 51. Market Value per Acre by Land Use in Upper South Sandy Creek

Upper South Sandy Creek							
Land Use	Est. Acreage in Upper South Sandy	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Upper South Sandy	% of Total MV in Upper South Sandy	Per Acre MV in Upper South Sandy	Per Acre MV in Sandy Creeks Watershed
Agricultural	3,919	18.68%	36.23%	$3,791,050	15.00%	$967	$828
Residential	3,955	18.85%	21.78%	$14,339,646	56.74%	$3,626	$10,594
Vacant	2,077	9.90%	14.18%	$1,110,034	4.39%	$534	$791
Commercial	0	0.00%	0.72%	$100,000	0.40%		$24,972
Recreation and Entertainment	5	0.02%	0.60%	$34,273	0.14%	$6,855	$9,695
Community Service	4	0.02%	0.24%	$156,997	0.62%	$37,292	$145,997
Industrial	84	0.40%	0.67%	$22,500	0.09%	$269	$1,519
Public Service	13	0.06%	0.92%	$77,922	0.31%	$5,903	$5,470
Public Parks, Wild, Forest	10,920	52.06%	24.65%	$5,640,950	22.32%	$517	$746
Totals	20,978	100.00%	100.00%	$25,273,372	100.00%	$6,995	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- The percentage of public park and forested land (52%) in Upper South Sandy Creek is much higher than average for the Watershed.
- The value of land per acre in Upper South Sandy Creek is significantly lower than average for the Watershed for many land use types, particularly residential, community service, industrial and recreation & entertainment.

Existing Studies

Few existing studies associated with Upper South Sandy Creek subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. This study has limited applicability to the rest of the subwatershed. Another technical report documented a multi-year project conducted by the NY Natural Heritage Program surveying and documenting significant stream systems and communities within the highest quality watersheds of Tug Hill. Due to partial coverage of surveying and documentation within the Upper South Sandy Creek subwatershed, limited conclusions could be made for on the entire subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of each article. The references for these studies are listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

Hunt, D.M, et al. *Tug Hill Stream Inventory & Watershed Integrity Analysis*. New York Natural Heritage Program. January 7, 2005.

6.9 FOX CREEK

Located in the South Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Fox Creek is located 96% within Jefferson County and 4.3% within Oswego County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Worth, Ellisburg, Boylston, Redfield, and Lorraine. The transportation system has a road density of 1.4 miles of road per square mile. There are a total of 55 road/stream crossings with a density of 1.6 crossings per square mile within the subwatershed.

Hydrology

Fox Creek subwatershed comprises approximately 32% of the total drainage area in the South Sandy Creek Watershed. Fox Creek subwatershed has a drainage area of 21,396 acres (33.4 square miles) with a drainage density of 2.1 stream miles per square mile. The total stream length within the subwatershed is 68.7 miles. The significant tributaries identified in the subwatershed include: Big Brook, Deer Creek, Fox Creek, Little Fox Creek, Raystone Creek, and Waterville Creek.

Precipitation

Table 52 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 52. Fox Creek Average Annual Precipitation from East to West, in general

% of Subwatershed Area	Precipitation (inches)
71	55
29	45

Land Cover

The major land cover consists of deciduous forest followed by palustrine forested wetlands at a significantly lower percentage of total area. Refer to Figure 22 for a graphic representation of the land cover composition for the entire subwatershed.

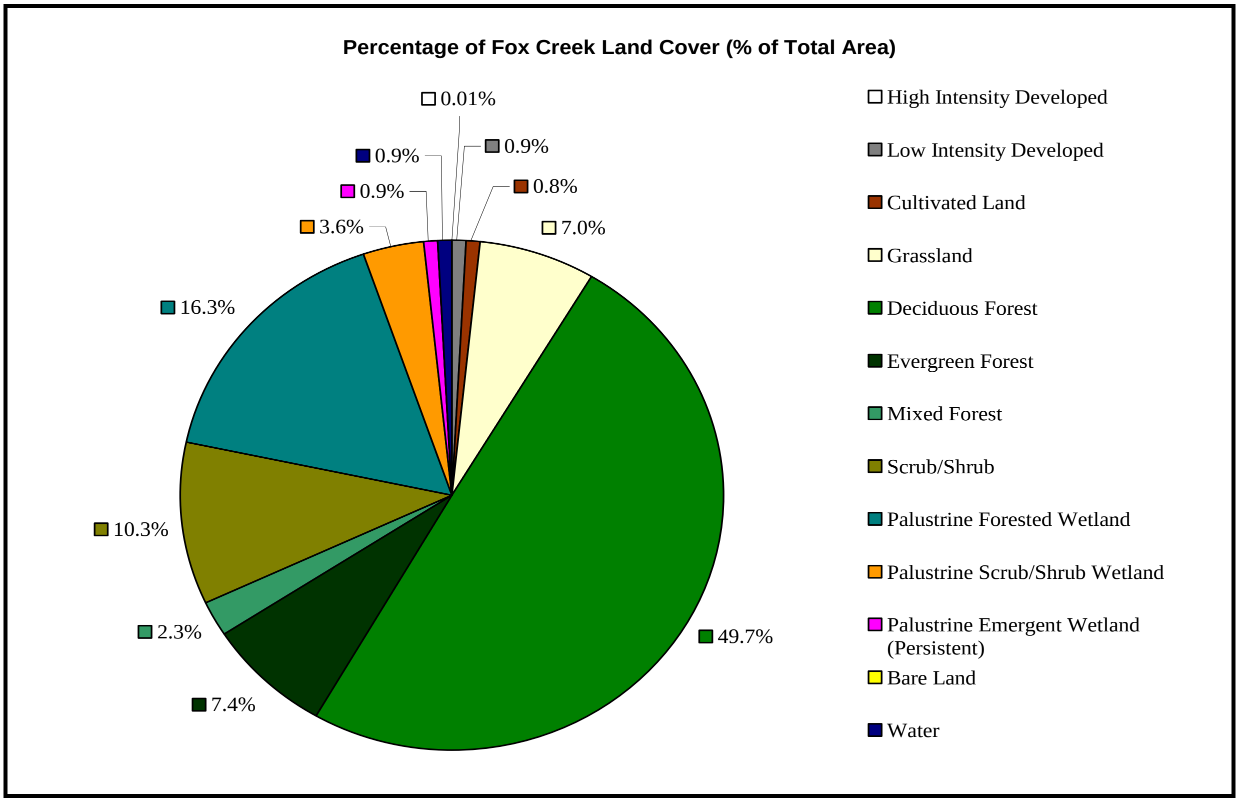

Figure 22. Fox Creek Land Cover Composition

Soils

Table 53 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under similar storm and cover conditions. Refer to Table 54 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 53. General Soil Map Units in Fox Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5952	Farnham-Blasdell-Alton	2701	12.6
s5950	Palmyra-Howard-Alton	35	0.2
s5912	Worth-Empeyville-Bice	17254	80.6
s6004	Worth-Westbury-Empeyville	1406	6.6

Table 54. Fox Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	2701	12.6
B	35	0.2
C	18660	87.2
D	-	-
Notes: HSG classes are defined as follows: A – High infiltration rate even when thoroughly wetted and low runoff potential. B – Moderate infiltration rate when thoroughly wetted. C – Slow infiltration rate when thoroughly wetted. D – Very slow infiltration rate when thoroughly wetted or high runoff potential. *U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.*		

Wetlands

There are 852 acres of wetlands, approximately 3.9% of the total area, within Fox Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 55 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 55. Fox Creek Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	100.4	0.5
Class II	545.8	2.6
Class III	147.8	0.7
Class IV	44.8	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	13.4	0.1

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

Managed Lands

Fox Creek subwatershed contains 5,110 acres (23.9% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 1,597 acres by the County and 3,513 acres by New York State.

Field Reconnaissance

The field observations within the subwatershed concluded: The upper portions of this subwatershed are located within a State Reforestation Area dominated by a mix of coniferous and deciduous trees. The remaining area in the subwatershed is dominated by agriculture and forests in and along deep, narrow gorges or gulfs. Fox Creek flows through Totman Gulf, a deep narrow gorge, surrounded by forest. Erosion is minimal in the stream due to bedrock control in the Totman Gulf area. Overall, water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 56. Market Value per Acre By Land Use in Fox Creek

Fox Creek							
Land Use	Est. Acreage in Fox Creek	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Fox Creek	% of Total MV in Fox Creek	Per Acre MV in Fox Creek	Per Acre MV in Sandy Creeks Watershed
Agricultural	3,513	11.06%	36.23%	$2,049,541	8.28%	$583	$828
Residential	6,200	19.52%	21.78%	$13,902,422	56.19%	$2,242	$10,594
Vacant	1,704	5.37%	14.18%	$781,487	3.16%	$459	$791
Commercial	1	0.00%	0.72%	$55,844	0.23%	$70,689	$24,972
Recreation and Entertainment		0.00%	0.60%				$9,695
Community Service	9	0.03%	0.24%	$431,928	1.75%	$50,224	$145,997
Industrial		0.00%	0.67%				$1,519
Public Service		0.00%	0.92%				$5,470
Public Parks, Wild, Forest	20,331	64.02%	24.65%	$7,520,913	30.40%	$370	$746
Totals	31,758	100.00%	100.00%	$24,742,135	100.00%	$20,761	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- Fox Creek has the greatest percentage of land used for public parks, wild or forested land and the smallest percentage used for agriculture.
- Public park land accounts for 30% of the market value of land in Fox Creek, which is more than in any other sub-watershed.
- Residential land is relatively inexpensive in the sub-watershed at $2,242 per acre, compared to over $10,500 in the overall Watershed.

Existing Studies

Few existing studies associated with Fox Creek subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. This study has limited applicability to the rest of the subwatershed. Another technical report documented a multi-year project conducted by the NY Natural Heritage Program surveying and documenting significant stream systems and communities within the highest quality watersheds of Tug Hill. Due to partial coverage of surveying and documentation within the Fox Creek subwatershed, limited conclusions could be made for on the entire subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant.

Appendix 1 provides a summary of each article. The references for these studies are listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

Hunt, D.M, et al. *Tug Hill Stream Inventory & Watershed Integrity Analysis*. New York Natural Heritage Program. January 7, 2005.

6.10 BEAR CREEK

Located in the South Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Bear Creek is located 99.8% within Jefferson County and 0.2% within Oswego County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Ellisburg, Boylston, and Lorraine. The transportation system has a road density of 2.4 miles of road per square mile. There are a total of 28 road/stream crossings with a density of 3.0 crossings per square mile within the subwatershed.

Hydrology

Bear Creek subwatershed comprises approximately 9% of the total drainage area in the South Sandy Creek Watershed. Bear Creek subwatershed has a drainage area of 5,883 acres (9.2 square miles) with a drainage density of 1.8 stream miles per square mile. The total stream length within the subwatershed is 16.2 miles. The significant tributary identified in the subwatershed is Bear Creek.

Precipitation

Table 57 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 57. Bear Creek Average Annual Precipitation from East to West, in general

% of Subwatershed Area	Precipitation (inches)
25	55
50	45
25	37.5

Land Cover

The major land cover consists of deciduous forest followed by scrub/shrub. Refer to Figure 23 for a graphic representation of the land cover composition for the entire subwatershed.

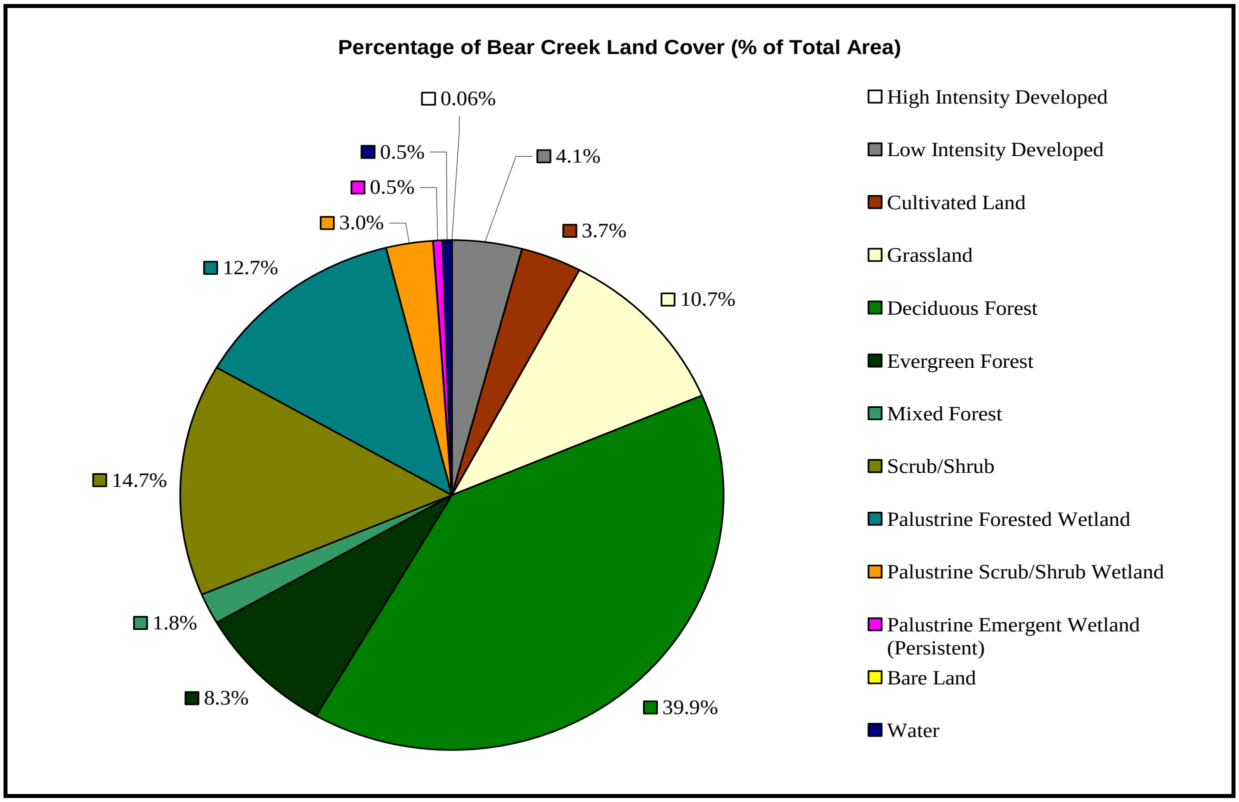

Figure 23. Bear Creek Land Cover Composition

Soils

Table 58 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under similar storm and cover conditions. Refer to Table 59 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 58. General Soil Map Units in Bear Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5952	Farnham-Blasdell-Alton	1736	29.5
s5950	Palmyra-Howard-Alton	454	7.7
s5912	Worth-Empeyville-Bice	2070	35.2
s5979	Sodus-Scriba-Ira	651	11.1
s5987	Rhinebeck-Niagara-Hudson-Dunkirk-Collamer	973	16.5

Table 59. Bear Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	1736	29.5
B	454	7.7
C	3693	62.8
D	-	-

Notes:
HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

Wetlands

There are 27 acres of wetlands, approximately 0.423% of the total area, within Bear Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 60 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 60. Bear Creek Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	0.2	0.003
Class II	0.9	0.02
Class III	NA	NA
Class IV	NA	NA
No Wetland Class Designated	25.8	0.4
Non-Wetland Features	NA	NA

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

<u>Managed Lands</u>

Bear Creek subwatershed contains 1,322 acres (22.5% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 181 acres by the County and 1,141 acres by New York State.

<u>Field Reconnaissance</u>

The field observations within this subwatershed concluded: The sampling point in the upper portion of Bear Creek is located within a State Reforestation Area and is dominated by coniferous trees with some deciduous trees. The middle of the subwatershed is dominated by agriculture, primarily hay and corn, and rural residential. A majority of the land use is residential and commercial in the lower portion of the subwatershed. This area is also forested; however, mowed areas are prevalent.

There is little to no erosion from the upper to the lower reaches within the subwatershed. The areas influenced by agricultural land use may exhibit some bank erosion from impacted buffers. Overall the water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 61. Market Value per Acre by Land Use in Bear Creek

Bear Creek							
Land Use	Est. Acreage in Bear Creek	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Bear Creek	% of Total MV in Bear Creek	Per Acre MV in Bear Creek	Per Acre MV in Sandy Creeks Watershed
Agricultural	2,018	43.03%	36.23%	$7,061,951	5.12%	$754	$828
Residential	1,158	24.69%	21.78%	$87,563,566	63.49%	$10,694	$10,594
Vacant	549	11.72%	14.18%	$6,074,023	4.40%	$1,097	$791
Commercial	12	0.25%	0.72%	$7,241,093	5.25%	$13,057	$24,972
Recreation and Entertainment	7	0.14%	0.60%	$1,559,965	1.13%	$4,333	$9,695
Community Service	5	0.12%	0.24%	$23,680,807	17.17%	$164,336	$145,997
Industrial	5	0.10%	0.67%	$578,147	0.42%	$1,064	$1,519
Public Service	18	0.39%	0.92%	$1,207,895	0.88%	$4,703	$5,470
Public Parks, Wild, Forest	918	19.58%	24.65%	$2,942,049	2.13%	$418	$746
Totals	4,690	100.00%	100.00%	$137,909,495	100.00%	$22,273	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- The top four largest land use categories are the same in Bear Creek as in the overall Watershed, but not in the same order.
- The value of commercial land and recreation & entertainment land per acre is much lower in Bear Creek than the average for the whole Watershed.

Existing Studies

Few existing studies associated with Bear Creek subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. This study has limited applicability to the rest of the subwatershed. Another technical report documented a multi-year project conducted by the NY Natural Heritage Program surveying and documenting significant stream systems and communities within the highest quality watersheds of Tug Hill. Due to partial coverage of surveying and documentation within the Bear Creek subwatershed, limited conclusions could be made for on the entire subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of each article. The references for these studies are listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

Hunt, D.M, et al. *Tug Hill Stream Inventory & Watershed Integrity Analysis*. New York Natural Heritage Program. January 7, 2005.

6.11 LOWER SOUTH SANDY CREEK

Located in the South Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Lower South Sandy Creek subwatershed is located entirely within Jefferson County, New York. One municipality, Ellisburg, is located partially within the subwatershed boundary. The transportation system has a road density of 2.62 miles of road per square mile. There are a total of 42 road/stream crossings with a density of 2.1 crossings per square mile within the subwatershed.

Hydrology

Lower South Sandy Creek subwatershed comprises approximately 19% of the total drainage area in the South Sandy Creek Watershed. Lower South Sandy Creek subwatershed has a drainage area of 12,633 acres (19.7 square miles) with a drainage density of 1.8 stream miles per square mile. The total stream length within the subwatershed is 35.8 miles. The significant tributaries identified in the subwatershed include: Bear Creek, Kibling Brook, Little Deerlick Creek, South Sandy Creek, and Taylor Brook.

Precipitation

Table 62 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 62. Lower South Sandy Creek Average Annual Precipitation from East to West, in general

% of Subwatershed Area	Precipitation (inches)
19	45
81	37.5

Land Cover

The major land cover consists of grassland and cultivated land. Refer to Figure 24 for a graphic representation of the land cover composition for the entire subwatershed.

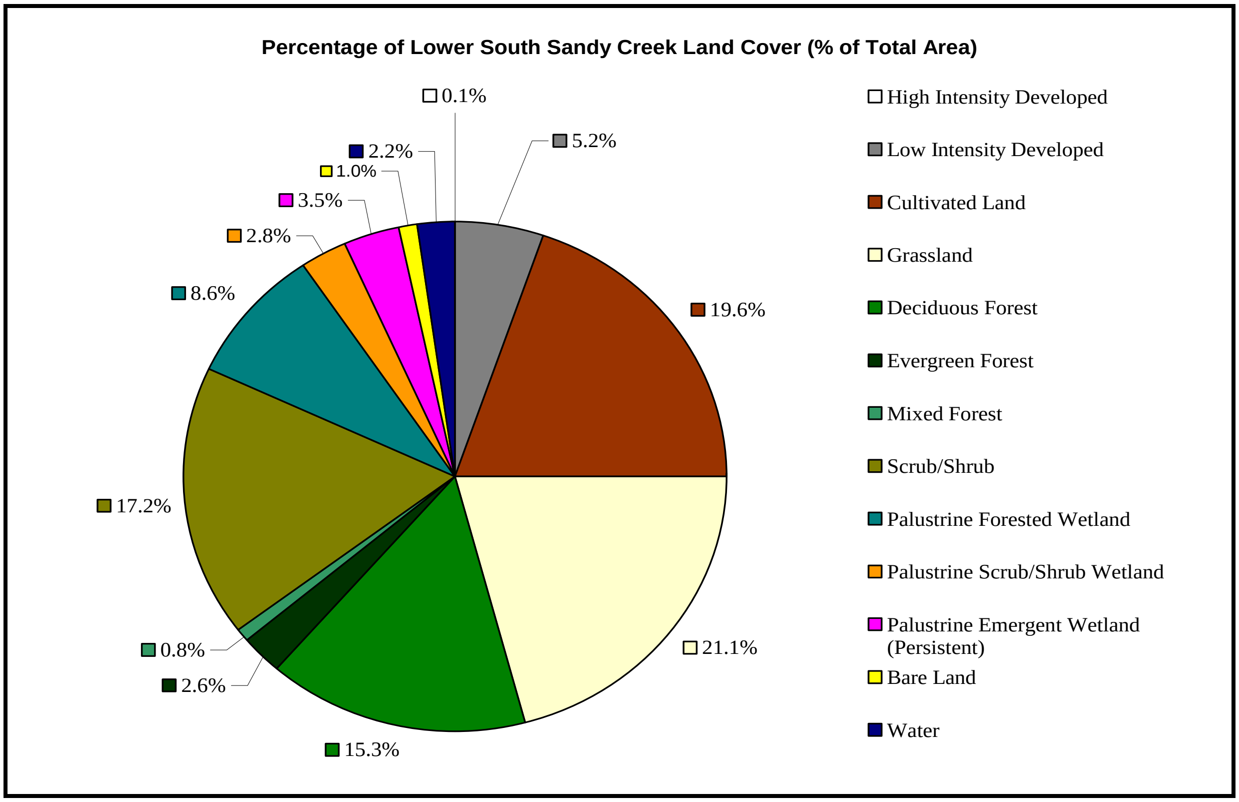

Figure 24. Lower South Sandy Creek Land Cover Composition

Soils

Table 63 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under similar storm and cover conditions. Refer to Table 64 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 63. General Soil Map Units in Lower South Sandy Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5942	Oakville-Elnora-Colonie	842	6.7
s5950	Palmyra-Howard-Alton	1979	15.7
s5952	Farnham-Blasdell-Alton	392	3.1
s5969	Wayland-Saprists-Fluvaquents-Aquents	1252	9.9
s5979	Sodus-Scriba-Ira	644	5.1
s5987	Rhinebeck-Niagara-Hudson-Dunkirk-Collamer	6766	53.6
s5991	Wassaic-Lairdsville-Farmington	758	6.0

Table 64. Lower South Sandy Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	1234	9.8
B	2737	21.7
C	7410	58.7
D	1252	9.9

Notes:
HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

Wetlands

There are 866 acres of wetlands, approximately 6.7% of the total area, within Lower South Sandy Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 65 for the acres of wetland by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 65. Lower South Sandy Creek Wetlands By Classification

Classification	Acres	% of Subwatershed Area
Class I	758.8	6.0
Class II	18.9	0.1
Class III	82.0	0.6
Class IV	NA	NA
No Wetland Class Designated	5.8	0.0
Non-Wetland Features	NA	NA

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

<u>Managed Lands</u>

Lower South Sandy Creek subwatershed contains 2,482 acres (7.9% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 486 acres by the County and 1,996 acres by New York State.

<u>Habitat and Macroinvertebrate Community Assessment</u>

Rivers and streams within the Lake Ontario basin were monitored based on a verbal habitat assessment and a macroinvertebrate community assessment as part of the Rotating Integrated Basin Studies portion (RIBS) of the Statewide Waters Monitoring Program. The verbal habitat assessment described the stream banks of South Sandy Creek in Ellisburg and South Sandy Creek in Allendale as moderately stable with small areas of erosion and vegetation or rock cover on the bank area. The streams banks of Raystone Creek in Giddingsville were assessed as largely unstable with erosion occurring on half the bank area and no vegetative or rock cover. South Sandy Creek in Ellisburg, South Sandy Creek in Allendale, and Raystone Creek in Giddingsville were all assessed as non-impacted based on macroinvertebrate community assessment results (Statewide Waters Monitoring Section, 2005).

<u>Intensive Site Monitoring</u>

South Sandy Creek in Ellisburg within the Lake Ontario basin was selected for an intensive monitoring involving a comprehensive sampling as part of the Rotating Integrated Basin Studies portion (RIBS) of the Statewide Waters Monitoring Program. This segment of the stream is located 7 miles upstream of the confluence with Lake Ontario in a densely forested rural residential area. The streambanks have a very steep gradient leading to the water covered with rocks, grass, and shrubs growing between the rocks and were described as moderately stable with little evidence of erosion. At the sampling site, the riparian zone is narrow due to rock formations along the streambanks. Iron and dissolved aluminum are two elements in the water column exceeding water quality standards. The macroinvertebrates assessment characterized the stream as non-impacted; however, the species density was low for a non-impacted stream possibly due to the bedrock substrate. Acute, significant mortality, and chronic, reproductive impairment, toxicity were not detected at this sample location. The collected samples of sediment results concluded no contaminants above reportable limits exceed the PEC. The sample did contain copper and nickel at levels of concern and dieldrin, endin, and heptachlor epoxide at levels below method detection limits. It is inconclusive whether the contaminants are a concern. However, they are not as levels likely to cause adverse biological effects to sediment-dwelling organisms (Statewide Waters Monitoring Section, 2005).

Analysis of Existing Water Quality Database from 1997 to 2005

The Jefferson County Water Quality Coordinating Committee collected water samples from six sites on both Sandy Creek and South Sandy Creek. Overall, the water quality of on the two creeks is quite good with relatively low levels of nutrients, high dissolved oxygen concentrations, and the ability to support a desirable and healthy aquatic ecosystem. Chemical methodology limits the analysis and interpretation of the existing data. There is no way to show if an improvement in water quality has occurred. However, it can be concluded there has been no major degradation in the water quality for either creek (Makarewicz and Lewis, 2006).

Field Reconnaissance

The field observations within the subwatershed concluded: A majority of the land use in this subwatershed is agricultural with associated residential areas interspersed. In the agricultural areas, the deciduous forests form narrow corridors along the stream channels and patches on adjacent steep slopes. There is little to no erosion within the subwatershed due to moderately forested buffers. However, impacted buffers along agricultural lands may cause some bank erosion to occur. Overall, water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 66. Market Value per Acre by Land Use in Lower South Sandy Creek

Lower South Sandy							
Land Use	Est. Acreage in Lower South Sandy	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Lower South Sandy	% of Total MV in Lower South Sandy	Per Acre MV in Lower South Sandy	Per Acre MV in Sandy Creeks Watershed
Agricultural	8,332	57.60%	36.23%	$8,880,235	20.93%	$1,066	$828
Residential	1,582	10.93%	21.78%	$15,363,706	36.21%	$9,714	$10,594
Vacant	900	6.22%	14.18%	$719,882	1.70%	$800	$791
Commercial	5	0.03%	0.72%	$293,529	0.69%		$24,972
Recreation and Entertainment		0.00%	0.60%				$9,695
Community Service	28	0.19%	0.24%	$1,537,059	3.62%	$54,856	$145,997
Industrial		0.00%	0.67%				$1,519
Public Service	33	0.23%	0.92%	$325,858	0.77%	$9,904	$5,470
Public Parks, Wild, Forest	3,585	24.79%	24.65%	$15,308,471	36.08%	$4,270	$746
Totals	14,464	100.00%	100.00%	$42,428,740	100.00%	$13,435	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- Lower South Sandy has the least amount of residential land of all the sub-watershed.
- Although Lower South Sandy has the same percentage of public parks & forestland as the overall Watershed, such land in Lower South Sandy is much more highly valued.

Existing Studies

Few existing studies associated with Lower South Sandy Creek subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. This study has limited applicability to the rest of the subwatershed. The NYSDEC Lake Ontario Drainage Basin *Rotating Integrated Basin Studies* (RIBS) report provides an assessment of channel condition and water quality based on macroinvertebrate indices at three stations in lower South Sandy Creek. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of this article and the reference is listed below.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

New York State Department of Environmental Conservation. 2005. *The Lake Ontario Drainage Basin: Sampling Years 1999-2003 Rotating Integrated Basin Studies Data Report*. Division of Water. Bureau of Watershed Assessment and Research.

6.12 LINDSEY/SKINNER

Located in the Salmon River to South Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Lindsey/Skinner subwatershed is located 58% within Jefferson County and 42% within Oswego County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Ellisburg, Boylston, Sandy Creek, Lorraine, Mannsville, and Lacona. The transportation system has a road density of 2.38 miles of road per square mile. There are a total of 100 road and stream crossings with a density of 1.7 crossings per square mile within the subwatershed.

Hydrology

Lindsey/Skinner Creek subwatershed comprises approximately 49% of the total drainage area in the Salmon River to South Sandy Creek Watershed. The subwatershed has a drainage area of 36,308 acres (56.7 square miles) with a drainage density of 1.7 stream miles per square mile. The total stream length within the subwatershed is 96.2 miles. The significant tributaries identified in the subwatershed include: Big Deerlick Creek, Blind Creek, Jacobs Brook, Lindsey Creek, Mud Creek, Skinner Creek, and South Branch Sandy Creek.

Precipitation

Table 67 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 67. Lindsey/Skinner Average Annual Precipitation from East to West, in general

% of Subwatershed Area	Precipitation (inches)
6	55
42	45
43	37.5
6	0

Land Cover

The major land cover consists of deciduous forest followed by scrub/shrub. Refer to Figure 25 for a graphic representation of the land cover composition for the entire subwatershed.

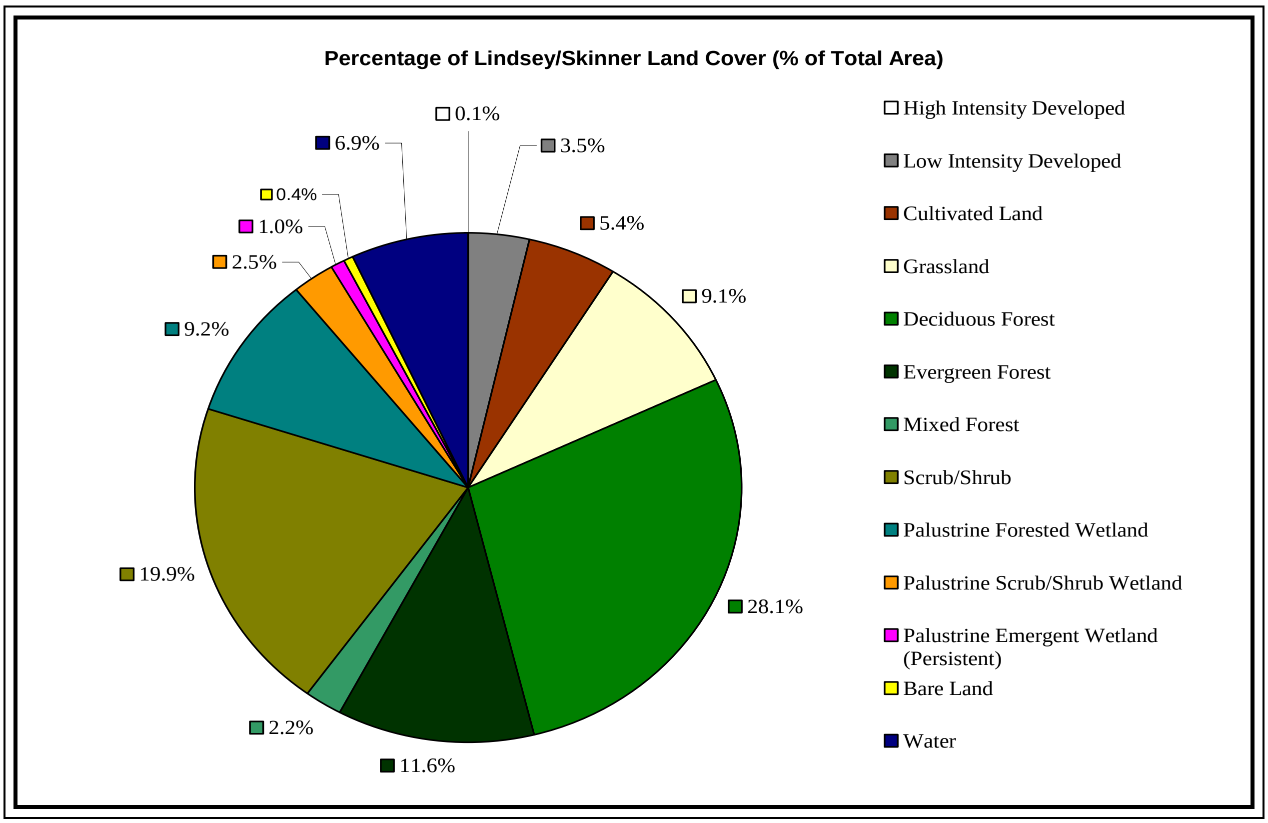

Figure 25. Lindsey/Skinner Land Cover Composition

Soils

Table 68 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under similar storm and cover conditions. Refer to Table 69 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 68. General Soil Map Units in Lindsey/Skinner

Map Unit Symbol	Map Unit Name	Acres	% of subwatershed area
s5942	Oakville-Elnora-Colonie	2494	6.9
s5952	Farnham-Blasdell-Alton	1398	3.8
s5950	Palmyra-Howard-Alton	5322	14.7
s5912	Worth-Empeyville-Bice	11016	30.3
s5979	Sodus-Scriba-Ira	10031	27.6
s5987	Rhinebeck-Niagara-Hudson-Dunkirk-Collamer	2364	6.5
s5969	Wayland-Saprists-Fluvaquents-Aquents	1546	4.3

Table 69. Lindsey/Skinner Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	3891	10.7
B	5322	14.7
C	23411	64.5
D	1546	4.3

Notes:
HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

Wetlands

There are 1,789 acres of wetlands, approximately 8.6% of the total area, within Lindsey/Skinner subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 70 for the acres of wetland

by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 70. Lindsey/Skinner Wetlands By Classification

Classification	Acres	% of subwatershed area
Class I	738.6	3.5
Class II	522.4	2.5
Class III	537.3	2.6
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	NA	NA

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

Managed Lands

Lindsey/Skinner subwatershed contains 6,326 acres (17.4% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 1,024 acres by the County and 5,301 acres by New York State.

Juvenile Steelhead Surveys

A density estimate of wild juvenile steelhead was conducted on Little Sandy Creek in the 1980s and resurveyed in 1997 along with sites on Lindsey Creek, Skinner Creek, and Trout and Orwell Brooks, Salmon River tributaries. Juvenile steelhead densities conducted in 1997 on Little Sandy Creek resulted in slightly higher densities than observed in 1986-1988. Similar densities to those found in Little Sandy Creek were also observed on the other tributaries in1997. To conclude, the production of wild steelhead in 1997 is similar and may show improvement compared to density estimates in the 1980s (Bishop et al., 1997).

Macroinvertebrate Community Assessment

The river and streams within the Lake Ontario basin were sampled as a part of the Rotating Integrated Basin Studies portion (RIBS) of the Statewide Waters Monitoring Program. A macroinvertebrate community assessment evaluated Lindsey Creek at The Elm sampled as slightly impacted. Riffle beetles and filter-feeding caddis flies dominated the stream fauna indicating non-point source nutrient enrichment. The surrounding land use alternated between rural residential, sparsely forested, and pastureland (Statewide Waters Monitoring Section, 2005).

Loss of Nutrients and Soil from Sandy Pond Tributaries

A three-year study on fiver major tributaries (Little Sandy Creek, Blind Creek, Mud Creek, Lindsey Creek, and Skinner Creek) to North and South Sandy Pond was performed to determine possible sources and to quantify loss of nutrients and soil to the pond system during hydrometeorological events. Skinner Creek and Little Sandy Creek have the highest average non-event and event flows. The study proved the greatest losses of nutrients and soil from the watershed occurred during hydrometeorological events. Conversely, the lowest losses on a per day basis occurred during non-events. Generally, during events total suspended solids, total phosphorus, and total Kjeldahl nitrogen daily losses increased two to ten times baseline losses. Phosphorus loading from the tributaries was highly correlated with discharge from Sandy Pond watersheds during events. This result suggests that phosphorus is delivered to the system by soil particulates washing off the landscape and eroding from streambanks. High salt loss was determined to be a result of deicing operations for roads near the tributaries. In four out of five tributaries, there was not a strong correlation between total Kjeldahl nitrogen and discharge indicating that organic nitrogen is not being washed off the landscape (Makarewicz et al., 2002).

Field Reconnaissance

The field observations within the subwatershed concluded: The upper portion of the subwatershed is located within a State Reforestation Area dominated by coniferous trees with some deciduous trees. Further downstream in the subwatershed, agriculture and rural residential become the major land uses. Forested wetlands become more prevalent lower in the subwatershed near North Sandy Pond, South Sandy Pond, and Lake Ontario. There is little to no erosion within the subwatershed due to moderately forested buffers. However, impacted buffers along agricultural lands may cause some bank erosion to occur. Overall, water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 71. Market Value per Acre by Land Use in Lindsey/ Skinner Creek

Lindsey Skinner							
Land Use	Est. Acreage in Lindsey Skinner	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Lindsey Skinner	% of Total MV in Lindsey Skinner	Per Acre MV in Lindsey Skinner	Per Acre MV in Sandy Creeks Watershed
Agricultural	9,369	29.29%	36.23%	$6,228,114	4.41%	$665	$828
Residential	8,188	25.60%	21.78%	$90,184,434	63.87%	$11,014	$10,594
Vacant	5,535	17.30%	14.18%	$6,053,817	4.29%	$1,094	$791
Commercial	555	1.73%	0.72%	$7,343,416	5.20%	$13,241	$24,972
Recreation and Entertainment	360	1.13%	0.60%	$1,675,037	1.19%	$4,653	$9,695
Community Service	144	0.45%	0.24%	$24,876,898	17.62%	$172,636	$145,997
Industrial	543	1.70%	0.67%	$579,100	0.41%	$1,066	$1,519
Public Service	257	0.80%	0.92%	$1,064,961	0.75%	$4,147	$5,470
Public Parks, Wild, Forest	7,034	21.99%	24.65%	$3,200,876	2.27%	$455	$746
Totals	31,986	100.00%	100.00%	$141,206,653	100.00%	$23,219	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- Land use in Lindsey Skinner is distributed in a relatively similar way to the overall Watershed. Land values per acre are relatively similar as well.

Existing Studies

Several existing studies associated with Lindsey/Skinner Creek subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. A report in 2002 for the Eastern Lake Ontario Sand Transport Study reviewed water movement in Eastern Lake Ontario, aerial photography, and ground penetrating radar to make conclusions about sediment transport patterns in the region and provide a basis for management of the Eastern Shore of Lake Ontario. A technical document by E. Stanton about developing a population monitoring program for the Bog Buckmoth, an endangered species in New York since 1999, was also reviewed. However, all three technical documents have limited applicability to the rest of the subwatershed. Bog Buckmoth population monitoring studies along Eastern Lake Ontario were summarized in a 2006 study by S. Bonanno. Limited conclusions could be made on the entire subwatershed because of narrow population monitoring coverage. The NYSDEC Lake Ontario Drainage Basin *Rotating Integrated Basin Studies* (RIBS) report provides an assessment of channel condition and water quality based on macroinvertebrate indices at one station on lower Lindsey Creek. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of each article. A reference for each study is listed below.

Bonanno, Sandra E. *Summary Report: Eastern Lake Ontario Bog Buckmoth Population Monitoring Program.* NYS Department of Environmental Conservation Endangered Species Unit, December 14, 2006.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

New York State Department of Environmental Conservation. 2005. *The Lake Ontario Drainage Basin: Sampling Years 1999-2003 Rotating Integrated Basin Studies Data Report*. Division of Water. Bureau of Watershed Assessment and Research.

Stanton, Edward. *Development of a Population Monitoring Program for the Bog Buckmoth (Saturniidae: Hemileuca sp.)*. The Nature Conservancy, December 2003.

Woodrow, D.E. et al. *Eastern Lake Ontario Sand Transport Study (ELOSTS): Final Report on Sediment Transport Patterns and Management Implications for Eastern Lake Ontario.* The Nature Conservancy. New York State Department of State. October 28, 2002.

6.13 LITTLE SANDY CREEK

Located in the Salmon River to South Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Little Sandy Creek subwatershed is located 99% within Oswego County and 1% within Jefferson County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Ellisburg, Boylston, Redfield, Sandy Creek, Richland, Lorraine, and Lacona. The transportation system has a road density of 2.65 miles of road per square mile. There are a total of 74 road and stream crossings with a density of 2.2 crossings per square mile within the subwatershed.

Hydrology

Little Sandy Creek subwatershed comprises approximately 28% of the total drainage area in the Salmon River to South Sandy Creek Watershed. The subwatershed has a drainage area of 21,041 acres (32.9 square miles) with a drainage density of 1.9 stream miles per square mile. The total stream length within the subwatershed is 63.8 miles. The significant tributaries identified in the subwatershed include: Little Sandy Creek and Stinson Creek.

Precipitation

Table 72 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 72. Little Sandy Creek Average Annual Precipitation from East to West, in general

% of Subwatershed Area	Precipitation (inches)
38	55
28	45
30	37.5
2	0

Land Cover

The major land cover consists of deciduous forest and scrub/shrub. Refer to Figure 26 for a graphic representation of the land cover composition for the entire subwatershed.

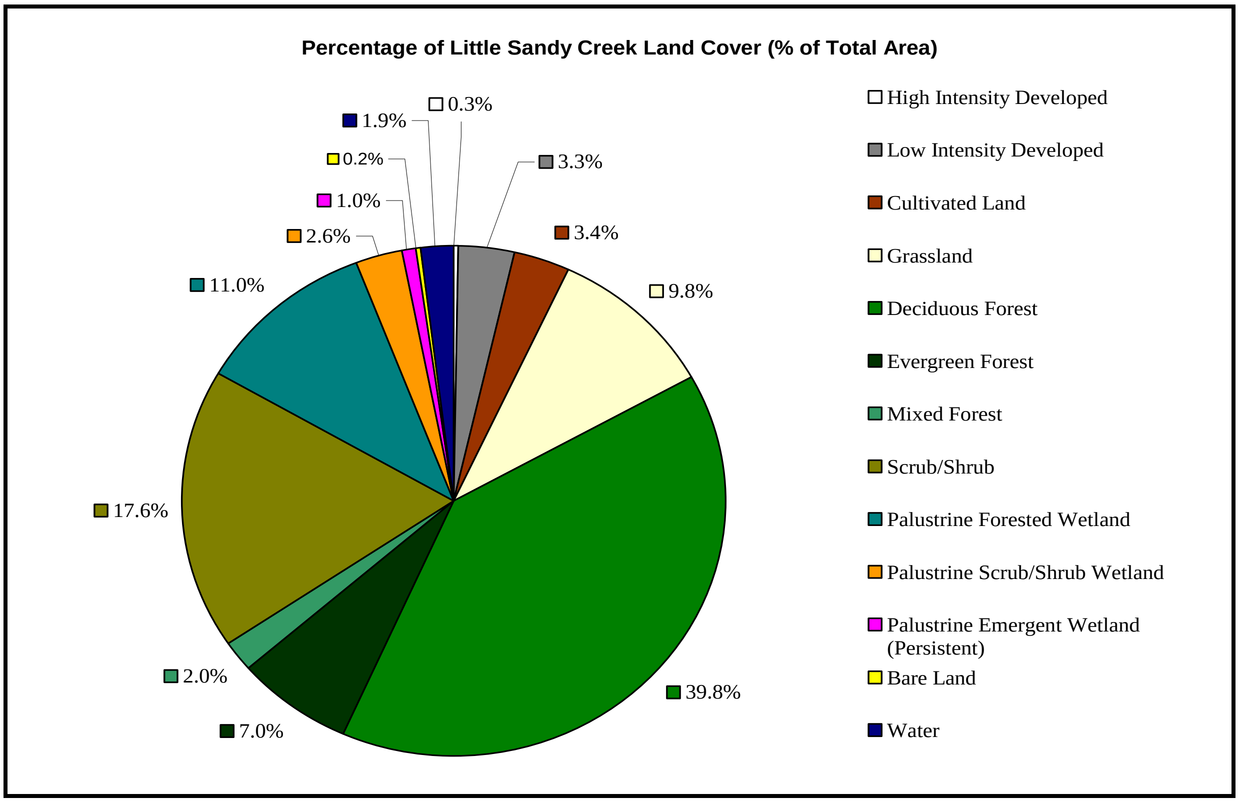

Figure 26. Little Sandy Creek Land Cover Composition

Soils

Table 73 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under similar storm and cover conditions. Refer to Table 74 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 73. General Soil Map Units in Little Sandy Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5912	Worth-Empeyville-Bice	9570	45.5
s5942	Oakville-Elnora-Colonie	936	4.4
s5950	Palmyra-Howard-Alton	2440	11.6
s5963	Westbury-Empeyville-Colosse-Bice-Adams	716	3.4
s5969	Wayland-Saprists-Fluvaquents-Aquents	497	2.4
s5979	Sodus-Scriba-Ira	5320	25.3
s6004	Worth-Westbury-Empeyville	1273	6.1
s8369	Water	265	1.3

Table 74. Little Sandy Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	1651	7.8
B	2440	11.6
C	16164	76.8
D	497	2.4

Notes:
HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

<u>Wetlands</u>

There are 1,807 acres of wetlands, approximately 8.6% of the total area, within Little Sandy Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 75 for the acres of wetland

by classification within the subwatershed and Appendix 12 for a description of each classification.

Table 75. Little Sandy Creek Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	823.7	3.9
Class II	676.2	3.2
Class III	105.6	0.5
Class IV	NA	NA
No Wetland Class Designated	NA	NA
Non-Wetland Features	201.6	1.0

Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV.
New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.

Managed Lands

Little Sandy Creek subwatershed contains 4,302 acres (20.4% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 417 acres by The Nature Conservancy and 3,886 acres by New York State.

Juvenile Steelhead Surveys

A density estimate of wild juvenile steelhead was conducted on Little Sandy Creek in the 1980s and resurveyed in 1997 along with sites on Lindsey Creek, Skinner Creek, and Trout and Orwell Brooks, Salmon River tributaries. Juvenile steelhead densities conducted in 1997 on Little Sandy Creek resulted in slightly higher densities than observed in 1986-1988. Similar densities to those found in Little Sandy Creek were also observed on the other tributaries in1997. To conclude, the production of wild steelhead in 1997 is similar and may show improvement compared to density estimates in the 1980s (Bishop et al., 1997).

Biological Assessment

A biological assessment was conducted on Little Sandy Creek on August 20, 1997 with the purpose of assessing general water quality and establishing invertebrate data. Based on invertebrate and fish populations, all sites sampled on Little Sandy Creek between the villages of

Lacona to Sandy Creek were evaluated as non-impacted. Rainbow trout dominated the all fish populations. Biota results indicated possible nutrient and organic additions in the villages of Lacona and Sandy Creek. There were minor effects on fauna due to these additions (Stream Biomonitoring Unit, July 1998).

Segment Analysis of Little Sandy Creek

A process called segment analysis was conducted on Little Sandy Creek to evaluate point and non-point sources of nutrients, soils, and salts contributing to North and South Sandy Ponds. Significant point and non-point sources of elevated loss of nutrients and soil is believed to be contributed by pipes carrying discharge near streams and nearby agricultural practices such as manure applications and tilling of the land. Overall, the quality and quantity of runoff from a watershed is affected by people's influence on the land (Makarewicz and Lewis, September 2004).

Macroinvertebrate Community Assessment

The river and streams within the Lake Ontario basin were sampled as a part of the Rotating Integrated Basin Studies portion (RIBS) of the Statewide Waters Monitoring Program. A macroinvertebrate community assessment evaluated the Little Sandy Creek in Sandy Ponds as slightly impacted. Riffle beetles and filter-feeding caddisflies dominated the stream fauna indicating nonpoint source nutrient enrichment. The surrounding land use was pasture agricultural (Statewide Waters Monitoring Section, 2005).

Loss of Nutrients and Soil from Sandy Pond Tributaries

A three year study on fiver major tributaries (Little Sandy Creek, Blind Creek, Mud Creek, Lindsey Creek, and Skinner Creek) to North and South Sandy Pond was performed to determine possible sources and to quantify loss of nutrients and soil to the pond system during hydrometeorological events. Skinner Creek and Little Sandy Creek have the highest average non-event and event flows. The study proved the greatest losses of nutrients and soil from the watershed occurred during hydrometeorological events. Conversely, the lowest losses on a per day basis occurred during non-events. Generally, during events total suspended solids, total phosphorus, and total Kjeldahl nitrogen daily losses increased two to ten times baseline losses. Phosphorus loading from the tributaries was highly correlated with discharge from Sandy Pond watersheds during events. This result suggests that phosphorus is delivered to the system by soil particulates washing off the landscape and eroding from streambanks. High salt loss was determined to be a result of deicing operations for roads near the tributaries. In four out of five tributaries, there was not a strong correlation between total Kjeldahl nitrogen and discharge indicating that organic nitrogen is not being washed off the landscape (Makarewicz et al., 2002).

Field Reconnaissance

The field observations within the subwatershed concluded: The subwatershed originates in a State Reforestation Area and Wildlife Management Area composed of deciduous forested wetlands and ponded areas. The upper portion of the subwatershed has few residential areas, mostly existing as camps. The stream channel has little to no erosion because of its low gradient and flow path through the wetland area.

A majority of the land use in the lower section of the subwatershed is agricultural, primarily dairy farms. There is a high density of recreational residential development in the area along the North Sandy Pond. There is evidence of stream channelization along the stream within the villages of Sandy Creek and Lacona. Overall, water quality appears to be excellent. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 76. Market Value per Acre by Land Use in Gulf Stream

Little Sandy Creek							
Land Use	Est. Acreage in Little Sandy Creek	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Little Sandy Creek	% of Total MV in Little Sandy Creek	Per Acre MV in Little Sandy Creek	Per Acre MV in Sandy Creeks Watershed
Agricultural	3,389	17.36%	36.23%	$2,277,925	1.94%	$672	$828
Residential	5,792	29.67%	21.78%	$87,325,935	74.46%	$15,077	$10,594
Vacant	4,056	20.78%	14.18%	$4,341,830	3.70%	$1,070	$791
Commercial	262	1.34%	0.72%	$9,647,600	8.23%	$36,872	$24,972
Recreation and Entertainment	143	0.73%	0.60%	$2,699,900	2.30%	$18,886	$9,695
Community Service	32	0.16%	0.24%	$4,333,500	3.70%	$136,102	$145,997
Industrial	72	0.37%	0.67%	$137,200	0.12%	$1,911	$1,519
Public Service	63	0.32%	0.92%	$3,125,106	2.66%	$49,922	$5,470
Public Parks, Wild, Forest	5,711	29.26%	24.65%	$3,390,178	2.89%	$594	$746
Totals	19,519	100.00%	100.00%	$117,279,174	100.00%	$29,012	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- The largest land uses in Little Sandy Creek are residential, public parks & forest, and vacant land. Agriculture is the fourth largest land use.
- Excluding Community Service, the most highly valued land in Little Sandy Creek is public service lands ($49,922 per acre) and commercial property ($36,872 per acre).
- In comparison to the entire Watershed, Little Sandy Creek has more residential land, which is also more highly valued.

Existing Studies

Several existing studies associated with Little Sandy Creek subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. A technical document by E. Stanton about developing a population monitoring program for the Bog Buckmoth, an endangered species in New York since 1999, was also reviewed. Both the studies have limited applicability to the rest of the subwatershed. Bog Buckmoth population monitoring studies along Eastern Lake Ontario was summarized in a 2006 study by S. Bonanno. Limited conclusions could be made on the entire subwatershed because of narrow population monitoring coverage. A multi-year project conducted by the NY Natural Heritage Program surveying and documenting significant stream systems and communities within the highest quality watersheds of Tug Hill was documented in a 2005 technical report. Due to partial coverage of surveying and documentation within the Little

Sandy Creek subwatershed, limited inferences could be made based on the entire subwatershed area.

The NYSDEC Lake Ontario Drainage Basin *Rotating Integrated Basin Studies* (RIBS) report provides an assessment of channel condition and water quality based on macroinvertebrate indices at one station on Little Sandy Creek. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of each article. A reference for each study is listed below.

Bonanno, Sandra E. *Summary Report: Eastern Lake Ontario Bog Buckmoth Population Monitoring Program.* NYS Department of Environmental Conservation Endangered Species Unit, December 14, 2006.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

Hunt, D.M, et al. *Tug Hill Stream Inventory & Watershed Integrity Analysis*. New York Natural Heritage Program. January 7, 2005.

New York State Department of Environmental Conservation. 2005. *The Lake Ontario Drainage Basin: Sampling Years 1999-2003 Rotating Integrated Basin Studies Data Report*. Division of Water. Bureau of Watershed Assessment and Research.

Stanton, Edward. *Development of a Population Monitoring Program for the Bog Buckmoth (Saturniidae: Hemileuca sp.).* The Nature Conservancy, December 2003.

6.14 DEER CREEK

Located in the Salmon River to South Sandy Creek Watershed

Existing Conditions

Municipal Boundaries/ Urban Influences

Deer Creek subwatershed is located entirely within Oswego County, New York. Several municipalities located entirely or partially within the subwatershed boundary include: Boylston, Sandy Creek, Orwell, Richland, Lacona, and Pulaski. The transportation system has a road density of 2.13 miles of road per square mile. There are a total of 51 road and stream crossings with a density of 1.8 crossings per square mile within the subwatershed.

Hydrology

Deer Creek subwatershed comprises approximately 23% of the total drainage area in the Salmon River to South Sandy Creek Watershed. The subwatershed has a drainage area of 17,455 acres with a drainage density of 1.5 stream miles per square mile. The total stream length within the subwatershed is 40.4 miles. The significant tributaries identified in the subwatershed include: Alder Creek, Deer Creek, and Little Deer Creek.

Precipitation

Table 77 displays the average annual precipitation trend across the subwatershed from east to west. Refer to Appendix 10 for a regional map of the average annual precipitation.

Table 77. Deer Creek Average Annual Precipitation from East to West, in general

% of Subwatershed Area	Precipitation (inches)
1	55
64	45
35	37.5

Land Cover

The major land cover consists of deciduous forest and scrub/shrub. Refer to Figure 27 for a graphic representation of the land cover composition for the entire subwatershed.

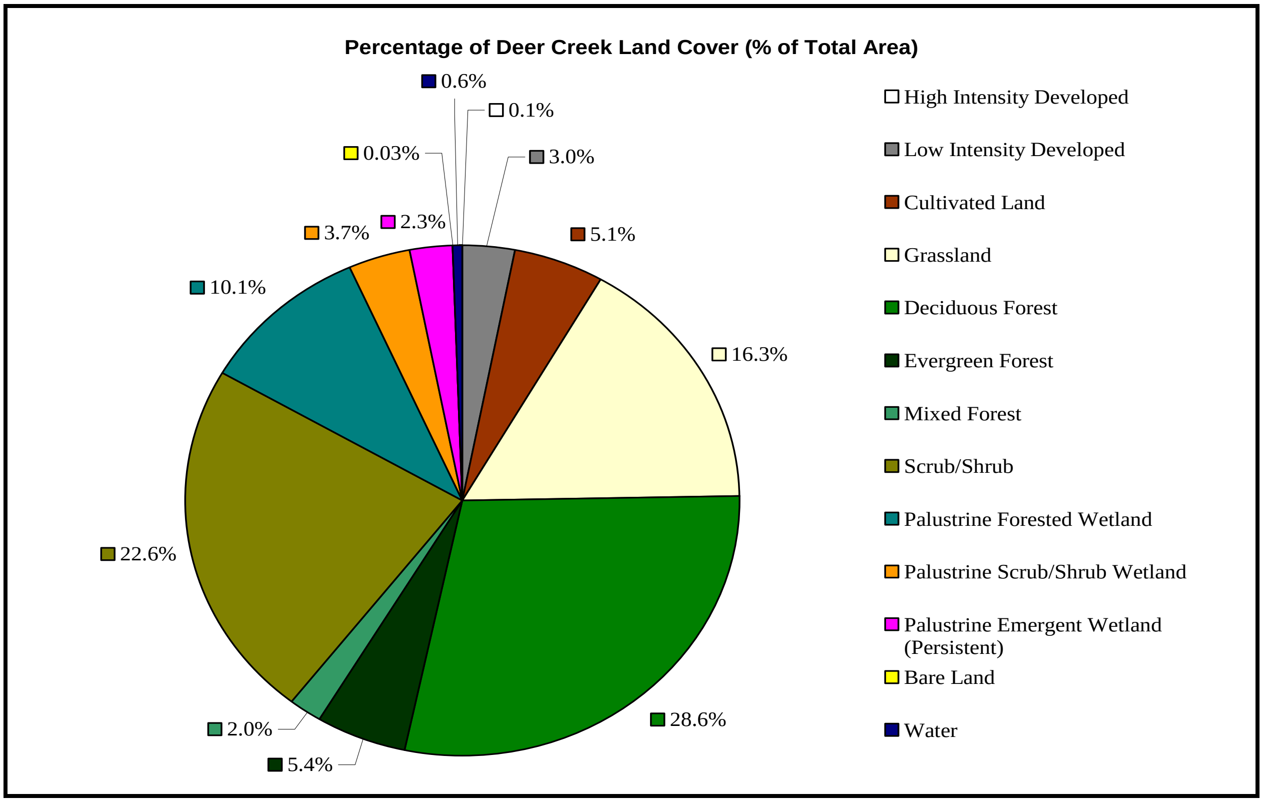

Figure 27. Deer Creek Land Cover Composition

Soils

Table 78 displays the general soil map unit acreage and percentage of subwatershed area. A hydrologic soil group is designated for each soil map unit based on the group of soils' runoff potential under similar storm and cover conditions. Refer to Table 79 for the acreage and percent of subwatershed area per hydrologic soil group and Appendix 11 for a description of each hydrologic soil group.

Table 78. General Soil Map Units in Deer Creek

Map Unit Symbol	Map Unit Name	Acres	% of Subwatershed Area
s5942	Oakville-Elnora-Colonie	130	0.7
s5963	Westbury-Empeyville-Colosse-Bice-Adams	760	4.4
s6001	Duxbury-Colton-Adams	15	0.1
s5950	Palmyra-Howard-Alton	1935	11.1
s5912	Worth-Empeyville-Bice	3338	19.1
s5939	Williamson-Wallington-Raynham-Niagara-Canaseraga	2922	16.7
s5962	Searsport-Pillsbury-Naumburg-Croghan-Beseman	1693	9.7
s5979	Sodus-Scriba-Ira	2561	14.7
s6004	Worth-Westbury-Empeyville	2984	17.1
s5969	Wayland-Saprists-Fluvaquents-Aquents	1116	6.4

Table 79. Deer Creek Hydrologic Soil Groups

Hydrologic Soil Group	Acres	% of Subwatershed Area
A	905	5.2
B	1935	11.1
C	13499	77.3
D	1116	6.4

Notes:
HSG classes are defined as follows:
A – High infiltration rate even when thoroughly wetted and low runoff potential.
B – Moderate infiltration rate when thoroughly wetted.
C – Slow infiltration rate when thoroughly wetted.
D – Very slow infiltration rate when thoroughly wetted or high runoff potential.
U.S. Department of Agriculture, Natural Resources Conservation Service, 2005. National Soil Survey Handbook, title 430-VI.

Wetlands

There are 2,165 acres of wetlands, approximately 12.4% of the total area, within Deer Creek subwatershed. A wetland classification system was developed by NYDEC to represent the benefits supplied by wetlands based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location. Data collected using the NY DEC classification system provides a more refined accounting of wetlands than what is captured in the land cover data. Refer to Table 80 for the acres of wetland

by classification within the subwatershed and Appendix 11 for a description of each classification.

Table 80. Deer Creek Wetlands by Classification

Classification	Acres	% of Subwatershed Area
Class I	1781	10.2
Class II	139	0.8
Class III	189	1.1
Class IV	NA	NA
No Wetland Class Designated	40	0.2
Non-Wetland Features	16.4	0.1
Notes: The highest ranking wetland based on vegetative cover, ecological associations, special features, hydrological control features, pollution control features, distribution, and location is Class I wetlands and descends through Classes II, III, and IV. *New York State Department of Environmental Conservation, May 20, 1980. Environmental Conservation Rules and Regulation, Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York.*		

<u>Managed Lands</u>

Deer Creek subwatershed contains 1,861 acres (10.7% of subwatershed area) of managed land. The total acreage of managed land is divided among two managing entities as follows: 58 acres by The Nature Conservancy and 1,803 acres by New York State.

<u>Field Reconnaissance</u>

The field observations concluded: The majority of land use in Deer Creek subwatershed is agricultural, primarily dairy farms. It was noted that the Deer Creek Marsh State Wildlife Management Area is almost completely within Deer Creek. Visual observations verified that there is a strong correlation between adjacent land use and buffer quality within the subwatershed. Refer to Appendices 4 and 5 for assessment locations and corresponding photographs.

Socioeconomic Analysis

Table 81. Market Value per Acre by Land Use in Deer Creek

Deer Creek							
Land Use	Est. Acreage in Deer Creek	% of Total Subwatershed	% of Total in Sandy Creeks Watershed	Total MV in Deer Creek	% of Total MV in Deer Creek	Per Acre MV in Deer Creek	Per Acre MV in Sandy Creeks Watershed
Agricultural	4,350	25.78%	36.23%	$2,782,200	4.88%	$640	$828
Residential	5,311	31.47%	21.78%	$39,301,020	68.88%	$7,399	$10,594
Vacant	4,663	27.63%	14.18%	$2,546,600	4.46%	$546	$791
Commercial	123	0.73%	0.72%	$3,884,800	6.81%	$31,689	$24,972
Recreation and Entertainment	243	1.44%	0.60%	$3,723,000	6.52%	$15,334	$9,695
Community Service	57	0.34%	0.24%	$2,414,600	4.23%	$42,668	$145,997
Industrial	0	0.00%	0.67%	$86,500	0.15%	$0	$1,519
Public Service	253	1.50%	0.92%	$1,571,075	2.75%	$6,215	$5,470
Public Parks, Wild, Forest	1,877	11.12%	24.65%	$749,400	1.31%	$399	$746
Totals	16,876	100.00%	100.00%	$57,059,195	100.00%	$13,111	$24,983

Note: Using GIS software, individual tax parcels were delineated as existing in the Watershed or individual Sub-watershed based on their Centroid, or central point. If the Centroid lay within the boundary, the entire parcel was wholly included in the Watershed and if it lay outside the boundary it was wholly excluded. Therefore, the acreages calculated are approximate values and do not correspond exactly with the acreage figures as described elsewhere.

- More than a third of the acreage in the Deer Creek sub-watershed is residential, closely followed by vacant and agricultural land. Vacant land constitutes a larger share of total acreage in Deer Creek than in the watershed as a whole. No land is classified as industrial in Deer Creek.
- Residential land accounts for 69% of the value of all land in the Deer Creek watershed. Although commercial properties account for less than 1% of the sub-watershed acreage, they account for 7% of the market value of all land in Deer Creek.
- Commercial properties are more highly valued in Deer Creek than in the overall Watershed ($31,689 per acre in Deer Creek compared to $24,972 in the overall Watershed) as are recreation lands ($15,000 per acre in Deer Creek, compared to $9,695 per acre in the overall Watershed).

Existing Studies

Several existing studies associated with Deer Creek subwatershed were found as part of this project effort. A broad-based economic report was reviewed documenting the declines in sport fisheries on Eastern Lake Ontario. A technical document by E. Stanton about developing a population monitoring program for the Bog Buckmoth, an endangered species in New York since 1999, was also reviewed. Both the studies have limited applicability to the rest of the subwatershed. Bog Buckmoth population monitoring studies along Eastern Lake Ontario were summarized in a 2006 study by S. Bonanno. Due to narrow coverage of Bog Buckmoth populations within the Deer Creek subwatershed, limited conclusions could be made for on the entire subwatershed. A Strategic Land Conservation Plan for the Tug Hill plateau was created for the Tug Hill Tomorrow Land Trust (THTLT) by Cornell University. The graduate students in the City and Regional Planning Department developed inventory tools to create a prioritization within five pre-proposed focus areas, areas of high priority regional landscapes. Although the data and inventory results are not specific to this entire subwatershed, it is regionally relevant. Appendix 1 provides a summary of each article. A reference for each study is listed below.

Bonanno, Sandra E. *Summary Report: Eastern Lake Ontario Bog Buckmoth Population Monitoring Program.* NYS Department of Environmental Conservation Endangered Species Unit, December 14, 2006.

Brown, Tommy L. and Nancy A. Connelly. *Economic Impacts of Declines in the Sport Fisheries of Eastern Lake Ontario.* Jefferson County Job Development Corporation and Lake Ontario Fisheries Coalition. June 2002.

City and Regional Planning Department at Cornell University. *Tug Hill Tomorrow Land Trust: Strategic Land Conservation Plan.* Tug Hill Tomorrow Land Trust. Fall 2006.

Stanton, Edward. *Development of a Population Monitoring Program for the Bog Buckmoth (Saturniidae: Hemileuca sp.).* The Nature Conservancy, December 2003.

7.0 FINDINGS AND RECOMMENDATIONS

This Baseline Conditions Report is primarily intended to serve as a summary of existing data that was either provided by project partners or acquired through internet searches and limited field reconnaissance by the Biohabitats Team. The scope of work also included a desktop analysis using best available information to identify opportunities for conservation and restoration. In addition, through this process of conducting a desktop analysis, it was recognized that a number of data gaps will exist, and that identifying these gaps is an important aspect of developing the EBM strategy for the watersheds. The following sections document the efforts associated with these two scope items.

7.1 GIS ANALYSIS RESULTS

Using the available GIS information, a series of land disturbances and conservation indicator metrics were identified in an effort to assist with preliminary prioritization of potential management strategies that can be applied at a subwatershed level. These land disturbance and conservation analyses are detailed in the subsequent sections.

It should be noted that the ability to assess the relative potential for management strategies at the scale of the Sandy Creeks Watersheds solely through a desktop analysis is limited. Ultimately, it is important to supplement any desktop analysis with robust and representative field data that can be replicated and tracked over time. Acquiring this data is one of the bigger challenges of working at such a large watershed scale, as it often requires significant skilled labor to conduct the field assessment work. Nevertheless, it is possible to establish preliminary findings that provide a valuable starting point for the development of management strategies and the identification of data gaps. These findings can also be useful for initial presentation of information to public forums to solicit feedback and encourage communication between stakeholders.

The GIS-based analytical frameworks developed to inform Ecosystem-based Management strategies should be flexible and adaptive to additional data inputs. As such, the metrics used to assess watershed conditions can be revised and added to, and altogether new assessments can be developed by watershed managers over time.

Disturbance Analysis

GIS was used to establish a relative understanding of the level of disturbance being observed in each subwatershed as measured by three primary metrics: effective imperviousness[4], stream road crossings, and road length. Each of these metrics is supported by the literature as good indicators of watershed impact. Watershed impervious cover has long been correlated with watershed health (CWP, 2003 and 2005) and is frequently used as an indicator in watershed assessment and planning efforts. The number of road crossings over streams is a good ecological indicator because of the correlation with fish barriers, buffer encroachments, and wildlife corridor disruptions. Road length is similar to impervious cover and is explicitly a component of imperviousness but it also represents a degree of access to watershed areas and therefore a higher potential for adjacent areas to be disturbed. In addition, these metrics were selected because they are easy to establish and quantify using GIS desktop analyses, making it possible to rapidly replicate the effort as data are improved and updated.

Metrics were normalized by area to enable like comparisons. For each metric, statistical methods (i.e., Jenks Classification[5]) were used to classify data into three groups. Rankings of 1, 3, and 5 were assigned to each group with the higher value being associated with a more significant disturbance factor (e.g., subwatersheds with the highest effective imperviousness levels received a value of 5 and those with lowest effective imperviousness received a value of 1). The results of the analysis are shown in Table 82 and Figure 27. Stony Creek, Lower South Sandy Creek, and Bear Creek are the three subwatersheds that exhibit the most significant amounts of ecological disturbance according to the selected indicators. Further analysis is warranted, but these preliminary results suggest that these three subwatersheds may be good

[4] Effective imperviousness is a term used here to reflect land cover categorized as either low intensity development or high intensity development as determined from the 2001 National Land Cover Data set, which is based on 30 meter by 30 meter satellite raster imagery.

[5] Jenks Classification is an algorithm in ArcGIS software used to create categories. The algorithm combines two methods. The first is Natural Breaks, where the data is partitioned into categories based on natural groups in distribution. The second is the Jenks Classification, a method of statistical data classification that partitions data into classes using an algorithm that calculates groupings of data values based on the data distribution. Jenks optimization seeks to reduce variance within groups and maximize variance between groups.

candidates for restoration projects including stormwater management retrofits, stream restoration, and riparian buffer enhancement.

Table 82. Disturbance Analysis

Subwatershed	Watershed	Disturbance Metric			
		Effective Impervious Surface	Road and Stream Crossing	Road Length	Disturbance Total
Fox Creek	South Sandy Creek	1	1	1	3
Gulf Stream	Sandy Creek	1	1	1	3
Upper South Sandy Creek	South Sandy Creek	1	3	1	5
Fish Creek	Sandy Creek	3	1	3	7
Deer Creek	Salmon River to South Sandy Creek	3	3	3	9
Lindsey/Skinner	Salmon River to South Sandy Creek	3	1	5	9
North Branch Sandy Creek	Sandy Creek	5	1	3	9
Upper Sandy Creek	Sandy Creek	3	3	3	9
Little Stony Creek/Lakeview	Sandy Creek to Stony Creek	5	1	3	9
Little Sandy Creek	Salmon River to South Sandy Creek	3	3	5	11
Lower Sandy Creek	Sandy Creek	5	1	5	11
Bear Creek	South Sandy Creek	3	5	5	13
Lower South Sandy Creek	South Sandy Creek	5	3	5	13
Stony Creek	Sandy Creek to Stony Creek	5	3	5	13
Note: 1=Least Urban Influences 3=Moderate Urban Influences 5=Most Urban Influences					

Conservation Analysis

A similar GIS analysis was conducted for the purpose of understanding subwatershed conservation opportunities. Under this analysis, three primary metrics were evaluated: managed lands, wetland area, and agricultural and forest land. Metrics were normalized by area to enable like comparisons. For each metric, statistical methods were used to classify data into three groups. Rankings of 1, 3, and 5 were assigned to each group with the lower value being associated with a more significant conservation factor (e.g., subwatersheds with the highest managed lands levels received a value of 1 and those with lowest managed lands levels received a value of 5). The rankings were done in this way to facilitate comparison between the disturbance analysis output with the conservations analysis output. For example, while there is not a direct relationship between all metrics, it is reasonable to expect that subwatersheds with lower levels of disturbance will also be more suitable for conservation. Some exceptions may apply, as discussed below. Table 83 and Figure 28 provide the results of the analysis, which shows Fox Creek and Upper South Sandy Creek as the two subwatersheds with potentially the most significant opportunities for conservation. Bear Creek is an interesting subwatershed, in that it ranks high in both the disturbance and conservation analyses. This status could be due to its small size and orientation (Bear Creek is the smallest subwatershed, with a long and skinny shape in the east to west direction), making it more sensitive to normalizing values; significant shifts in watershed characteristics can occur from one end to the other (e.g., the east half of the watershed is dominated by more rural conditions, and the west half is more influenced by urbanization factors associated with Interstate 81).

Table 83. Conservation Analysis

Subwatershed	Watershed	Conservation Metric			
		Managed Lands	Wetland Area*	Agricultural and Forest Land	Conservation Total
Upper South Sandy Creek	South Sandy Creek	1	1	1	3
Gulf Stream	Sandy Creek	1	1	1	3
Fox Creek	South Sandy Creek	3	1	1	5
Fish Creek	Sandy Creek	1	3	1	5
Bear Creek	South Sandy Creek	3	3	1	7
Little Sandy Creek	Salmon River to South Sandy Creek	3	5	1	9
Upper Sandy Creek	Sandy Creek	3	3	3	9
Little Stony Creek/Lakeview	Sandy Creek to Stony Creek	3	3	5	11
Deer Creek	Salmon River to South Sandy Creek	5	3	3	11
Lindsey/Skinner	Salmon River to South Sandy Creek	3	5	3	11
Lower Sandy Creek	Sandy Creek	5	5	3	13
Lower South Sandy Creek	South Sandy Creek	5	5	3	13
Stony Creek	Sandy Creek to Stony Creek	5	3	5	13
North Branch Sandy Creek	Sandy Creek	5	5	5	15

Note: 1=Most Conservation Opportunities 3=Moderate Conservation Opportunities 5=Least Conservation Opportunities
*Wetland data provided by raster land cover data provided by Tug Hill Commission

Further analysis is warranted to better understand the implications of this conservation analysis, but the results suggest that the lower scoring subwatersheds may be good candidates for conservation projects ranging from land acquisition, establishment of conservation easements, wetland protection measures, and agricultural preservation measures. It is also of note that three of the five subwatersheds identified as most suitable for conservation are all part of the larger South Sandy Creek watershed. In land conservation planning, adjacencies of protected lands provide greater ecological benefits, as larger patches of habitats are preserved. These larger, inter-connected habitat matrices can support more robust ecological communities; the chances of maintaining a species of concern increases as the size and number of habitat patches increases (Groves *et al.*, 2003).

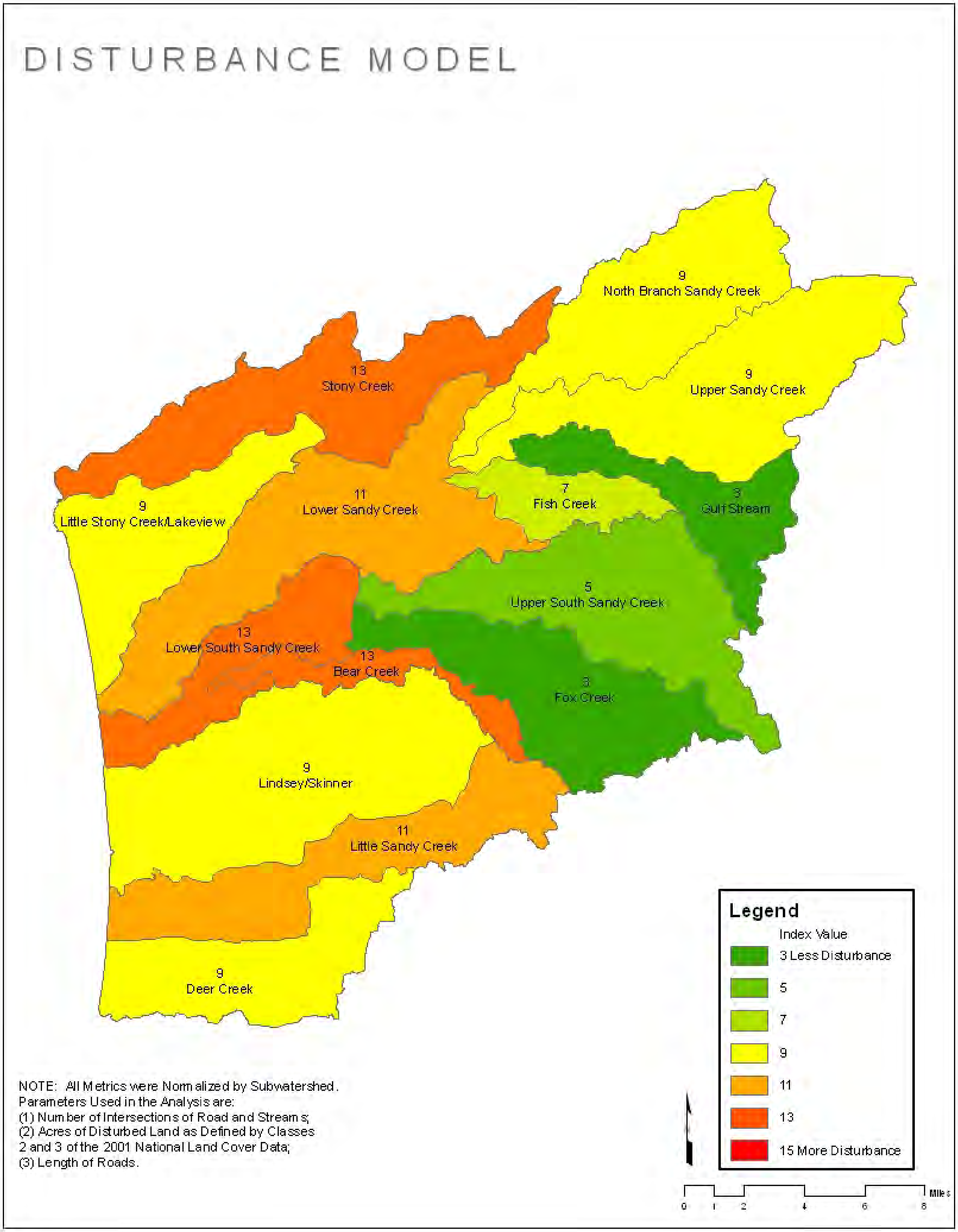

Figure 28. Sandy Creeks Watersheds Disturbance Model Results

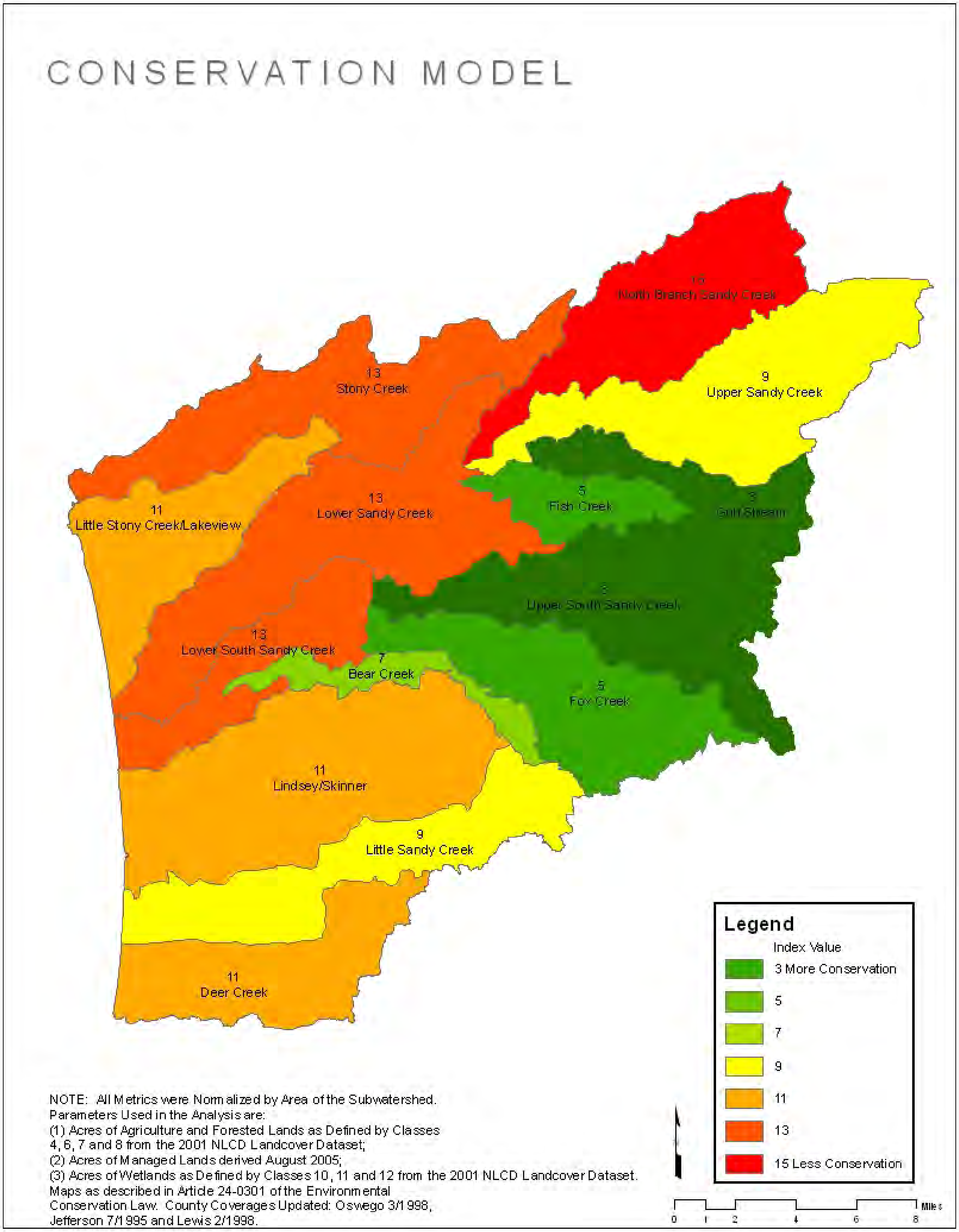

Figure 29. Sandy Creeks Watersheds Conservation Model Results

There is general correlation between these disturbance and conservation modeling results and the results of the Cornell University GAP analysis: areas of less disturbance and corresponding higher species richness are found in the Tug Hill Plateau region habitats (including sugar maple mesic, successional hardwoods, and evergreen-northern hardwood, and deciduous wetlands) located in the eastern uplands of the study area. Areas of higher disturbance tend to be associated with areas in the Ontario Lowlands that have been more developed for agriculture and urban land uses (including parts of the Sandy Creeks Watersheds).

Integration of Disturbance Analysis & Tax Parcel Analysis

Camoin Associates integrated the disturbance model developed by Biohabitats with property tax data collected for the subwatersheds. The purpose of this analysis was to assess the possible links between the ecological state of the subwatershed (the Biohabitats metrics) and the economic value of the property (as measured by market value).

We began by coding each of the subwatersheds using a dummy variable that identified those subwatersheds that scored low or high (less than 6 or more than 12) on the disturbance model:

Table 84. Subwatershed Disturbance Coding

Subwatershed Coding			
	Disturbance		
		Data Coding	
Subwatershed	Metric	Low	High
Bear	13		x
Stony	13		x
Upper South Sandy	5	x	
Upper Sandy	9		
North Branch Sandy	9		
Lower South Sandy	13		x
Lower Sandy	11		
Lindsey Skinner	9		
Gulf Stream	3	x	
Fish	7		
Fox	3	x	
Little Stony	9		
Little Sandy	11		
Deer	9		

Source: Biohabitats' Disturbance Model

Note that three subwatersheds were rated "high" disturbance, three as "low" disturbance, and eight as neither. We added this coding to the existing database of tax parcel information and performed a number of analyses listed and described briefly below. (We referred to these as the "Metrics," below).

Important Limitations to Data Analysis

There are a number of important limitations to the data analysis we conducted:

- First and foremost, for those analyses using Market Value per Acre, there is an inherent bias to the information. To compare one parcel to the next without regard to the size of the parcel, we divided market value by acreage to get Market Value per Acre (MVpA). We then averaged the MVpA for various groups of parcels (based on watershed characteristics or land use categorizations). Because we are taking the average of a series of averages, we are introducing bias into the results because we are treating the MVpA of very large parcels with the same weight as the MVpA of very small parcels. For this reason, the average MVpA of all parcels will not equal the overall market value per acre of the watershed (i.e. total watershed market value divided by total watershed acreage). Despite this inherent bias, if we assume that the variation of small-to-large parcels is approximately the same across the watersheds, we can reasonably conclude that the comparisons across watersheds are accurate (i.e. the bias is roughly uniform across areas).
- While the State of New York regulates how tax parcel information is collected and provides a uniform method of recording information, individual municipalities are ultimately responsible for maintaining the assessment roles. The quality of information can vary from location to location. In this case, for example, some parcels did not have acreage information (but may have contained frontage and depth data) and had to be removed from consideration for analysis #1 and #3, below. Also, different communities have different standards for valuation, which can lead to non-uniform reporting.
- Some non-taxable properties have dubious market values assigned to them. This is particularly true in the case of parcels in the "community service" land use category. Certain inter-municipal tax distribution formulas take into consideration non-taxable land

values, so municipalities have an incentive to "over assess" those properties. Since the owners are exempt from taxation, the over-assessment is not challenged. For this reason, we removed community service parcels for purposes of the regression analysis.

Analysis #1: Market Value per Acre Regression Analysis

Here we first eliminated all records that did not contain information on acreage. This left us with 7,873 tax parcels, for which we calculated the normalized market value per acre.[6] We ran four regression analyses with market value per acre as the dependent variable and the Metrics as the independent variables. Results are shown in the table below.

Table 85. Average Market Value per Acre – Results from Regression Analysis

Average Market Value Per Acre						
	Coefficients	*Std Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	$ 26,183	864	30.32	-	$ 24,491	$ 27,876
Low Disturbance	$ (17,941)	2460	-7.29	0.000	$ (22,764)	$ (13,118)

Note: Excludes conservation parcels and parcels without acreage information. N = 7873

Properties in "Low Disturbance" watersheds had market values per acre averaging approximately $18,000 less than those in non-Low Disturbance watersheds. The average parcel in a Low Disturbance watershed had a value of approximately $8,000 per acre versus $26,000 for parcels in non-Low Disturbance watersheds. These results are highly statistically significant, with p-values well below 0.001.[7]

From these results, we see that Low Disturbance watersheds have property values per acre averaging only 30% of those in other watersheds. This result is consistent with the general notion that undeveloped areas will have less economic value than highly improved ones, since they have less infrastructure, less development, fewer businesses, etc. However, the magnitude of the difference in values and the strength of the correlation were surprising. These findings support the idea that the EBM strategy can seek to focus development away from the Low Disturbance

[6] (Assessed value divided by equalization rate = Market Value) / Acreage
[7] P-values below 0.01 are normally considered statistically significant. "P-value" refers to the probability that the results obtained (i.e. a change from the two conditions studied) were merely the result of sampling error. Thus a p-value of 0.001 means that there is less than a 0.1% chance that the results obtained were due solely to chance.

watersheds with minimal economic distortion. Conversely, we would expect more significant economic distortion if development were restricted in non-Low Disturbance watersheds.

Analysis #2: Average Market Value of Seasonal Homes Regression Analysis

We eliminated all parcels except those categorized as "seasonal homes" (N=1,230) and compared their market values using the watershed Metrics. Unfortunately, it was not possible to "normalize" the market values to account for differently sized houses, since building square footages were not available. The results are shown in Table 86.

Table 86. Average Market Value of Seasonal Homes – Result from Regression Analysis

Average Market Value of Seasonal Homes						
	Coefficients	*Std Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	$ 80,148	1475	54.34	-	$ 77,255	$ 83,042
Low Disturbance	$ (52,117)	3659	-14.24	0.000	$ (59,296)	$ (44,938)

Note: Excludes all parcels other than those classified as "Seasonal Homes". N=1230

The market value of seasonal homes in Low Disturbance watersheds is significantly lower than in other watersheds ($28,000 versus $80,000). No statistically significant findings could be made for High Disturbance watersheds.

There could be a number of explanations for this phenomenon. As noted above, we could not take into consideration the size of the residence, so the results could simply mean that smaller houses are built in Low Disturbance areas. Lack of infrastructure (roads, electric service, water, and sewer systems) could mean that seasonal homes in Low Disturbance areas are rudimentary cabins as opposed to fully equipped houses. It might also be a reflection that seasonal visitors prefer the amenities of more developed areas: hard surface roads, shops, entertainment and restaurants, thus raising demand and prices in non-Low Disturbance watersheds.

Whatever the explanation, the results are intriguing from a municipal finance point of view. Seasonal homes produce property tax revenue and support tourism-related sales tax dollars, while requiring little in the way of municipal services (particularly as it relates to schools). Our results seem to say that allowing seasonal home development in non-Low Disturbance watersheds could enhance this effect.

Analysis #3: Comparison of Market Value per Acre by Major Use Type

Here, we again eliminated those parcels without acreage information and calculated the market value per acre. This time, however, we then added an additional factor of "Major Use Type" as shown in Table 87. For more information on these categorizations, please see the property tax data section of this report.

Table 87. Categorization by Major Use Type

Categorization by Major Use Type	
Property Classification	Major Use Type
100-199	Agricultural
200-299	Residential
300-399	Vacant
400-499	Commercial
500-599	Recreational
600-699	Community Service
700-799	Industrial
800-899	Public Service
900-999	Wild, Forested, etc.

Because of both the potential for bias using average Market Value per Acre figures, as described above under "Limitations," and the relatively fewer data points available for each Major Use Type, we chose not to run a regression analysis in this case. Instead, we simply compared average Market Value per Acre for each Major Use Type for each of the Metrics (Table 88). We excluded any comparison where fewer than ten parcels existed in the watersheds studied. We highlighted significant positive variances (+50%) in green and negative variances (-50%) in yellow.

Table 88. Average Market Value per Acre by Land Use Code and Metrics

Average Market Value per Acre by Land Use Code and Metrics								
	Agric.	Resid.	Vacant	Commer.	Recreat.	Industrial	Public Ser	Forest, etc.
Low Disturbance Watersheds								
No	$ 1,042	$ 42,448	$ 4,675	*	*	*	*	$ 1,387
Yes	$ 1,782	$ 14,805	$ 1,645	*	*	*	*	$ 428
Difference	$ 740	$ (27,643)	$ (3,030)	*	*	*	*	$ (958)
% Difference	71%	-65%	-65%	*	*	*	*	-69%
High Disturbance Watersheds								
No	$ 1,098	$ 38,948	$ 4,491	$ 69,888	*	*	*	$ 785
Yes	$ 1,069	$ 40,231	$ 3,308	$ 80,681	*	*	*	$ 4,250
Difference	$ (29)	$ 1,283	$ (1,183)	$ 10,792	*	*	*	$ 3,465
% Difference	-3%	3%	-26%	15%	*	*	*	441%

Note: Excludes conservation parcels and parcels without acreage information. N = 7873.

* Results were omitted where fewer than 10 data points were available.

Perhaps the most interesting observation that can be made from this analysis is that while we identified in Analysis #1 that Low Disturbance watersheds have a lower average Market Value per Acre (MVpA) than in other watersheds, when we look at individual land uses, this trend appears to be reversed in the case of agricultural land, which has a 71% higher MVpA in Low Disturbance watersheds.

7.2 DATA GAPS

Having an understanding of the data gaps that exist across the Sandy Creeks Watersheds area is important with respect to informing the Ecosystem Based Management strategy development. With that in mind, and with the understanding that additional data gaps are likely to be realized as more focus is placed on the management of the watersheds, the Biohabitats Team has identified GIS and ecological data gaps that became apparent in the course of developing this Baseline Conditions Report. Socio-economic data gaps were previously identified in Section 4.6.

GIS Data Gaps

During initial assessment and cataloging of datasets collected from various sources, Biohabitats noticed several data gaps including:

1. Limited or no documentation of metadata.
2. Lack of a centralized GIS data repository.
3. Scale of data is too small to support desired level of assessment.
4. Poor data quality that may result in faulty analysis.

The following describes each type of data gap. In most cases these same GIS data gaps are identified and expanded upon in more detail in the March 2007 report by Stone Environmental Inc. entitled: *Task 10: Ocean and Great Lakes GIS Data Catalog, Data Gaps, and Mapping Strategies.* Data gaps were documented for all GIS data layers collected for this report according to the type of gap as encountered during the analysis process (see Appendix 13). If no data gap is identified, then the data were able to be used as they were provided. Appendix 13 also includes a list of references that may be useful for closing data gaps.

- Some data files have limited or no metadata inhibiting the user's knowledge of processing, originating source, and attribute definitions. Ideally, to have truly useful GIS data, the files should contain robust 'metadata' attached to the data itself. Metadata is the "documentation" behind the data and includes information on: identification reference, data quality, data organization, spatial reference, entity attributes, and distribution. An additional benefit to preparing metadata is that the record content contains a process description, which specifies the methods and rigor chosen to create the data and can help to minimize haphazard data collection or interpretation. In some cases metadata most likely exists, but was not attached to the data presented to Biohabitats. It was beyond the scope of this project to pursue the original datasets and associated metadata.
- A single GIS data repository would increase the efficiency and accuracy of geospatial analyses, increasing the value of this tool for the purpose of EBM planning. Currently, data has to be acquired by multiple sources with it being unclear (in part due to poor metadata) what data sets take precedence and what the original source of the data are. In

the process of data acquisition for this Baseline Conditions Report, other relevant geospatial data sources were found which had been compiled by other groups not directly involved in this project and not made available for use in this project. Examples include GIS datasets created by researchers affiliated with local universities and colleges (specifically, the Cornell University *Strategic Land Conservation Plan* performed for the Tug Hill Tomorrow Land Trust), consultants performing tasks for local governments and agencies, and stakeholder groups that are conducting informal but valuable data collection (including the Tug Hill Tomorrow Land Trust).

- The scale of the source data provides insight as to the level for which the data might be used. Many datasets did not contain this information. In addition, the scale at which some data was recorded and displayed is not accurate enough to support a subwatershed level of assessment. Any assessment made based on the subwatershed level must be presented with a caveat of the data's scale.
- Related to the poor condition of the metadata is the uncertainty it presents about the data quality. Data quality is important for many reasons, especially when management based decisions and strategies are predicated upon the data. Several data files had poor data quality including limited attribute information and detached metadata files. Limited attributes in the attributes table prohibited any valuable analysis of the data.

Ecological Data Gaps & Future Monitoring Efforts

Because there was only a very limited field reconnaissance effort associated with this study, much of the ecological data presented in this Baseline Conditions Report was extracted from larger studies (specific to the entire New York State region, Tug Hill region, or Lake Ontario watershed region) and existing datasets acquired or provided as part of this project effort. In some cases, data specific to the Sandy Creeks watershed are informative and of good quality. In other cases, datasets are very coarse, and data are incomplete, unavailable, or were not located. For the purposes of EBM planning and management, there is a need to assess how environmental or ecological conditions have changed over time in response to different land uses or environmental variables (this is often called "trend analysis"). The lack of sufficient time-series datasets for key attributes makes this type of trend analysis impossible or uninformative.

Table 89 describes the various ecological resources (in addition to the GIS resources listed in Appendix 2) used in this study, the sources of this data, utility in EBM planning for the Sandy Creeks watershed, and notes about the overall quality of the datasets. Detailed descriptions of these studies are included in Appendix 1: Annotated Bibliography.

Table 89. Review of Ecological Resources for the Sandy Creeks Watersheds

Ecological / Environmental Attribute	Data Type	Data Source	Utility for EBM Planning and Management	Notes on Data Quality
Geology / Topography	GIS datasets / paper maps	New York State Geological Survey	Provides definition of physiographic provinces and landscape function.	No detailed geologic mapping available. Topography exists at 20m resolution.
Soils	Database	USDA Soils Survey	A metric of suitability for habitat matrices.	
Climate	Time series datasets	NCDC datasets		
Hydrology	Time series datasets	USGS NWIS: http://waterdata.usgs.gov/nwis/uv?04250750	Allows assessment of flow patterns / aquatic ecosystem health.	Only 1 stream gauge in project area.
Channel and Riparian Condition / Stream Morphology	Observations on channel and riparian habitat conditions at 7 sites.	NYSDEC Lake Ontario Basin RIBS, Sampling Years 1999-2003	Allows assessment of geomorphic stability / ability to support aquatic and riparian ecosystems.	Data provides single occurrence assessments of stream stability and riparian condition at various locations in the study area. Data is not available in GIS format.
	Field surveys and GIS analysis along four perennial stream types.	Hunt, D.M. et al., 2005		
	28 sites mapped and inventoried.	Upper Susquehanna Coalition, 2006.		
	Biohabitats field reconnaissance at 53 sites documenting channel and riparian conditions.	Biohabitats Inc. and Camoin Assoc., 2007		
Water Quality	Sampling along Little Sandy Creek.	Lewis, T.W. and Markarewicz, J.C, 2004	Provides an indicator of aquatic ecosystem health.	Present-day water quality conditions at specific sites along mainstem channels well quantified. General sources of pollution identified, specific point sources not identified.
	Sampling of nutrients and sediments along Sandy Pond tributaries	Lewis et al. 2002		
	Biological sampling at 3 sites on Little Sandy Creek	NYSDEC, 1997		
	Habitat assessment and macroinvertebrate sampling at 6 sites. Intensive monitoring at 1 site.	NYSDEC Lake Ontario Basin RIBS, Sampling Years 1999-2003		
	Analysis of existing datasets at Sandy Creek and South Sandy Creeks	Markarewicz, J.C. and Lewis, T.W., 2006		
Land Cover	GIS datasets.	USEPA National Land Cover Dataset.	Allows assessment of the inter-relationship of habitat complexes across a landscape.	Good quality at a regional scale.
	GIS analyses to identify conservation priorities.	Cornell University, 2006.		

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Ecological / Environmental Attribute	Data Type	Data Source	Utility for EBM Planning and Management	Notes on Data Quality
Wetlands	GIS datasets and wetland classifications.	USFWS NWI datasets.	Provides conservation targets for EBM planning.	Good quality at a regional scale.
	GIS datasets and wetland classifications.	USEPA National Land Cover Dataset.		
Aquatic Communities (fish, macro-invertebrates)	Macroinvertebrate sampling at 7 sites. No data for fish.	NYSDEC Lake Ontario Basin RIBS, Sampling Years 1999-2003	Provides a metric of species richness and diversity for freshwater aquatic communities.	Current datasets provide single occurrence assessments of macro-invertebrate populations and species-specific fish populations. Data is not available in GIS format.
	Survey of wild juvenile steelhead populations along Little Sandy creek, Lindsey-Skinner Creeks in 1980's and 1997.	Bishop et al., 1997		
	Biological sampling at 3 sites on Little Sandy Creek.	NYSDEC, 1997		
	SEQRA supplemental report on fish species on South Sandy Creek.	Cooper (TNC), 2007		
Avian Communities (birds)	No data.	N/A	Provides a metric of species richness and diversity for avian communities.	No data available.
Terrestrial Communities (amphibians, reptiles, mammals, insects)	General description of habitats in the Tug Hill region.	Central New York Regional Planning and Development Board, 2003.	Provides a metric of species richness and diversity for terrestrial communities.	Limited data available.
Species of Concern (RTE)	Online datasets for New York State.	NYSDEC: http://www.dec.ny.gov/animals/7494.html	Provides conservation targets for EBM planning.	NYSDEC keeps active lists of RTE species in the state.
	Bog Buckmouth population monitoring program.	Bonanno, S.E., 2006		
	Bog Buckmouth population monitoring program.	Stanton, E., 2003		
Invasive Species	Lists of invasive plant species of concern in project area.	St. Laurence Eastern Lake Ontario Weed Management Area: http://media.cce.cornell.edu/hosts/counties/jefferson/agriculture.asp	Threatens health and diversity of conservation targets.	Limited information on the spatial distribution of invasive species / no information on invasive fauna.

As observed in this summary of data sources, much of the data that could be used as indices of ecological condition is based on a single occurrence of monitoring – at discreet locations in the subwatersheds. This type of data provides the ability to make an initial assessment, but not the ability to perform trend analyses over time, or measure ecosystem response to land use paradigms. An effective Ecosystem-based Management Strategy will be dependent upon continuous, verifiable data input of selected ecological indicators that have robust literature support for their use as effective indicators of watershed health. This type of monitoring framework does not currently exist in the Sandy Creeks Watersheds. Effective EBM planning and implementation will require a minimum level of commitment to collecting and analyzing these types of datasets spatially and temporally across all subwatersheds.

The foundation of an effective EBM strategy is sound ecological and economic datasets, which are used to a) characterize current conditions, b) identify conservation, restoration, and economic development opportunities, and c) perform trend analyses to measure the response of natural and human communities. Because ecological and economic systems are complex, there is the potential for a large body of information which could be input as the basis of Ecosystem-based Management. To this end, future data collection efforts should be directed by a limited set of indicators which can be used to derive these analyses. This will provide a focused allocation of limited resources, and allow the identification and prioritization of data gaps. This approach is further discussed in the Future Monitoring Efforts section below.

To further address data gaps and inconsistencies, it is also recommended that future data collection efforts should:

- Establish a series of data collection protocols which can be replicated and practiced throughout the study area at spatially and temporally relevant intervals. This will allow comparable analyses of this data to be performed.
- Identify ecological indicators that have robust literature support for their use as effective indicators of watershed health.
- Establish regular monitoring intervals in which to collect data. This will allow trends to be established and responses to Ecosystem-based Management actions to be determined.
- Use GIS-based tools to manage, analyze, and retrieve the data. The database power and geospatial capabilities of GIS make it one of the most valuable tools available to the EBM planning efforts for the Sandy Creeks Watersheds.

The following ecological datasets could potentially be used to develop an EBM strategy. It is worth noting that these data sets may already exist or may exist in a non-GIS format, but were not found as part of this project effort.

- Comprehensive hydrologic information for each subwatershed, including in-channel flows, and surface and groundwater flows.
- Location and performance of existing stormwater management facilities (stormwater Best Management Practices [BMPs]).
- Location and documentation of industrial discharges into waterbodies.
- Primary sources of non-point source pollution into stream networks.
- An inventory and hydraulic / ecological performance rating of road crossings.
- Comprehensive physical and biological stream conditions data for all perennial stream networks in the study area. The current datasets include measurements at specific locations in the stream network, some areas are well-documented; others are completely unsurveyed.
- Condition of the riparian buffer along stream networks. This has been noted in some locations by Biohabitats field observations.
- Location and condition of floodplains.
- Distribution of invasive species across the subwatersheds.
- Specific inventories of avian, terrestrial, and aquatic communities supported by habitats in the Sandy Creeks Watersheds.
- Historical ecological data: what types of habitats and natural communities did these areas support pre-disturbance? Useful to identify reference conditions and conservation targets.

Future Monitoring Efforts

Natural resource monitoring is "the collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective" (Elzinga et al. 1998). Currently, the only formal monitoring effort in operation with the Sandy Creeks Watersheds is the ongoing NYSDEC Rotating Integrated Basin Studies (RIBS) portion of the Statewide Waters Monitoring Program, which includes screening (a verbal habitat assessment and a macro invertebrate community assessment), and intensive monitoring (a macro invertebrate community assessment, toxicity testing, sediment contamination, bacteriological results, and field, nutrient, mineral, and metal parameters) in discrete locations within the subwatersheds. The RIBS program allows comparative water quality of Lake Ontario tributaries.

An expanded and more comprehensive monitoring effort in the Sandy Creeks Watersheds would allow additional data to be collected which could help to determine overall watershed integrity, and allow for an assessment of ecological trends.

The determination of appropriate ecological data monitoring programs should be dictated by the types of data required to inform EBM strategy development – defined by agreed upon indicators of watershed condition. For example, in the conservation and disturbance models presented in Section 7.1, the level of disturbance being observed in each subwatershed as measured by three primary metrics: effective imperviousness, stream road crossings, and road length; while subwatershed conservation opportunities were analyzed using three primary metrics: managed lands, wetland area, and agricultural and forest land. Establishing monitoring protocols for each of these metrics will allow comparative results over a defined time interval. These metrics are based upon large scale spatial analyses, thus GIS is the effective tool. Monitoring each environmental metric will be based upon GIS datasets that reflect conditions at a certain period; measuring effective imperviousness area at regular intervals will allow a quantification of that disturbance trend.

To a certain extent, the ecological indicators that are chosen to reflect watershed condition may be influenced by the datasets that are readily available, or the degree of effort that must occur to launch an effective monitoring program. For example, it is not expected that the number of road crossings will change significantly as a result of effective EBM implementation. However, the *type of road crossing structure* or the *ecological functionality of that crossing* may be more indicative of a disturbance pattern, thus a monitoring strategy could be initiated to collect data on the number of crossings, the type of crossing, and a rating of their ecological effectiveness. As EBM strategies are initiated, these data could be reassessed at a defined interval to provide a rating of program success. To use another example, effective impervious area may not be a valuable metric because it uses data that is unrefined when applied to a smaller scale setting, and it does not take into account local stormwater management strategies. A more effective metric may be obtained from a more detailed study of *directly connected impervious areas*. The monitoring framework would likely require extensive ground truthing and GIS analysis at a fine scale; hydrologic modeling of the storm water network would account for local reductions in peak flow associated with stormwater management strategies associated with EBM implementation. This type of monitoring effort may be cost prohibitive. This underscores the importance of selecting metrics that are informative, and defining a monitoring strategy up front that can be cost effective.

To be certain that changes detected by monitoring are actually occurring in nature and not simply a result of measurements taken by different people or in slightly different ways, detailed and exacting monitoring protocols should be developed and implemented as part of all long-term monitoring programs (Geoghegan et al., 1990; Shampine, 1993; Geoghegan, 1996; Beard et al., 1999). Monitoring protocols are 1) a key component of quality assurance for monitoring programs to ensure that data meet defined standards of quality with a known level of confidence, 2) necessary for the program to be credible so that data stand up to external review, 3) necessary to detect changes over time and with changes in personnel, and 4) necessary to allow comparisons of data among places and agencies[8].

It is recommended that a monitoring protocol include at least 3 sections (Oakley et al., 2003):

1. *Narrative*. The Protocol Narrative provides the rationale for why a particular resource or resource issue was selected for monitoring, gives background information concerning the resource or resource issue of interest, describes how monitoring results will inform management decisions, and discusses the linkages between this and other monitoring projects.
2. *Standard Operating Procedures (SOPs)*. A series of SOPs present the details on how all aspects of the components described in the narrative will be carried out. The SOPs are likely to be updated more often than the protocol narrative. The SOPs should be written

[8] Excerpted from Oakley et al., 2003.

in the form of instructions, with step-by step details of how to carry out each procedure (Wieringa at al. 1998).

3. *Supplementary Materials*. Supplementary Materials include example databases, supporting data and reports (e.g., digital maps of soil strata, guild assignments of bird species), custom data management, data analysis or decision support tools (e.g., link to software programs), as well as materials that cannot easily be formatted and included as part of the digital protocol document (e.g., paper maps, photographs, binders of peer reviewers' comments and authors' responses).

Guidelines for developing protocol narrative are provided in Table 90 below.

Table 90. Guidelines for Long-term Monitoring Protocols
(recommended content of the protocol narrative)

1. Background and objectives
   a. Background and history; describe resource issue being addressed
   b. Rationale for selecting this resource to monitor
   c. Measurable objectives
2. Sampling design
   a. Rationale for selecting this sampling design over others
   b. Site selection
      i. Criteria for site selection; define the boundaries or "population" being sampled
      ii. Procedures for selecting sampling locations; stratification, spatial design
   c. Sampling frequency and replication
   d. Recommended number and location of sampling sites
   e. Recommended frequency and timing of sampling
   f. Level of change that can be detected for the amount/type of sampling being instituted.
3. Field methods
   a. Field season preparations and equipment setup (including permitting and compliance procedures)
   b. Sequence of events during field season
   c. Details of taking measurements, with example field forms
   d. Post-collection processing of samples (e.g., lab analysis, preparing voucher specimens)
   e. End-of-season procedures
4. Data handling, analysis, and reporting
   a. Metadata procedures
   b. Overview of database design
   c. Data entry, verification, and editing
   d. Recommendations for routine data summaries and statistical analyses to detect change
   e. Recommended reporting schedule
   f. Recommended report format with examples of summary tables and figures
   g. Recommended methods for long-term trend analysis (e.g., every 5 or 10 years)
   h. Data archival procedures
5. Personnel requirements and training
   a. Roles and responsibilities
   b. Qualifications
   c. Training procedures
6. Operational requirements
   a. Annual workload and field schedule
   b. Facility and equipment needs
   c. Startup costs and budget considerations
7. References

(Oakley et al., 2003)

Monitoring efforts should conform to already established and well recognized monitoring protocols already employed by the State and region. This includes monitoring efforts established as part of the NYSDEC RIBS and Waterbody Classification programs (including macro invertebrate sampling methods, in-stream water quality, sediment toxicity classifications, NYSDEC wetlands classifications, etc.).

Beyond these existing programs, additional resources that can be used to develop effective watershed monitoring programs are listed below.

- Center for Watershed Protection - http://www.stormwatercenter.net/intro_monitor.htm#about
- United States Environmental Protection Agency - http://www.epa.gov/owow/monitoring/
- Santa Clara Valley Urban Runoff Pollution Prevention Program - http://www.scvurppp-w2k.com/emms_pmis.htm

7.3 STAKEHOLDER FEEDBACK

In keeping with the EBM principles, a stakeholder outreach effort was conducted between June and October 2007. EcoLogic facilitated nine meetings and additional interviews in an effort to bring local stakeholders together to discuss EBM and their ideas, concerns and interests in the future of Sandy Creeks watersheds. A detailed report, Sandy Creeks Ecosystem-based Management Stakeholder Outreach Final Report, is included in Appendix 14.

The following analysis of stakeholder participation is based on the attendance records from the meetings, included in the Sandy Creeks EBM Stakeholder Outreach Report (Ecologic, 2007). Table 91 below summarizes the anticipated and actual participation in each of the meetings. In general, the meetings were small (1-20 participants) with some people participating in two or three meetings while others attended one. Overall, the meetings resulted in approximately 50% participation based on the list of 140 invitations; however, 53 individuals (approximately 40% of the invitation list) participated in the outreach effort. About half of the people who participated in the initial meeting also participated in subsequent meetings. The conservation group had the greatest representation overall, while the business sector had the lowest. The wrap-up meeting was attended mostly by people who had participated in earlier meetings, with seven attending for the first time.

Table 91. Stakeholder and Focus Group Meeting Attendance

Focus Group	Date	Location	Invited	Present	% (pres/inv)
Initial Meeting	6/27	Sandy Island Beach State Park	140	18	13%
Conservation	7/25 8/15*	Sandy Island Beach State Park	30	11	37%
Municipalities	7/30	Adams Center Municipal Building	30	5	17%
Agriculture	8/6	Sandy Island Beach State Park	18	5	28%
Recreation / Anglers	8/8	Sandy Island Beach State Park	23	7	30%
Business	8/29	Sandy Island Beach State Park	20	1	5%
Foresters/Large Landowners	8/30	Sandy Island Beach State Park	19	5	26%
Wrap-up Meeting	9/20	Sandy Island Beach State Park	140	20	14%
TOTAL			140	72	51%

* Represents a second open-invitation meeting for people with scheduling conflicts. The majority of attendees were associated with the conservation focus group.

Stakeholder Interests and Concerns

EcoLogic reviewed the comments from the initial meeting and found that they centered around three basic themes:

a) native species and natural communities;
b) economically successful natural resource-based industries (including forestry, agriculture, recreation, and fisheries); and
c) intact forests and high quality streams.

These three basic areas, which are components of Ecosystem-based management, were echoed in the focus groups when the discussions centered on changes observed over the years (EcoLogic, 2007). Specific comments and a more detailed summary are available in the Sandy Creeks Ecosystem-based Management Stakeholder Outreach Report in Appendix 14. The following information was summarized from that report.

When considering *native species and natural communities*, participants discussed changes in vegetation (increase in invasive plant species) throughout the watersheds and management of shoreline habitats (dunes and beaches). Participants perceived the increase in invasive plants to be a long –lasting threat to native species. Furthermore, they speculated that the invasive species problem would need a solution that includes cooperation and coordination among local constituents as well as enforcement by local agencies. The Dune Coalition was recognized for its positive contributions to protecting dune habitat yet participants noted that more resource management is needed within and beyond the dunes. Significant changes in beach access prompted a range of comments including a desire for more access to beaches, wishing private landowners would adopt a stewardship ethic when managing their stretch of beech and setting aside beach areas for wildlife.

Interest in *economically successful natural resource based industries* (i.e., agriculture, forestry and recreation) revealed an appreciation for the rural landscape and the industries that support it. Changes in population were identified as sources of conflict centered on agricultural practices, land value and land use (accepting the work that defines the landscape). Forestry was also recognized as an important piece of the rural landscape. While forestry practices vary throughout the watersheds participants voiced a collective concern about state lands being managed poorly and that funds from local forest products go to Albany rather than local natural resource management. Recreation was the third natural resource based economy to receive significant attention during the meetings. Maintaining a viable resource for outdoor, adventure recreation is extremely important to participants. Their greatest concern was the degradation of the land and water resources on which the recreation depends (fisheries, lakes, streams, forests, dunes, etc).

As just mentioned, the success of the recreation industry hinges on the quality of the local natural resources, thus *intact forests and high quality streams* are valued by the participants. Improvements in water quality were acknowledged and an interest in sustaining the improvement was conveyed. Participants understand that agricultural, forestry and recreation uses impact the resources they rely upon, thus they are interested in increasing conservation measures. Past efforts to reduce negative impacts on water quality were acknowledged, however increased population was noted as an additional challenge to sustaining good water quality throughout the watersheds.

Threats to the Sandy Creeks Watersheds Ecosystem

Based on participants comments concerning what was important to them and what changes they had observed, potential threats were identified. The responses may be grouped into three overall categories:

a) development pressure (loss of farmland, rural character and open space; rural/urban conflicts);
b) lack of funds for infrastructure (camps with rustic septic “systems”, failing wastewater systems, and drinking water quality); and
c) incompatible lake level management (water level to serve shipping industry or shoreline habitat health.

As mentioned above, preservation of native species is important to residents in the watershed and invasive species were broadly reported as a threat (EcoLogic 2007).

When asked to identify specific projects that they would support, participants offered the following:

- Integrated trails and creek walks
- Low-interest revolving loan fund for farmers to implement best management practices
- Wastewater management: invest in wastewater collection and treatment infrastructure
- Permit system for hunting on private agricultural lands
- Several participants discussed the need for and opportunity represented by alternative energy in this rural area of the state. A willow biomass plant was cited as an example.
- Construct bridges over streams in areas used for recreation, perhaps in the context of a citizen conservation corps initiative
- The need for science-based development planning was recognized by many of the stakeholders. The Tug Hill Commission was referenced as a valuable resource of objective planning for rural communities (excerpted from EcoLogic, 2007).

Future Stakeholder Involvement

The nine meetings facilitated by EcoLogic, Inc. informed an initial group of interested and knowledgeable local constituents of the new Ecosystem-based management planning initiative in the Sandy Creeks watersheds. While the group was unfamiliar with the term Ecosystem-based management, their visions and suggestions were congruent with the concept. There was general agreement that a grassroots, education based approach, similar to the one used by the Dune Coalition is preferred over a top-down, regulatory approach although some regulatory control may be needed for some management issues. The challenges revealed included reaching consensus among a diverse collection of interests and getting agencies aligned to support local efforts in a cooperative manner. In general, although the participants in the 2007 outreach project voiced some frustration with the direction of changes in the Sandy Creeks watersheds, they were eager to support steps toward a more desirable future. They are anxious to see early returns from their efforts and cooperation from state and local agencies (EcoLogic, 2007).

Future stakeholder involvement will no doubt build on the initial group of participants. Assessing invitation and attendee lists to determine strategies for increasing participation and representation is needed to ensure a balanced assessment of interests and concerns throughout the watersheds. While names were helpful to determine participation of individuals, the absence of their affiliation makes it difficult to know whether specific organizations, within focus groups, were over or under represented. Additionally, a spatial analysis would show representation throughout the Sandy Creek watersheds highlighting areas that were over or under represented.

The following recommendations, formulated from EcoLogic's Stakeholder Outreach Report, are intended to support a successful and active stakeholder component of the EBM planning process.

- Establish strong lines of communication, education and outreach to keep stakeholders involved.
- Empower local governments to be responsive to the stakeholders.
- Incorporate the specific concerns revealed during the 2007 meetings into the adopted measures and targets for success as developed during the EBM planning process.
- Integrate the stakeholder community into the natural resource inventory stage of the EBM planning process to incorporate site-specific data and knowledge.
- Emphasize and rely on 'grass roots' tactics.
- EBM management plan should explicitly include objectives and measures to address the impacts of development/human population on the rural character.
- Use traditional print media in addition to electronic distribution and project websites.
- Stakeholders must remain convinced that their input is desired and fully considered by decision makers.
- Solicit stakeholder input via public meetings (open forum or targeted for particular projects/participants) and supplement with e-mail, phone or mail contact.
- Investigate low turn-out at the Business Focus Group meeting.
- Review meeting attendance sheets to determine representation of specific organizations and strive to achieve equal representation.
- Assess spatial distribution of participants to address representation across all watersheds.

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