ORANGE COUNTY, NEW YORK

FINAL

WATER MASTER PLAN

ORANGE COUNTY COMPREHENSIVE PLAN AMENDMENT

Adopted October 7, 2010

Prepared for

County of Orange, New York
Goshen, New York 10924

Prepared by:

Orange County Department of Planning
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Introduction

This proposed County Comprehensive Plan Amendment was prepared through a partnership between the Orange County Water Authority (OCWA) and the Orange County Department of Planning with the assistance of a team of consultants, led by Henningson, Durham & Richardson Architecture and Engineering, P.C. (HDR). Other members of the consultant team were Stone Environmental, Inc. and McGoey, Hauser & Edsall Consulting Engineers, P.C. A work group of representatives from OCWA, the County Planning Department, the County Planning Board and other interests selected by the OCWA Board of Directors has guided and advised the plan development process. Members of the work group included experts in planning and land use, local government, infrastructure, water supply, water resource protection, stormwater management, and flood mitigation. The work group provided oversight of the Plan development at key points through a series of workshops and reviewed early documentation.

Through adoption of this Plan as an amendment to the Orange County Comprehensive Plan, it is expected that the County of Orange and the OCWA will be able to clarify and enable the ways that County government can smartly and effectively function in the future to assure the availability of water in the County. This Plan assumes that success for such function must be based on collaboration between municipalities, water purveyors, and the County including the OCWA.

This Amendment also addresses core issues of concern and recommended actions from the 2003 County Comprehensive Plan, notably towards “defining … water carrying capacities” and “to foster cooperation with municipalities including inter-connections among local systems where possible.”, County policy also focuses attention in support of “Priority Growth Areas”. These Growth Areas are identified as the historic cities and villages of the County where growth has historically occurred, with some outlying areas including “local centers” such as existing hamlets for logical projected growth. It is also the intent of both the adopted Comprehensive Plan and this Amendment to continue to preserve the primarily rural character of the areas within the County which lie outside the Growth Areas. See Figure 1 (Growth Areas).

This Plan Amendment describes the approach that the County of Orange, in collaboration with the numerous water purveyors within the cities, villages and towns of the County along with the Orange County Water Authority (OCWA), will use to continue to help meet the growing demand for water within the County as well as to protect and conserve the County's source waters over the next decade. While this Plan focuses on the overall evaluation of future demand for water within the County and the formulation of initiatives to address these demands, the Plan also addresses the essential need for source water protection, research and monitoring, conservation and the promotion of water policies that encourage the efficient use of energy.

Background

Orange County is located in southeastern New York State, in the lower Hudson Valley, and adjoins New Jersey to the southwest and Pennsylvania to the west. The County consists of 846 square miles of land stretching from the Hudson River in the east to the Delaware River in the west. See Figure 2.

The County has a population (July 2009) of 383,532 and consists of 42 municipalities, including 20 towns, 19 villages, and three cities. Orange County relies on water from both surface and groundwater sources within the 11 County watersheds. The majority of the County's water supply is provided by 160 community water supply systems which draw fresh water from County reservoirs and aquifers. One hundred and thirty-one (131) of these systems rely on groundwater while 29 use surface water. There are 63 water districts that serve the County, some of which cross municipal boundaries. Eighty percent (80%) of the County's land area is serviced by individually-owned wells providing the only available fresh water to primarily single-family residences. Figure 3 depicts the percentage of water used by residences (homes) and commercial facilities within the County from groundwater, surface water, or New York City Aqueduct water sources.

Figure 1. Orange County Priority Growth Areas

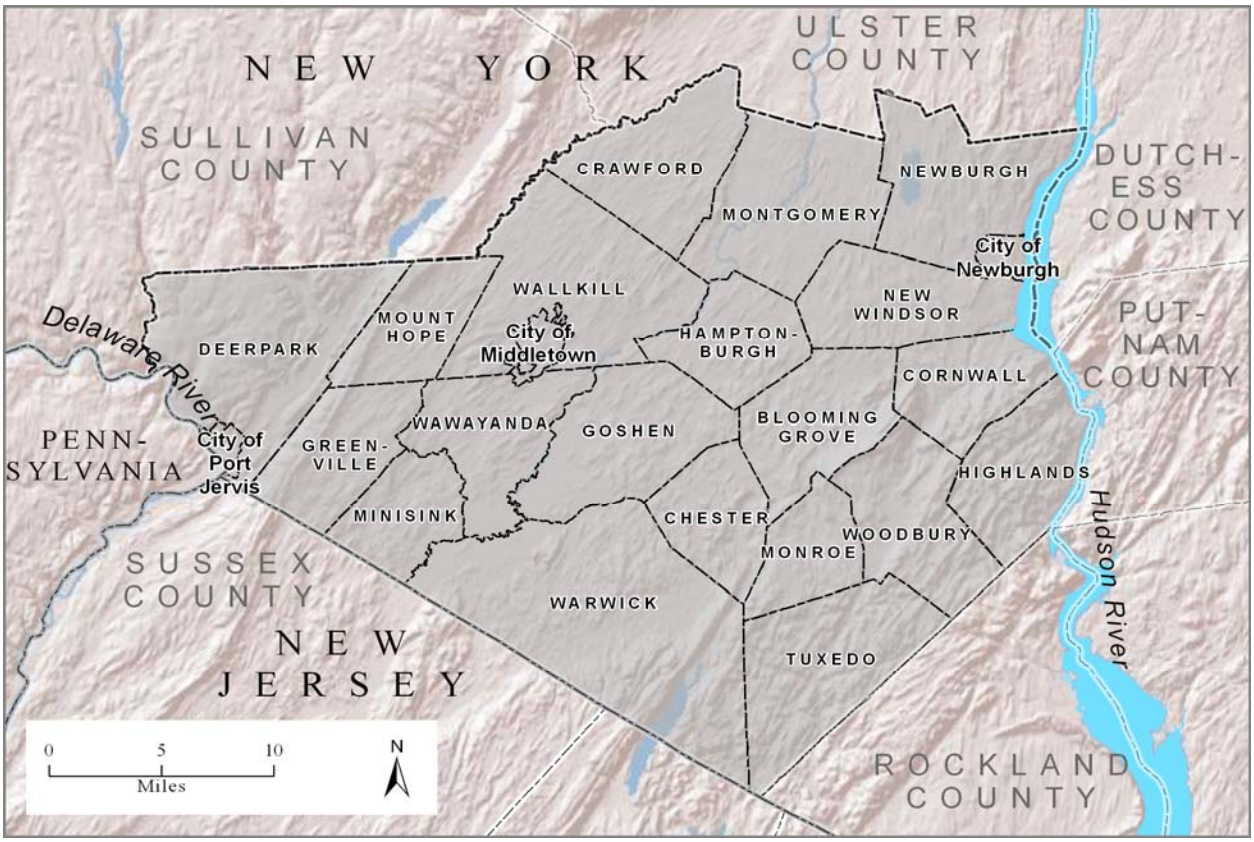


Figure 2. Geographic Setting

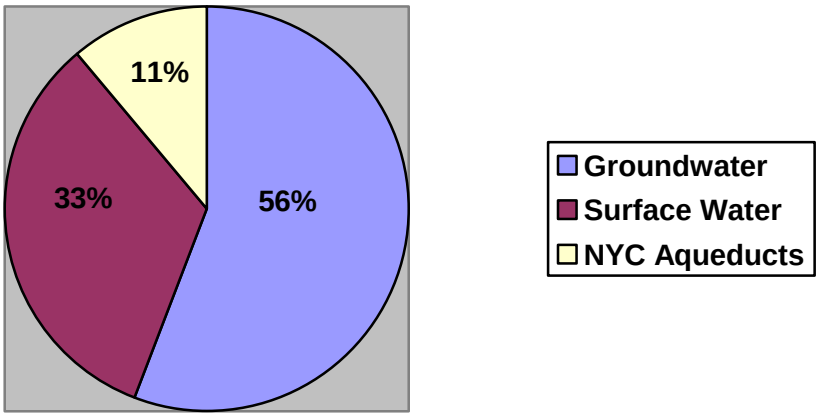


Figure 3. Sources of Water Supply within Orange County, New York (%)

Previous Water Supply Studies

There have been five water supply plans for the County (in total or for a major part of the County) since 1959. These studies, as well as summaries of each, are on file with the OCWA. Certain observations are offered on the water supply plans taken collectively. There are a number of common themes that are echoed in the reports reviewed. First, the urban-rural development plan for the County places most of the future need for water in the urban areas served primarily by municipal systems. Second, the projected deficits in water supply, particularly in the Hazen and Sawyer 1959 report, have not materialized in part because the population of the county has not grown as fast as the projections indicated it would. Third, there is a need for better coordination among the municipal, community and institutional water districts in meeting the demand, particularly during drought conditions. The OCWA was formed to provide a framework for coordination; however, the County's planning for water supply has been limited to programmatic initiatives since the regional plan or the "Loop Project" was abandoned in the early 1990's due to high cost and apparent lack of demand for water from the proposed participating communities.

Other aspects of the picture have changed or evolved during the period of these studies. Safe yield estimates for the numerous Orange County reservoirs are presented by Hazen and Sawyer (1959), Bowe Walsh (1975), CDM (1982) and MPI (1987). Reductions in safe yield values for Walton, Glenmere, Mombasha and Tuxedo lakes are evident between Hazen and Sawyer's report and the other reports because of the 1960's drought. Documentation of the safe yields is generally lacking, so it is not possible to determine which estimates are the most accurate.

There is also a change in regulatory requirements and environmental permitting that poses greater challenges to constructing reservoirs in the County now than in the past. This applies particularly to the proposed Indigot Reservoir, where wetlands permeate through the proposed site. Although these regulatory changes do not rule out the construction of any of the reservoirs, they affect the cost and schedule for implementing a new reservoir.

The scheme for water transmission throughout the County has changed over the years. As noted above, the looped transmission plan recommended by MPI in 1987 and further planned by Hazen and Sawyer/Stetson-Harza in 1990 lost its backing due to the high cost of this plan and the lack of interest amongst the proposed participants. The transfer of water out of one basin and into another was an additional weakness associated with this approach

Overall Approach and Methodology

Using 2008 as the starting point, the five-year planning horizon is 2013 and the ten-year planning horizon is 2018. Estimates of the future demand for water require estimation of the future population to be served. A *Per Capita Model* was used to forecast future demand; as the name of the model implies this analysis calculates the total production or consumption per capita for a historical period and applies the current year per capita consumption to the population projections for future periods. It was felt that this approach would produce satisfactory results in that the customer mix in Orange County is not projected to change substantially with time. The study uses previously developed

U.S. Census population data, U.S. Census population estimates, as well as estimates of population growth rates, to forecast populations at the three planning horizons. The estimated population growth rates were derived from population estimates provided by the Orange County Planning Department.[1] Forecast demand for water is expressed in terms of millions of gallons of water per day. The forecasts are based on a per resident (per capita) daily water use, which is expressed as gallons of water per capita per day. A fundamental assumption of this calculation is that the per capita demands will remain approximately constant over the next 10 years. Per capita demand was determined to be 118 gallons per day (gpd) for water districts and 62 gpd for communities and individual wells. This per capita usage compared favorably with other communities on a regional basis.

Water Supply Classification Nomenclature

A primary source for information concerning drinking water systems is the United States Environmental Protection Agency (USEPA) Safe Drinking Water Information System (SDWIS), administered in New York State by the NYSDOH, Bureau of Water Supply Protection (BWSP). Permitting of public water systems and annual reporting by their operators is managed by the State's use of SDWIS. For the purposes of this project, four basic categories of water purveyors operating within Orange County were created. The categories are:

- Municipal Water Districts
- Non-Municipal Water Districts
- Institutional Water Districts
- Private Wells

Please note that the nomenclature used for these categories is different than that used by the NYSDOH. The first three categories are considered to be divisions of the overarching public water supply systems as defined in SDWIS. Municipal, non-municipal, and Institutional water systems are classified as "Community Water Systems" by the New York State Department of Health. The fourth category is not reported in SDWIS.[2]

The bulk of water supply for public use in Orange County is provided by water supply districts, drawing fresh water from Orange County reservoirs and wells. To a limited extent, the New York City water supply system via the Catskill and Delaware Aqueducts is the source of water supplied by municipal water districts in the northeast part of the County.

The SDWIS database maintained by the NYSDOH identifies a total of 160 community water suppliers in Orange County, of which, with the assistance of the Orange County Department of Health, 63 have been identified as municipally-operated water districts, 89 as privately-owned community water suppliers and an additional 8 suppliers are identified as operated by residential institutions such as prisons.

[1] Appendix A presents optional population projections completed in response to public comment on prior technical reports. This additional information is provided to show a range of projections based on varying assumptions.

[2] A community water system is a SDWIS-reporting water supplier with an annual operating period of 365 days a year and serving a residential population of at least 25.

Results and Key Findings

The results of the study indicated that by 2018 the County's population would rise by 44,329 to 420,734 people; an increase of 12%. The total population within the Municipal Public Water Supply Districts would increase from 2007 to 2018 by 26,510 people or by 11% (see Table 1).

	2007	2009	2013	2018
Municipal Public Water Supply Population	247,027	249,155	260,681	273,537
County-wide Population	376,405	383,532	396,255	420,734

Table 1. Current and Projected Population

As such, it was estimated utilizing the Per Capita Model that water demand would rise from 29.8 million gallons per day (mgd) in 2008 to 32.0 mgd in 2018. Table 2 presents a comparison of supply and demand for municipal water districts at each planning horizon and Figure 4 illustrates the aggregate supply and demand numbers over the three planning horizons.

Despite this increase in demand, a 20.4-mgd surplus would remain County-wide. This surplus is based on the assumption that certain water districts will be augmenting their supplies with the development of new water sources over the next 10 years. However, it is projected that a number of communities (Cities, Towns and Villages) will experience supply deficits due to distribution inadequacies.

The municipalities with 2018 projected deficits are identified below along with a brief description of the situation.

- Village of Goshen – supply in 2008 and 2013 is attributable to the safe yield of village's two reservoirs; two well fields maintained by the town as a backup are not included in the supply; a potential supply increase (pending regulatory approval) in 2018 will reduce the deficit accordingly.

- City of Middletown – demand may be overestimated because of inaccurate flow meter at water treatment plant; new master meter expected to be online in the near future as part of new WTP.

- Village of Kiryas Joel – demand exceeds supply in 2018.

- Village of South Blooming Grove - is serviced by the Village Consolidated Water District that is compromised of the previous Town Water Districts 1 and 6 (Blooming Grove Water District No. 1 and Blooming Grove Water District No.6; Water District Number 6 is the larger of the two districts). The Consolidated Water District draws water

from several wells. The average daily and average monthly supply for a number of these wells (based on the Village's 2007 NYSDOH Water System Operations Report) has declined since the original water taking permit was filed with the Orange County Health Department. In fact, many of the wells need to be operated 24 hours, seven days a week to marginally meet average daily demand within the districts. Furthermore, during periods of elevated demand, the existing supply cannot meet demand and the Village needs to truck in additional supply. As such, the current demand exceeds the existing supply, and the current supply deficit is expected to increase through 2018 unless the Village brings new sources of supply on-line. The Village is currently exploring various water supply augmentation options.

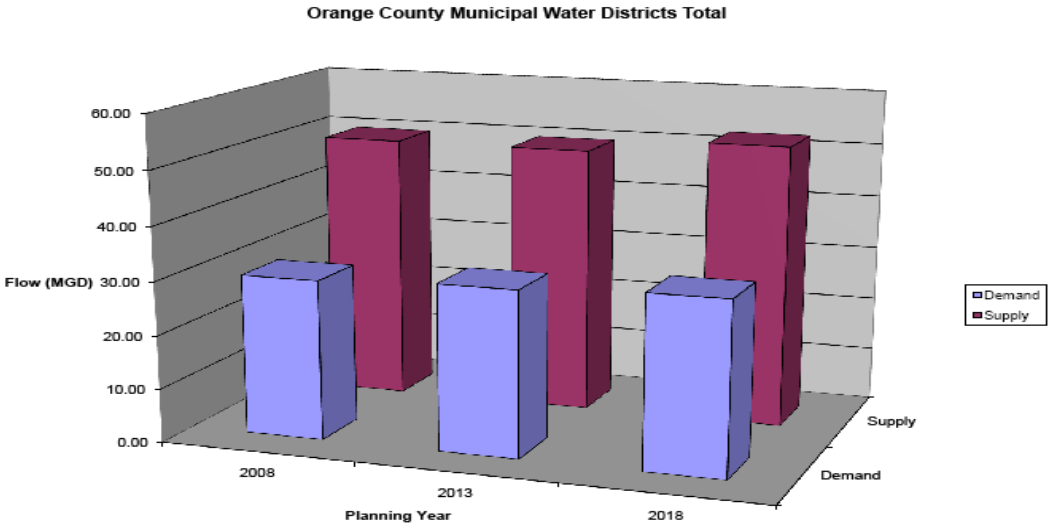
Table 2. Comparison of Supply and Demand for Municipal Water Districts at Each Planning Horizon

Water District(s) Associated with Named Municipality	2008			2013			2018			2018 Issue?
	Supply	Demand	Surplus	Supply	Demand	Surplus	Supply	Demand	Surplus	
Town of Blooming Grove	244,800	125,413	119,387	244,800	124,477	120,323	244,800	123,457	121,343	NO
Village of South Blooming Grove *	210,494	227,051	**-16,557**	210,494	229,708	**-19,214**	210,494	232,364	**-21,870**	**YES**
Village of Washingtonville	540,000	335,251	204,749	540,000	346,282	193,718	540,000	357,696	182,305	NO
Town of Chester	518,400	417,360	101,040	518,400	438,761	79.639	518,400	461,089	57,311	NO
Village of Chester	1,044,000	540,366	503,634	1,044,000	546,410	497,590	1,044,000	552,455	491,545	NO
Town of Cornwall	0	0	0	0	0	0	0	0	0	NO
Village of Cornwall-on-Hudson	2,175,000	1,254,564	920,436	2,175,000	1,265,578	909,422	2,175,000	1,276,680	898,320	NO
Town of Crawford	351,360	195,270	156,090	351,360	204,323	147,037	600,860	213,790	387,070	NO
Town of Deerpark	0	0	0	0	0	0	0	0	0	NO
Town of Goshen	529,920	254,051	275,869	529,920	260,280	269,640	779,420	266,602	512,818	NO
Village of Goshen	500,000	863,553	**-363,553**	500,000	898,188	**-398,188**	843,100	934,214	**-91,114**	**YES**
Town of Greenville	0	0	0	0	0	0	0	0	0	NO
Town of Hamptonburgh	102,240	18,747	83,493	102,240	19,859	82,381	102,240	21,040	81,200	NO
Town of Highlands	0	0	0	0	0	0	0	0	0	NO
Village of Highland Falls	715,000	557,323	157,677	715,000	574,057	140,943	715,000	591,119	123,881	NO
City of Middletown	3,140,641	4,045,286	**-904,645**	3,140,641	4,087,983	**-947,342**	3,390,141	4,130,993	**-740,852**	**YES**
Town of Minisink	0	0	0	0	0	0	0	0	0	NO
Village of Unionville	129,600	38,162	91,438	129,600	39,688	89,912	129,600	41,360	88,240	NO
Town of Monroe	66,240	37,284	28,956	66,240	37,331	28,909	66,240	35,695	30,545	NO
Village of Monroe	1,432,000	1,023,919	408,081	1,432,000	1,053,026	378,974	1,432,000	1,077,590	354,410	NO
Village of Harriman	969,120	419,824	549,296	969,120	416,187	552,933	969,120	404,890	564,230	NO
Village of Kiryas Joel	1,928,800	1,359,883	568,917	1,928,800	1,657,718	271,082	1,928,800	2,020,699	**-91,899**	**YES**
Town of Montgomery	669,600	88,845	580,755	669,600	88,671	580,929	669,600	86,557	583,043	NO
Village of Montgomery	720,000	304,840	415,160	720,000	374,797	345,203	720,000	460,893	259,107	NO
Village of Walden	1,141,920	744,983	396,937	1,141,920	766,872	375,048	1,141,920	789,295	352,625	NO
Village of Maybrook	731,520	347,510	384,010	731,520	348,030	383,490	731,520	348,551	382,969	NO
Town of Mount Hope	0	0	0	0	0	0	0	0	0	NO
Village of Otisville	250,000	219,018	30,982	250,000	220,027	29,973	250,000	221,036	28,964	NO
Town of New Windsor	3,500,000	2,819,981	680,019	3,500,000	2,933,121	566,879	3,500,000	3,050,859	449,141	NO

Water District(s) Associated with Named Municipality	2008			2013			2018			2018 Issue?
	Supply	Demand	Surplus	Supply	Demand	Surplus	Supply	Demand	Surplus	
City of Newburgh	9,500,000	3,850,298	5,649,702	9,500,000	3,857,971	5,642,029	9,500,000	3,865,781	5,634,219	NO
Town of Newburgh	5,960,000	2,831,158	3,128,842	5,960,000	2,999,196	2,960,804	5,960,000	3,177,279	2,782,721	NO
City of Port Jervis	1,900,000	1,128,509	771,491	1,900,000	1,135,817	764,183	1,900,000	1,143,249	756,751	NO
Town of Tuxedo	0	0	0	0	0	0	0	0	0	NO
Village of Tuxedo Park	1,000,000	300,723	699,277	1,000,000	300,041	699,959	1,000,000	299,360	700,640	NO
Town of Wallkill	3,767,359	2,458,334	1,309,025	3,767,359	2,544,308	1,223,051	4,016,859	2,633,328	1,383,531	NO
Town of Warwick	590,400	344,123	246,277	590,400	352,859	237,541	590,400	361,468	228,932	NO
Village of Greenwood Lake	720,000	248,177	471,823	720,000	247,451	472,549	720,000	246,725	473,275	NO
Village of Warwick	1,402,000	769,461	632,539	1,402,000	812,718	589,282	1,402,000	858,377	543,623	NO
Village of Florida	600,000	519,738	80,262	600,000	568,470	31,530	693,600	621,833	71,767	NO
Town of Wawayanda	272,160	39,643	232,517	272,160	50,887	221,273	521,660	65,315	456,345	NO
Town of Woodbury	0	0	0	0	0	0	0	0	0	NO
Village of Woodbury	2,308,800	1,097,949	1,210,851	2,308,800	1,113,971	1,194,829	3,308,800	1,130,197	2,178,603	NO
Countywide Total	49,799,600	29,826,597	19,973,003	49,799,600	30,915,063	18,884,537	52,483,800	32,101,835	20,381,965	NO

***** The Village of South Blooming was incorporated as a new Village during our research. Therefore, their supply number is based on the 2007 average monthly yield number for both relevant water districts combined as listed in the NYSDOH Water System Operation Report- this number is used since other supply numbers listed in the table for all municipalities are from 2007; to be conservative, since the NYSDOH report yield numbers for 2008 and 2009 are a bit higher – i.e. 220,888 and 228,792 respectively – with the exception of the 2009 number in which a slight surplus could exist in 2008, no surplus would exist at other times no matter which year was used. The demand numbers for 2008, 2013, & 2018 reflect the change in Village population as per the projections provided by the OC Planning Department.

Figure 4. Orange County Municipal Water Districts Supply and Demand Projections



Planning Initiatives

The Plan presents the following key water supply planning initiatives geared at addressing these inadequacies and the County's overall water supply needs over the next 10 years:

- **Conservation/Drought Management/Energy Efficiency,**
- **Source Water/Watershed Protection,**
- **Research and Monitoring,**
- **Capital Projects and Interconnections, and**
- **Formulation of a Financial and Institutional Framework to Facilitate the Implementation of the Various Initiatives.**

It is important to note that the overall success of this Plan relies on an integration of these initiatives. A balance between water quantity management through conservation, drought management, distribution/delivery improvements, and new source development and water quality management through source water protection is critical to the health and welfare of the County's water resources.

Some of the initiatives presented in this Plan have the potential to address both existing and projected water supply deficits over the short-term, i.e., within a one to three year timeframe. As such, these "early action" projects may qualify for funding made available via the American Recovery and Reinvestment Act (ARRA). In addition, a number of initiatives discussed in this Chapter may help to centralize water supply development amongst users within contiguous water districts and thus help to promote overall efficiency of water use and encourage "smart growth" as defined in the Mid-County Land Use Study (RPA, 2008).

This Strategic Plan proposes that Orange County considers employing a "hybrid" approach to implementation that consists of a combination of current planning and technical assistance functions coupled with its utilization of its financing and bonding capacity to support a capitally funded resource conservation and construction\operations functions – the later when in partnership with municipalities .

A brief discussion of each of the water supply planning initiatives is discussed below:

Conservation

The necessity for water conservation goes beyond the simple balance of supply versus demand. Water must be used wisely regardless of a water supply's abundance. In order to supply water to a consumer, the treatment and delivery processes take both energy and resources. Orange County has demonstrated, and will continue to demonstrate that conservation consciousness is essential for ensuring if resources will continue to be available to growing communities.

Since 1994, the County through the OCWA has provided an outstanding Water Conservation Education Program to school districts across Orange County. The program, offered free of charge, includes multiple sessions of NYSED-standards-based learning about the water cycle, community water use, pollution and its prevention. The education program is multi-disciplinary, spanning the scope of students' regular classes including Science, Math, Social Studies, and Language Arts as well as challenging students to work in groups to solve problems. An asset of this program, the "Trickle-Down" instruction, allows older students, having learned the lessons from conservation education staff, to assist in the planning and then teaching of the lessons to younger students. This hands-on, thought provoking approach is taken with hopes to instill the message that water conservation consciousness should be part of our daily routine.

In addition to this Water Conservation Education Program, the OCWA has also established a public information program in the field of water use efficiency. This information programming initiative was set up to guide consumers through water conservation methods for the purpose of establishing a framework for ensuring future water supply availability within the County. This information program consists of an electronic collection of water conservation documents. In an effort to promote the wise

use of water, to avoid waste, and to reduce energy demands, OCWA developed a water conservation primer in November 1992.
In 1988, legislation passed requiring a water conservation plan as a condition of a water supply permit. In 1992, the NYS DEC developed a "how to" manual for preparing a water conservation program to assist municipalities in complying with this state regulation. This Water Conservation Manual, in addition to numerous books, manuals and articles, was used as the basis for the compilation of information in the OCWA's Water Conservation Primer.

The OCWA also provides additional resources as part of their public information program. These resources include both a Consumer's Guide to Water Conservation and a list of water conservation tips for inside the bathroom and kitchen of the home, outside the home, while washing cars, for plantings and for conserving groundwater. Despite the availability of this information, only a portion of the municipalities within the service area of the OCWA identified conservation methods currently being employed. The following is a listing of the municipalities identified as having a conservation program on file:

- Village of Chester
- Village of Florida
- Village of Harriman
- Village of Maybrook
- Village of Monroe
- Village of Montgomery
- Town of New Windsor (recommendation of plan in annual report)
- City of Port Jervis
- Village of Unionsville
- Village of Warwick

The remaining water purveyors only implement water conservation measures when supplies are in danger and lift requirements when the urgency has subsided. These municipalities either did not specifically identify that a conservation plan is in place or listed that a conservation plan would be developed on an as needed basis.

Through the adoption of this Water Master Plan, the County with the OCWA will be establishing the framework for the development of new programmatic options going forward for water conservation. OCWA can retool the successful programs currently being implemented by taking advantage of new technology. The new program could use an internet-based strategy to foster the wider use of water conservation devices, and better use of the Evapotranspiration Lawn Watering program. This new program approach could potentially be implemented on a more permanent basis rather than only for the temporary periods of when an emergency exists.

In 2001, Stearns and Wheler, LLC (S&W) conducted a Mid County Water Supply Study on behalf of OCWA for a study area consisting of the Town of Wallkill, City of Middletown, Town of Wawayanda, Town and Village of Goshen, and the Town of Mt.

Hope. This water supply study included a discussion of the water conservation measures and recommendations for a water conservation program to be instituted throughout the study area to decrease the regions water demand. The major focus water supply methods addressed in this study included the following:

- Water Meters – The installation of water meters on all service connections which, at the time of the report, was a requirement of all suppliers in the mid County study region.
- Rate Structures Encouraging Conservation – The increase cost rate for water as consumption increased.
- Use Restrictions – The enacting of drought type restrictions that dictate water use time constrictions and limit activities for which water can be used (lawn watering, car washing).
- Low Flow Fixtures – The encouraging of the retrofit of existing buildings with new low flow fixtures.
- Water Audits – To perform detailed monitoring of consumption for areas to determine trends in water use and locate possible leaks.
- Investigate Leaks – To investigate for potential leaks by monitoring differences between totals recorded for water main meter readings and consumer meter readings.
- Public Outreach/Education – To provide educational material to the public on the importance of water for life and importance of water conservation.

This Plan recommends that the major components of the 2001 S&W water supply study be implemented with an internet based strategy. Since there are quite a substantial number of golf courses throughout Orange County, evapotranspiration (ET)-based lawn watering education would be a key element of the conservation plan. (ET is the loss of water from the soil both by evaporation and by transpiration from the plants.) The ET lawn watering program would focus on outdoor water use and be based on monitoring regional ET data. OCWA would educate customers on proper lawn watering techniques, and provides a daily ET lawn watering guide number to help consumers use water efficiently while maintaining healthy lawns. In addition, the potential reuse of treated wastewater for irrigating golf courses within the County should be investigated.

Prior to development and implementation of a water conservation plan, OCWA should initiate a study of the potential opportunities for water conservation and water reuse throughout the County. This study would include the following activities:

- An assessment of current water demand patterns in the Orange County, including demands by customer group and seasons.
- An evaluation of the effectiveness of existing conservation practices and programs (current and past) for municipalities within Orange County. This will include an assessment of the impact of low flow/volume plumbing fixture laws.

- Review of state-of-the art efforts in conservation programs used by other utilities in the U.S., and by other United Water Operating units (these include the water conservation device distribution, water audit, ET and non-residential water saving programs).

- Assess water recycling opportunities in the County by identifying potential users and alternate sources. The reuse of treated wastewater use for golf course irrigation should be investigated.

- Review alternate seasonal demand management options including odd/even watering and rate structures.

- Develop a weighted ranking of a wide range of water conservation activities based upon effectiveness and cost\reward ratio

Energy Efficiency and Water Policy

Federal and State resources are expected to remain available and prioritized for energy efficiency and for water resource protection and water infrastructure. For example, as part of the American Recovery and Reinvestment Act of 2009, New York State will receive approximately $435 million for its Clean Water State Revolving Fund Program and $86.8 million for the Drinking water State Revolving Fund. A portion ($86.5 million) of this funding has been directly applied to “green infrastructure projects.” Green infrastructure includes water use efficiency, energy efficiency, green wet weather infrastructure, and environmental infrastructure. Broader scale “green initiatives” include adaptation to climate change, energy savings and sustainable design, total water management, and integrated water resource management. The Water Master Plan encourages and supports municipal water suppliers’ participation in this effort. The OCWA will apply this approach to the advancement of the various planning initiatives presented in this document.

Source Water Protection

There is a clear need for greater protection of the County’s surface water and groundwater resources. This Comprehensive Plan encourages the completion of watershed management plans as a tool to strategically protect and restore the County’s important surface water bodies. Watershed management plans characterize a watershed (also called a drainage basin) and recommend actions that can be taken to maintain or restore water quality and quantity in a particular waterbody or stream network.

Consistent with the 2005 Open Space Plan amendment to the County Comprehensive Plan, land preservation in support of source water protection of surface and groundwater water resources should also remain a priority for the County where willing property owners and municipalities are partners.

Reservoirs

Reservoirs are the among the water bodies most worthy of protection due to our reliance on them for potable water. The need for protection is greatest in areas where water supply watersheds for reservoirs reside in adjacent communities; for example, the reservoirs serving the City of Newburgh are in the Town of New Windsor, and the Village of Chester's Walton Lake is in the Town of Monroe. There appears to be a need to reconcile Town planning efforts with source water protection initiatives both within Towns as well as across Town boundaries. This applies to wellhead protection initiatives as well.

Management of watersheds is the most fundamental step in protecting drinking water resources. Protecting these resources is not only in our best interest ecologically, but is also ultimately more cost-effective. The Trust for Public Land's "Protecting the Source" (2004) report used data from across the country to correlate increases in development of a drinking water supply's watershed with increases in the cost of treating that water to make it potable. This increase in cost is due to the fact that increasing development within a watershed will enhance the likelihood that surface or groundwater contamination will occur, which in turn leads to higher treatment costs to remove the contaminants. Land protection is therefore typically among the highest priorities in a reservoir watershed management plan, alongside the strategic application of land use controls and best management practices.

This Plan recommends that watershed management plans be created for all reservoirs, with priority given to those reservoirs with documented impairments or that are under development pressures. These priority reservoirs, shown in Figures 5 and 6 include:

- **Glenmere Lake** (Towns of Warwick, Chester) serves the Village of Florida as well as portions of the Town of Goshen. A small watershed, encompassing 2.5 square miles, it is especially vulnerable to the effects of land use changes within this area but would also be responsive to restoration efforts that target water quality. The Village of Florida's park and Orange County's holdings encompass a large percentage of the lakeshore, but despite this protection the lake has experienced sedimentation, exotic weed outbreak, and eutrophication in recent years. Documented biological resources in and around the lake should affect water supply management decisions.

- **Brown's Pond/Silver Stream Reservoir** (New Windsor) serves both the City of Newburgh and the Town of New Windsor (as an emergency source). While the City of Newburgh owns substantial tracts of land around the borders of the lake, most of the watershed is unprotected and thus vulnerable to development, examples of which have recently added significant amounts of sediment to the Reservoir.

- **Goshen Reservoirs #1 and #2** (Town of Goshen) serve the Village of Goshen and have very small watersheds. The larger reservoir, #1, has little protected land around it and is currently experiencing eutrophication.

- **Walton Lake** (Town of Monroe) serves the Village of Chester and is located in a highly developed area of the County. Existing residential development, especially on the west side of the lake, could compromise water quality if not carefully regulated or monitored.

- **Mombasha Lake** (Town of Monroe) serves the Village of Monroe and, like Walton Lake, is also located in a highly developed area of the County. Existing residential uses combined with the potential development of unprotected vacant land within the Lake's watershed could compromise the water quality of this important reservoir.

- **Chadwick Lake** (Town of Newburgh) serves the Newburgh Consolidated Water District. The Town of Newburgh owns parkland around the entire lake, thereby successfully protecting the lakeshore from deforestation and other infringement. This large waterbody is undergoing eutrophication which could ultimately reduce available water volume in the lake.

- **Shawangunk, Highland and Monhagen Lakes & Indigot Properties** (Towns of Mount Hope and Wallkill) The City of Middletown's surface water system is a complex of water bodies including Shawangunk, Highland, and Monhagen lakes The Indigot properties are located in the Town of Mt. Hope at the southern terminus of Lake Shawangunk. These properties are a set of County-owned parcels, totaling approximately 950 acres that were acquired for reservoir development as part of the County's "Water Loop" study project, a project abandoned in the 1990's. However, these properties do include important groundwater resources. Future water supply generated from the Indigot wellfield has the potential to supplement the City of Middletown's supply as well as other neighboring communities. As such, it is important to formulate an aggressive well head\aquifer protection program for this important resource and develop a focused watershed protection plan for the City of Middletown water supply watershed as well.

A local example that could serve as a model for these reservoirs is the Lake Management Plan currently being developed by the Village of Tuxedo Park, in partnership with the Town of Tuxedo and funded in part by the OCWA and a County Planning Grant. The Village has a series of three lakes in its center and much of the area within the Village drains into the lake network. The largest of the three lakes, Tuxedo Lake, provides drinking water to the Village and part of the Town of Tuxedo and the Village is therefore interested in ensuring that land uses within the lake's watershed do not impair the water quality of this important reservoir. This Lake Management Plan, which is expected to be completed in 2009, uses a holistic watershed approach to preserve and protect the water quality and quantity of its reservoir and lakes.

Figure 5. Selected Reservoirs and their Subbasins

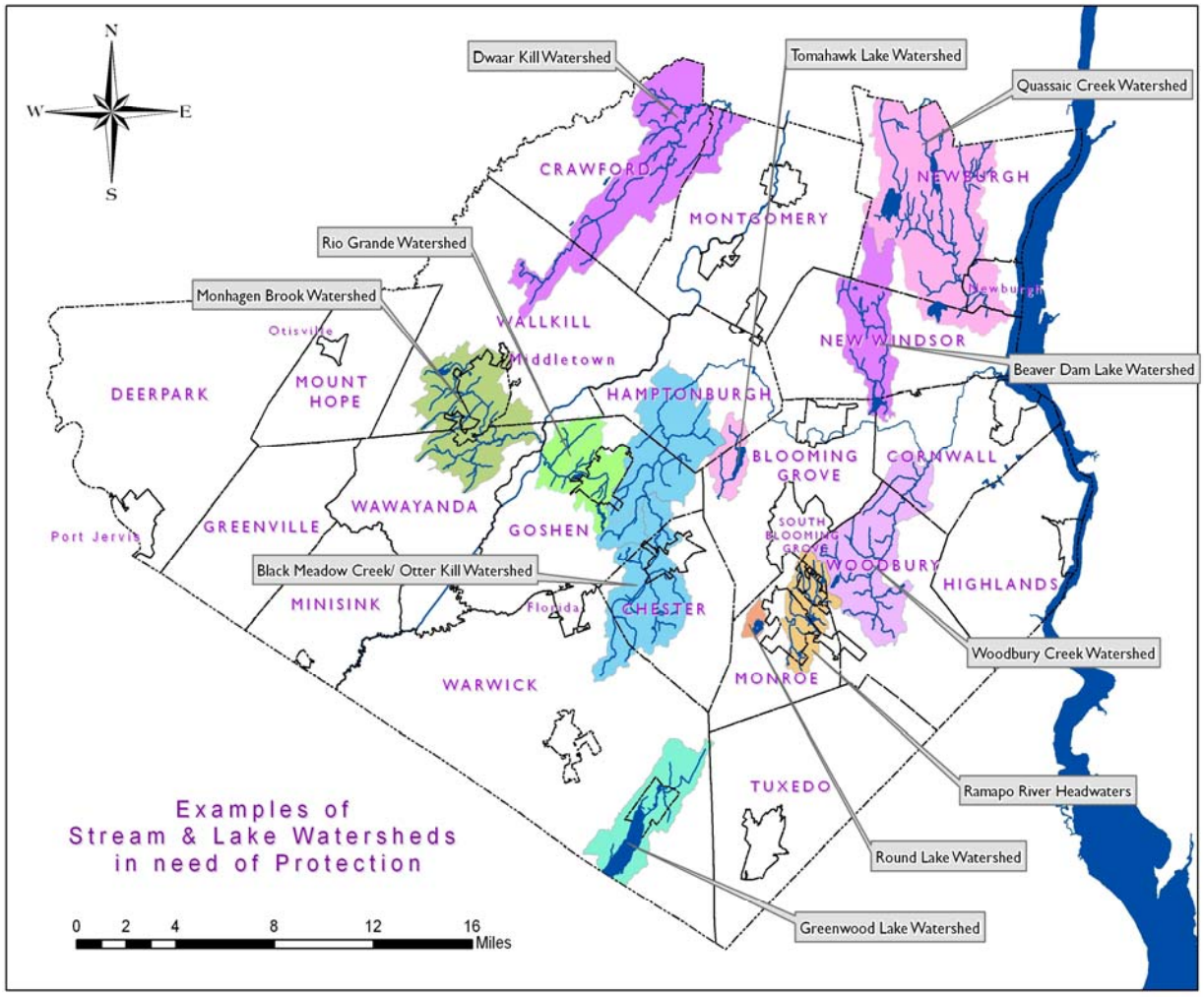


Figure 6. Examples of Stream and Lake Watersheds in Need of Protection

Protection of Groundwater and Recharge Areas

Under the NYS Department of Health Source Water Assessment Program, source water assessments must be completed for all sources of public drinking water which are used by public water systems. Source water assessments provide information on the potential contaminant threats to public drinking water sources. Completed source water assessments also provide a rational basis for future source water protection activities in wellhead and watershed areas because the source water assessments will identify the most significant threats of contamination to the source of public drinking water.

The 1999 study by LBG (Leggette, Brashears & Graham *Model Ground-Water Protection Plan*; OCWA January 1999) provides a foundation as part of a county-wide Groundwater Protection Plan. Delineation of sand and gravel aquifers within Orange County was completed as part of the 1999 LBG study. Sources of contamination were also inventoried and assessed for the OC Groundwater Study, Existing Conditions

Report (LBG 1995). The 1999 LBG study identified a key step advocated by this Plan, the determination and implementation of types of management controls necessary to protect source water. Regulatory measures such as zoning and other municipal local laws should be used to address pressing threats of contamination, to provide maximum protection to sensitive aquifer areas and control specific activities that pose risks for contamination of underlying aquifers.

Also recommended are complementary, non-regulatory programs such as water quality monitoring, household hazardous waste collection, and acquisition of sensitive aquifer areas. Strategic investment in sewer and water service extensions can also mitigate development pressures on sensitive sites. Public education and participation are cornerstones of any community's efforts towards groundwater development and protection. These controls and programs are best bundled for the unique conditions in each municipality or water supplier as part of a strategic groundwater protection plan as recommended in both the Mid-County Water Supply Study (S&W/LBG 2001) and the Model Ground-Water Protection Plan and Strategies (LBG, 1999)

Wellhead Protection Areas in the County were proposed in the 1999 study based on a portion of the baseline delineation advocated by the New York State Wellhead Protection Program (NYSDEC, 1990). The delineation of Wellhead Protection Areas for bedrock wells was generally proposed as a radius of 200 ft from the wellhead, and the delineation of Well field Management Areas (WMA) was generally proposed as a radius of 1,500 ft from the wellhead.

Most of the bedrock underlying Orange County is highly fractured sand- and mudstone, some areas of bedrock require special consideration (see Figure 7). Karst limestone/dolostone bedrock underlies an area of southwestern Orange County of nearly 40,000 acres. The limestone/dolostone is exposed on the surface in many locations in the Towns of Warwick, Minisink, Wawayanda and Goshen. For example, the Duchess Quarry and caves near Goshen are a phenomenon of the karst limestone/dolostone formation. Because of the unusual properties of karst, water flows swiftly and extensively through openings in this bedrock, carrying whatever potential pollutants may enter it. Much of this karst additionally underlies a large sand and gravel aquifer, part of the Wallkill River aquifer, which in turn underlies the Black Dirt region of drained marshlands now extensively developed for agriculture. Given the high permeability of the sand and gravel aquifer and the conditions of karst limestone/dolostone, the potential exists for rapid and widespread surface to groundwater pollution. Delineation of a Well field Management Area for this karst limestone/dolostone is recommended and should include the areal extent of the formation.

In the same LBG study, the delineation of the Wellhead Protection Areas for sand and gravel wells was proposed as a 200-foot radius from the wellhead. The New York State Wellhead Protection baseline delineation of a Wellhead Management Area for a sand and gravel well includes the areal extent of the sand and gravel aquifer in which the well or well field is completed. Most of the 17 significant sand and gravel aquifers in

the County extend continuously over several miles. For example, Wallkill River Valley Aquifer extends 28 miles across Orange County, crossing 9 municipalities. The Neversink River Valley Aquifer extends 17 miles across the county, and Woodbury Creek Valley Aquifer extends 8 miles (see Figure 7). All 17 aquifers are currently or are potentially essential to public water supply. Many are currently tapped by municipal water systems.

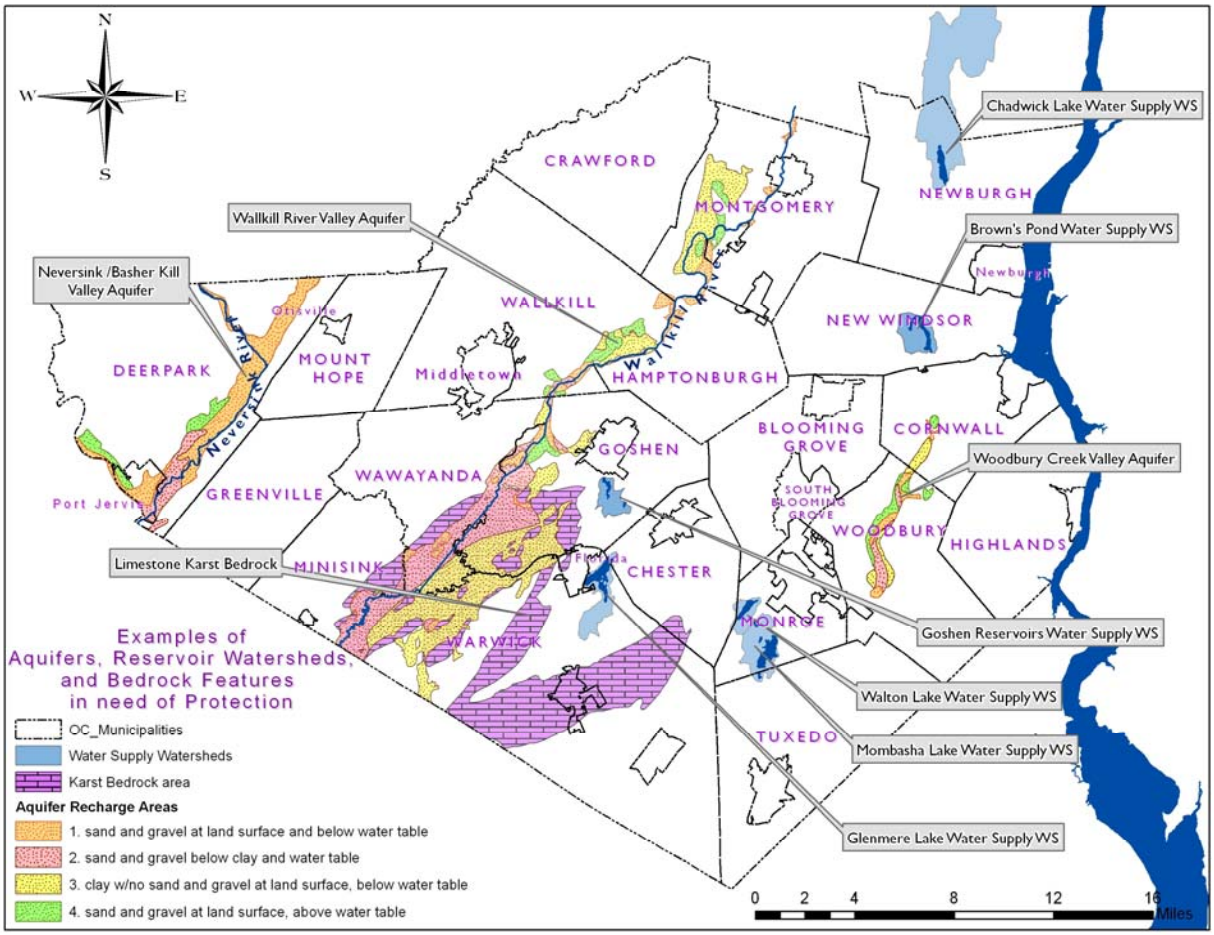


Figure 7. Aquifers, Reservoirs, Watersheds and Bedrock Features in Need of Protection

The Neversink River Valley Aquifer is a good example of a large groundwater resource in need of a comprehensive protection plan (see Figure 8). In addition to its extent within Orange County, it extends beyond the County's boundaries into Sullivan County in the north and the State of Pennsylvania in the south, is nearly two miles wide throughout its length, and is in places 600 feet deep, according to USGS Hydrogeology studies (USGS Open File report 98-275: *Hydrogeology of the Port Jervis Area in Orange County, NY)*. This aquifer is moving storage for billions of gallons of water. The area above the Neversink Aquifer is approximately 20% agricultural and 75 % forested land and is still largely undeveloped. No groundwater contamination has been reported

to NYS DEC within most the aquifer area to date. However, groundwater beneath a site in the city of Port Jervis has been found to contain metals and volatile organic contamination, has been designated a Federal Superfund Site, and has undergone remediation to remove sources of contamination. Nevertheless, the Neversink Valley Aquifer represents a groundwater resource of significant proportions, still largely unaffected by development. It could be protected and maintained in a nearly pristine state as a water resource for the future.

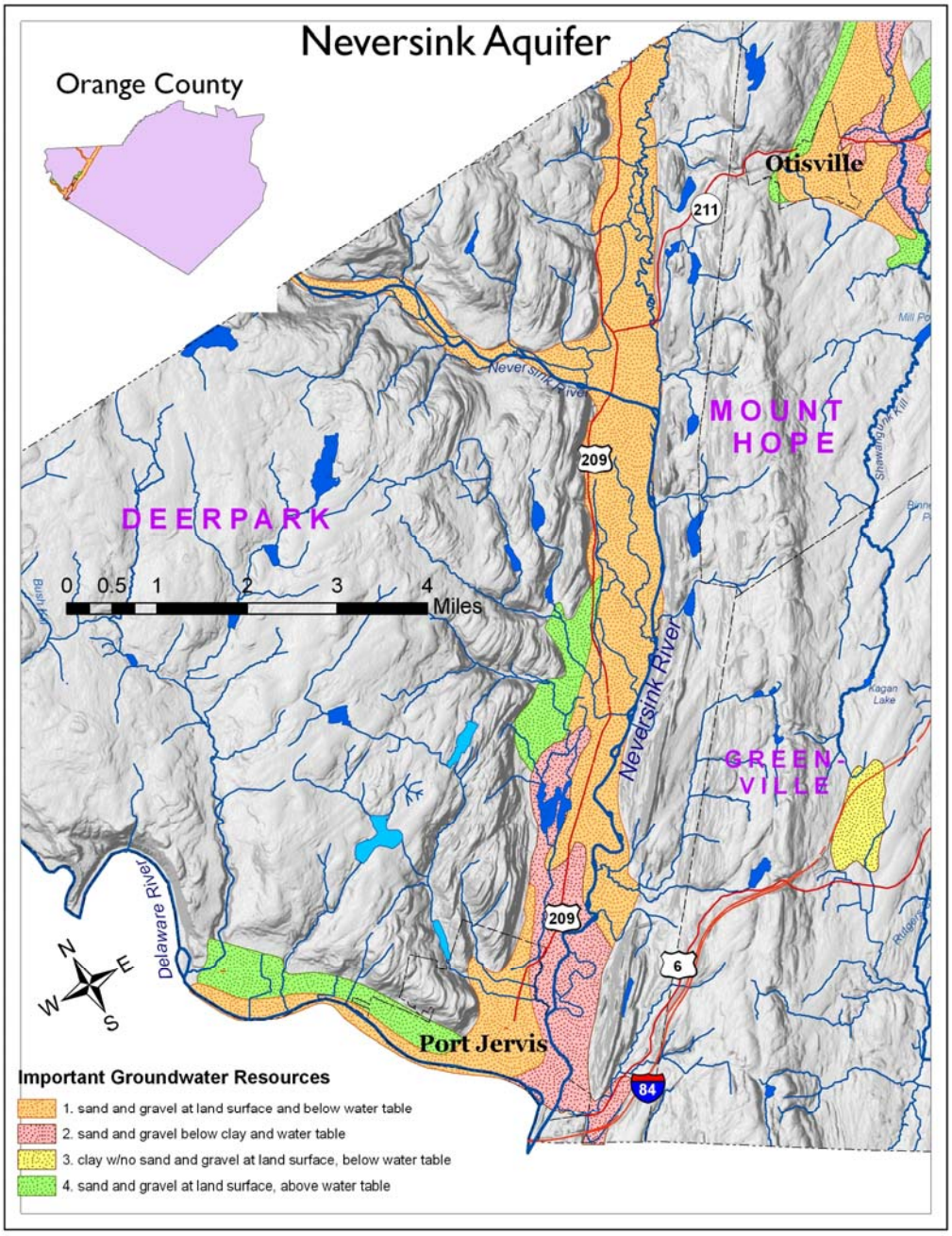


Figure 8. Neversink Aquifer – Important Groundwater Resources

Rivers, Streams, and Lakes

The development of watershed plans for all basins within the County would benefit overall surface water protection efforts. The County, led by the OCCWA and the Orange County Soil & Water Conservation District, has already developed a watershed plan for the Wallkill River (Wallkill River Watershed Conservation and Management Plan, 2001) and for the Moodna Creek Watershed (Moodna Creek Watershed Conservation and Management Plan, 2009). Funding has also been recently secured by the County for a Quassaick Creek Watershed Plan; and the OCWA has also recently committed funds for a management plan for the Glenmere Lake Watershed. While these plans are extensive in the breadth and scope of information presented and the protective actions recommended, the need for comprehensive implementation still exists and thus requires attention from both government officials and other stakeholders. Implementing watershed management plans for all basins in the County would identify high priority actions to protect or restore water quality and quantity as well as allow for integration of stormwater management plans, the development of hydrologic budgets, and the design and implementation of a flow gage monitoring network to assist in flood management.

This Plan emphasizes the development of watershed plans for the below list of streams, rivers, and lakes either because the waterbody has a documented impairment, or because the water quality and watershed are in relatively pristine condition (Figure 6, above). Watershed management plans for degraded waterbodies typically stress the need for restoration through best management practices, retrofits, point and non-point source pollution identification and control, and education; plans for more pristine watersheds often focus on recreation, maintaining water quality, and conserving high priority lands.

- The **Rio Grande** exhibited among the worst water quality from 2005 to 2007 of all sites sampled in the OCWA's Stream Biomonitoring project. Impact Source Determinations (ISDs) for one site indicated that a combination of organic and impoundment sources caused these poor conditions. Water quality is easily affected in this stream due to its relatively small watershed size, a characteristic that should also simplify the identification of pollutant sources.

- The **Monhagen Brook** also exhibited poor water quality when sampled for the Stream Biomonitoring project. Many factors influence the health of this watershed, which covers most of the City of Middletown, but the ISD pointed to organic and toxic sources.

- The **Quassaick Creek** is listed on DEC's Priority Waterbodies List (PWL) because of impacts from sewer overflow and urban/stormwater runoff. The Creek has been the subject of urban greenway and trail planning for years, but such plans have yet to be implemented.

- The **Woodbury Creek** has exceptionally high values for its fisheries but has experienced substantial water quality impacts in recent years.

- The **Black Meadow Creek/Otterkill** was recently listed on the PWL as Threatened due to impacts from construction and habitat modification.

- Certain **headwaters of the Ramapo River** in Kiryas Joel and the Town of Monroe were documented as having increasingly high specific conductance levels when tested annually for the Stream Biomonitoring project.

- The **Dwaar Kill** was sampled for the Stream Biomonitoring project in 2006, 2007, and 2008, during which time water quality decreased dramatically. The high percentage of agricultural land in the watershed combined with the presence of hundreds of acres of County-owned reservoir lands create unique opportunities in this watershed.

- **Glenmere Lake** (Warwick & Chester) is a public supply reservoir also offering non-motorized recreation. Increasingly known for its habitat diversity, intrusive vegetation and overall eutrophication are increasing problems. The OCWA has committed support to complete a management plan building on prior research.

- **Greenwood Lake** is the only lake in Orange County to be on the DEC's list of Impaired Waterbodies (303[d] list) due to phosphorous loading. Year-round use of converted seasonal residences surrounding the Lake has degraded water quality primarily through septic system leachate.

- **Tomahawk Lake** (Blooming Grove) is a large lake with limited residential uses along its shores, but the significant swaths of undeveloped land in the watershed are currently unprotected and thus vulnerable to development. Water quality has not been tested by OCWA but is expected to be relatively good due to percent forest cover in the watershed.

- **Beaverdam Lake** (Blooming Grove/Cornwall/New Windsor) is surrounded by a large network of residences that use the Lake for recreation, making it an ideal candidate for a watershed or lake management plan that focuses on maintaining water quality, aesthetics, and recreational value.

- **Round Lake** (Monroe) is surrounded by residences on almost all sides and is used for recreation. A lake management or watershed plan would help to identify sources of contamination and solutions for minimizing point and non-point source pollution.

Research and Monitoring

The County, primarily through the OCWA, has performed a significant amount of research and monitoring within the County, much of which continues today. Activities include: comprehensive water quality sampling of streams; research into relationship of impervious surfaces with surface water quality degradation; assessment of aquifer resources and strategies for their protection; and evaluation of alternative wastewater treatment technologies. Such work has enhanced the understanding of the County's water resources and also led to official designations, such as listing on the Department of Environmental Conservation's Priority Waterbodies List. This Plan recommends that this type of work be continued in the future as it is essential to many of the County's water resource planning initiatives.

A broadly based stream flow monitoring network is an essential element of any watershed management program. The implementation of a strategically designed flow gauging network within the County would allow the County to utilize the National Weather Service's Advanced Hydrological Prediction System (AHPS) to assist in emergency management during extreme hydrological events such as floods, which are expected to become more common in the future due to the effects of climate change. Stream gauges are also an essential tool for determining the hydrologic budget of a watershed. Moreover, the long-term information generated by a gauging network is key to assessing the effectiveness of watershed management initiatives. As such, the Plan recommends that the Authority perform an evaluation of implementing enhancements to the existing United States Geological Survey stream gauging network currently established within the county

OCWA's corporate profile notes that "the Authority coordinates analysis of County water resources to provide a scientific basis for planning and decision-making." The Water Authority initiates and supports scientific research on water issues, commissioning research by academic scientists and consultants to provide a foundation for actions by the Authority and a means to provide guidance to the County and to County municipalities. OCWA serves as a repository for water related data developed over two decades.

The County maintains data and maps, primarily created by studies completed by the OCWA since the 1990's. These include:

- Four water quality studies:
  - September 1996 Water Quality Management Program Community Water Supply Report
  - October 2005 Impervious Cover, Road Density, Land Use and Population Density
  - October 2005 Water Quality Biomonitoring Project Phase 1 Report
  - February 2008 Water Quality Biomonitoring Project Summary report 2004-2006

- Five wastewater management studies:
  - October 2008 Decentralized Wastewater Management Study for Mountain Lodge Park
  - March 2008 Orange County Decentralized Wastewater Demonstration Project
  - November 2007 Decentralized Solutions to Wastewater Management in Greenwood Lake
  - November 2003 Decentralized Wastewater Treatment and Integrated Wastewater management
  - September 1991 Comprehensive Sewerage Study

- Five Groundwater resource studies:
  - May 1995 Ground-water resources of Orange County, New York
  - October 1995 Well-Head Protection Strategies Report
  - March 1996 Well-Head Protection Areas Delineation Options Report
  - January 1997 Well-Head Protection Areas for 13 Municipal Water Supplies
  - January 1999 Model Ground-Water Protection Plan

- Water Conservation Study:
  - November 1992 Water Conservation Primer

- Watershed Plan:
  - June 2008 Atlas of the Moodna Creek

- "Get Wet Program":
  - April 2008 Valley Central School District Groundwater Education Through Well Water Evaluation and Mapping
  - April 2009 Valley Central School District Groundwater Education Through Well Water Evaluation and Mapping

The text and figures of all of these studies currently reside on the OCWA website at: http://waterauthority.orangecountygov.com/ under the pull-down menu "documents".

Capital Projects and Potential Interconnections

Water supply system, capital projects including interconnections between municipalities are consistent with the founding principals of the 2003 Comprehensive Plan. The Comprehensive Plan notes that the County should foster cooperation with municipalities including interconnections among local systems where possible, particularly in "Growth Areas."

The County's water supply resources are widely distributed, with a decentralized, somewhat fractured ownership and maintenance responsibilities. The systems tend to be clustered around the existing cities and villages, and some are smaller systems that are marginally cost-effective. Additionally, water supply systems outside of the villages and cities are even smaller than the village systems. This distribution of systems coupled with the home rule legal framework of New York State has tended to discourage a regional approach to development of water supply resources in the County.

As a way to make the County's existing water resources available to more users, encourage consolidation of marginally efficient systems and to provide for options during drought periods, interconnections between existing water systems is recommended for consideration. Interconnections were conceptually identified where systems are close, where interconnection piping would support smart growth concepts and where adjoining communities could interconnect to satisfy a deficit in supply. Additionally, there was an effort to review needs around the County.

While specifically not on the scale of a County-wide water supply system, interconnections would help to establish shared or sub-regional supplies when and where a series of standards are met and can be documented. These standards include:

- ✓ Willing Water Supply Partners: Any project must be based on the willingness of partners, notably the municipalities directly involved.
- ✓ Need: Any project should be defined by an identifiable need – or set of needs – including, but not limited to, issues of demand versus capacity limits, existing source water quality or quantity challenges, existing infrastructure limitations, system redundancy or backup requirements, or safe yield analysis for predictable periods of stress or drought.
- ✓ Feasibility: Before final design, permitting and construction, any project must be screened for feasibility. Feasibility includes conceptual design and design options, cost-benefit analysis, environmental soundness, and administrative/ financial options.
- ✓ Priority Growth Areas: Established County policy sets preferred capital investment and infrastructure to municipal centers, communities, neighborhoods, or corridors within the Priority Growth Areas. These are described and mapped in the County Comprehensive Plan and include the historic cities and villages as well as a set of "local centers" including a set of hamlets such as Sugar Loaf, Bullville, or Fort Montgomery,

Additionally, any water supply capital project – notably system interconnections referenced here - must address direct or induced sewage treatment needs. The need for additional sewage treatment capacity that may be needed as a result of the implementation of any recommended interconnection will need to be assessed as part of the above referenced feasibility analysis.

As background and to help inform this Plan, a series of potential supply interconnection projects were conceptualized and outlined in earlier documentation presented to the public for comment. These projects were identified through the analysis of supply versus demand (See Table 2), through previous and on-going study recommendations (i.e. Mid County Study), or through recommendations from the work group mentioned in the Introduction to this Plan.

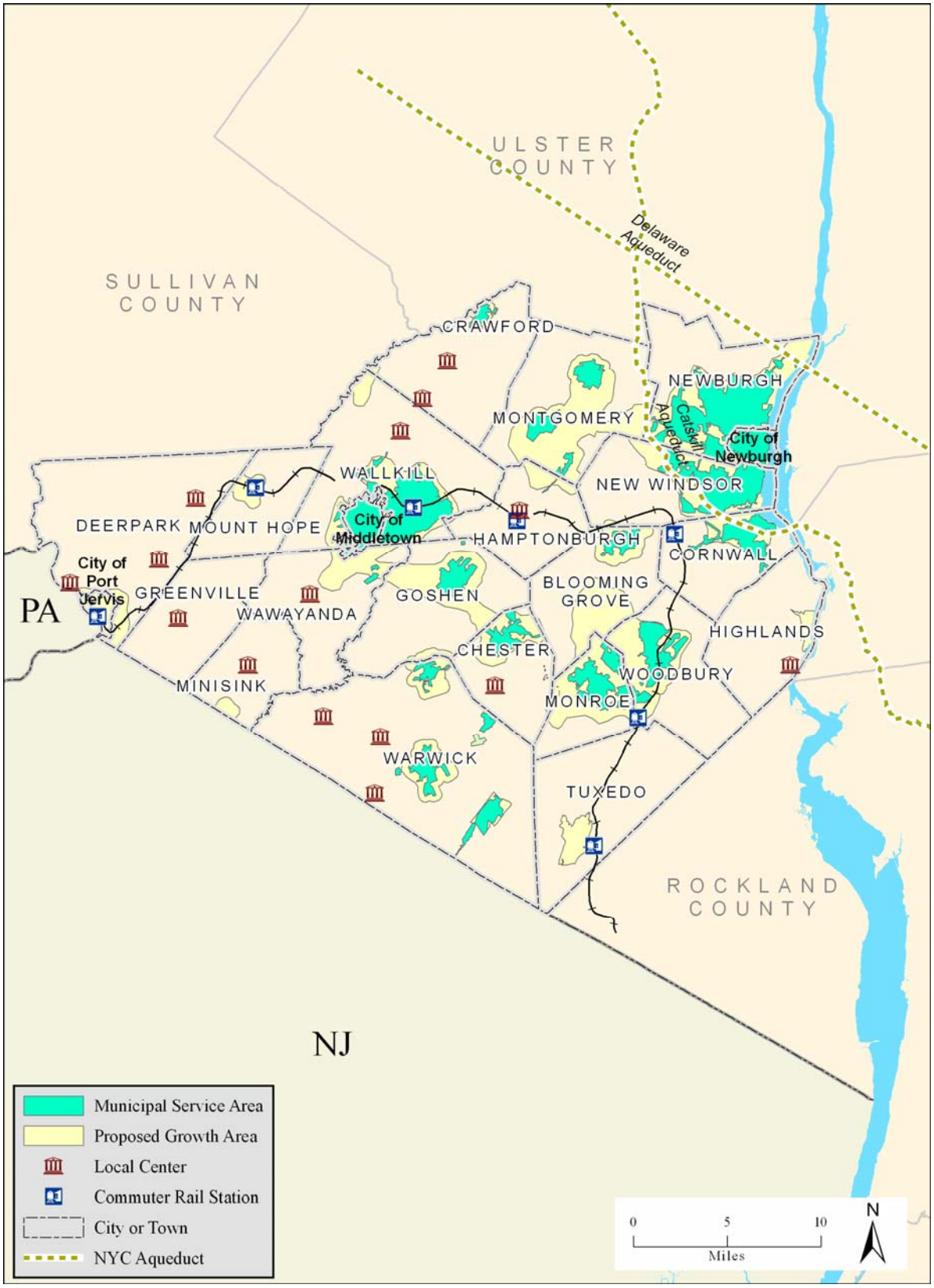


Figure 9. Overview of Priority Growth and Service Areas

Development of New Water Sources and the Enhancement of Existing Sources

From the project conceptualized as background for this Plan , a short list of infrastructure projects are worthy of further, active consideration given preliminary evidence that they meet the standards of: municipal support, need, feasibility, and priority growth area service. These are offered here for illustrative purposes, and they fall into two key areas:

- The modification and/or expansion of connections to the New York City Aqueduct System; and
- The development of new sources of supply from County-owned assets with the development of attendant conveyance infrastructure.

Modifications and/or Expansion of Connections to the New York City Aqueduct System

There are currently four “community” systems in Orange County that obtain water from the New York City Water Supply system via the Catskill Aqueduct, they include: Stewart Airport, City of Newburgh, Cornwall-on-Hudson, and the Town of New Windsor. Stewart Airport and the Town of New Windsor rely on the New York City System for 100% of their supply. In addition, a future connection to New York City’s Catskill Aqueduct that is currently under consideration involves the Village of Kiryas Joel. The Village has proposed building a 13-mile pipeline to convey up to 2 mgd from an aqueduct connection to be established in the Town of New Windsor.

The Plan presents a series of options describing an interconnection between the Catskill and Delaware Aqueducts where the two aqueducts come in close proximity of each other within the vicinity of Shaft 4 of the Delaware Aqueduct. Figure 10 illustrates one of the proposed options for connecting to the New York City System.

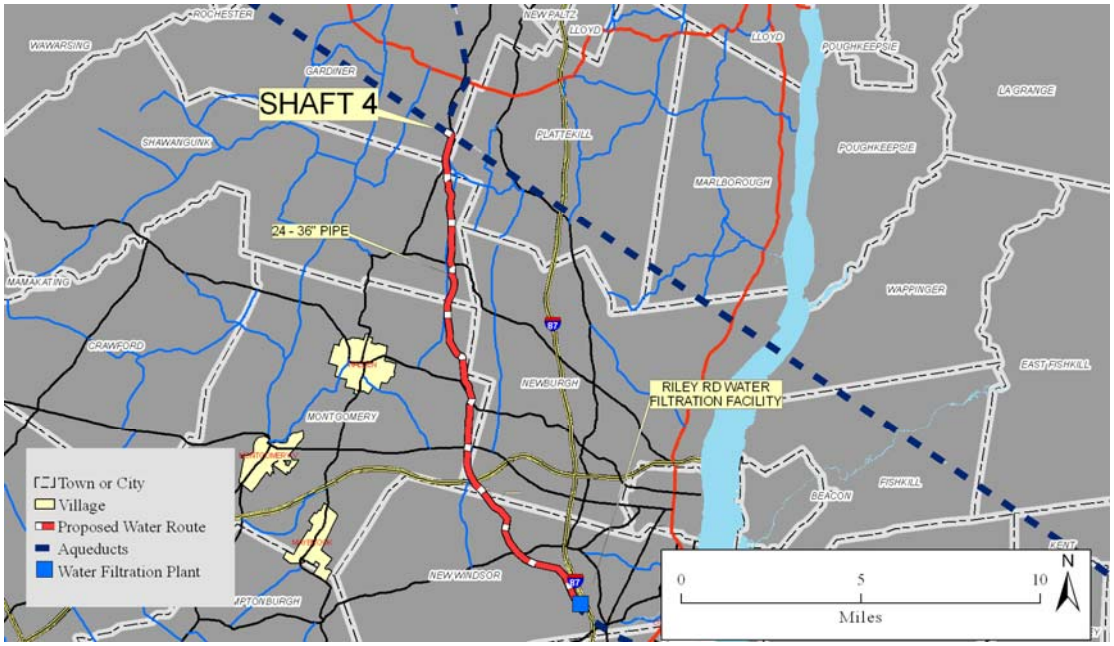


Figure 10. Catskill-Delaware Aqueduct Proposed Pipeline Extension to the Riley Road Water Treatment Plant

It is important to note that the City of New York is in the process of awarding a contract which contains a provision for making a connection at Shaft 4 of the Delaware Aqueduct to the nearby Catskill Aqueduct. This connection should have the ability to deliver 275 million gallons a day from the pressurized Delaware Aqueduct into the open channel flow of the Catskill Aqueduct. As of the writing of this plan, the contract has yet to be awarded, as such the OCWA should anticipate at least a 3- to 5-year period for New York City to design and construct such a connection. Nonetheless, the successful completion of such a connection could have a profound effect on water supply within the northeast section of the County in terms of water quality improvements and the expansion of supply. The County could help to facilitate cooperation, technical interchange, and the formulation of an intermunicipal agreement between New York City and the northeastern Orange County communities.

The Towns of Newburgh and New Windsor and the City of Newburgh contain approximately 71,000 people or 20% of the Orange County's population. These municipalities also utilize a daily average of roughly 9.5 mgd which is 25% of the County's daily water supply demand (see Table 5). The total population within these municipalities is expected to increase to 79,500 people by 2018 with a corresponding increase in water demand to 10.5 mgd.

Table 5. Population and Water Supply Statistics for the Towns of Newburgh and New Windsor and the City of Newburgh

Water District	Population Served	Demand (daily average, gpd)	Capacity (gpd)	Sources
Town of Newburgh	22,800	2,868,060	5,960,000	NYC Aqueduct (Delaware 3.86 mgd, 8.0 mgd capacity); Chadwick Lake (2.1 mgd)
City of Newburgh	28,000	3,870,569	9,500,000	Washington Lake, Brown's Pond, NYC Aqueduct (Catskill - 4.5 mgd allotment)
Town of New Windsor	20,276	2,833,054	3,500,000	NYC Aqueduct (Catskill); Brown's Pond;

As such, given that the northeast portion of the County has been classified as a "growth area" (as per the approval of the County Legislature as part of the 2003 Comprehensive Plan), and water use amongst these municipalities is already linked as a result of numerous interconnections, an inter-municipal or "regional approach" to water supply management is worthy of consideration as part of the Authority's water master planning process. Figure 11 depicts the configuration of the regional water supplies within the northeast section of the County. The need for this type of regional approach is further warranted by the following water supply issues confronting the northeast section of the County:

- All three municipalities are dependent on the New York City aqueduct system (which runs through the northeast section of the County, i.e., the Catskill or Delaware aqueducts), for either their entire supply, or a portion of their supply during certain parts of the year or during drought conditions. Both aqueducts have either planned or unplanned outages. These outages could result from water quality problems or from the need to perform repairs. An aqueduct shutdown can have a profound effect upon the water delivery to consumers in each of these water districts.

- Both the Towns of Newburgh and New Windsor are in need of new or upgraded water treatment facilities- the construction of one state-of-the-art regional water treatment facility would result in cost efficiencies, energy conservation, and overall water management flexibility.

- The lack of strategically designed interconnections amongst the three municipalities inhibits water movement and threatens overall reliability throughout the northeastern County region. A proposed interconnection between the Catskill and Delaware Aqueducts at Shaft 4 of the Delaware Aqueduct in Gardiner, New York will present a number of advantages to both the Orange County municipalities and the City of New York.

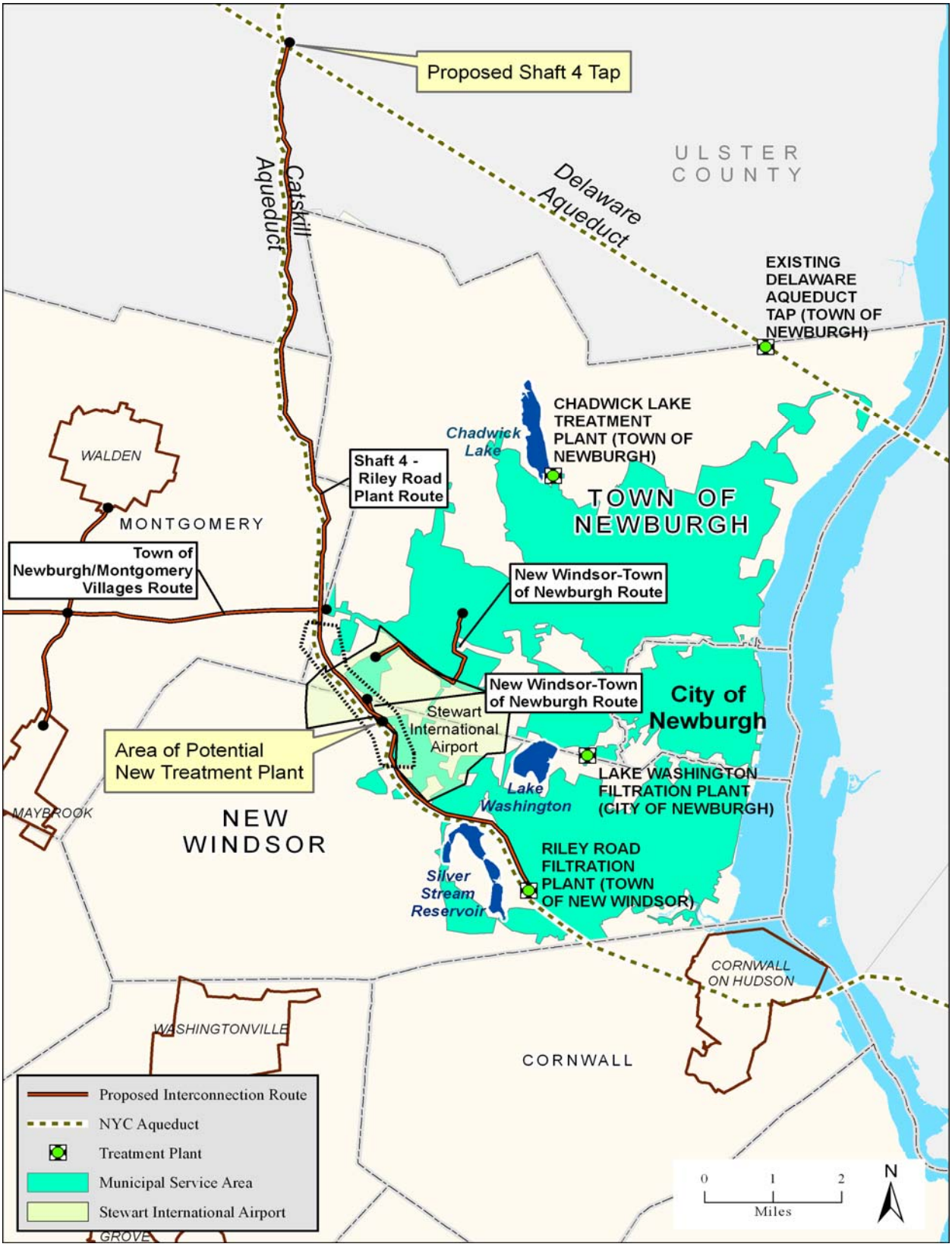


Figure 11. Water Supplies within the Northeast Section of Orange County

A regional system with built in reliability for the northeastern Orange County municipalities will benefit the City of New York by allowing for increased flexibility which will allow New York City to perform more frequent aqueduct shutdowns with minimal disruption to the communities that depend on the aqueduct system for their primary supply. It is important to note that a prolonged Delaware aqueduct outage is planned for 2012. It is recommended that a regional interconnection strategy be developed with the Authority playing a key role as both a facilitator between the County municipalities and the City of New York in terms of advancing the various aqueduct connections, and as a regional coordinator between each of the Orange County municipalities.

New Source Development

As part of this Plan, an assessment was completed - "Potential Impacts of Climate Change on Water Availability in Orange County, New York." The assessment indicated that "water supply management in the face of global climate change will become more challenging…..requiring water suppliers to adapt to a wider range of climatic conditions…..generally these adaptations may include institutional arrangements, changes in infrastructure, operational changes of existing infrastructure, development of additional sources, and demand management." In order to offset future high variability in precipitation events due to climate change, the County, and all water purveyors, will need to investigate the development of additional water supply storage areas to help address climate variability.

An example of such work is the Mid-County Water Supply Feasibility study and project, where a consortium of municipalities with the County are evaluating the potential for additional sources of supply through a variety of intermunicipal project options including, but not limited to groundwater production at two locations originally planned for reservoir development, i.e., the Indigot Basin, and the Dwaar Kill Basin. It is estimated that each of these locations is capable of producing enough water to supply 2000 homes respectively (production between 600 and 800 gpm at each location). In addition, the Indigot & Dwaar Kill sites may also provide viable locations for surface water supply storage reservoirs. Both sites were investigated previously as part of an earlier County Water Supply System Development Plan (1987) and the Mid-County Water Supply Study (2001). At that time the proposed Indigot Reservoir would have yielded 3 mgd and the Dwaar Kill Reservoir would have yielded 18 mgd. These sites could be re-evaluated for reservoirs of smaller capacity or different configuration as part of the groundwater development project discussed above. The additional storage, which could be interconnected to neighboring water districts, could help to mitigate the effects of more frequent droughts projected for the future as a result of climate change. Moreover, it is important that the potential of developing reservoirs at either one of these sites be factored into the conceptual design of any infrastructure associated with the groundwater projects in order to ensure an overall efficiency to the overall design.

Organizational and Financial Framework Supporting Plan Implementation

Through adoption of this Plan the County of Orange, with strategic support from municipalities, the Orange County Water Authority (OCWA) and others, will be able to clarify and enable the ways that County government can smartly and effectively function in the future to assure the availability of water in and throughout the County. This Plan assumes that success for such function must be based on collaboration between municipalities, water purveyors, and the County, including the OCWA – and such collaboration in many cases will likely require formal intermunicipal agreements whenever the County role exceeds simple facilitation, research, or matching finances.

This Plan recommends that the County consider employing a "hybrid" approach to project facilitation, implementation and/or leadership that consists of utilizing a combination of its current planning functions, technical expertise, and financing tools including a capital funded construction\operations function if and when capital projects have documented willing partners and are feasible. Such an approach will allow the County the flexibility to define its role or roles for individual initiatives proposed as part of this Plan but based on known partnerships. County leadership can also be important to take full advantage of available outside financing, including to assist the municipalities in need by applying and acquiring capital funds from various sources, notably Federal and New York State.

Over the longer term, any capital project including source water protection will require significant funding that many of the involved municipalities individually do not have available. The Plan recommends the County define its various technical assistance and financing tools to be smartly positioned given the critical importance of water supply to every community. This should include a thorough review and assessment of the Orange County Water Authority's organizational structure in order to assess its capability to support the various institutional agreements or projects – ranging from research and monitoring, source water protection, and watershed planning, to development of new water sources and advancement of feasible supply interconnections - to implement this Plan.

APPENDIX A
POPULATION PROJECTIONS & DEMAND FORECASTS

For the proposed Orange County Water Master Plan, 2008 was set as the starting point or baseline year, and the five-year planning horizon is 2013 and the ten-year planning horizon is 2018. Estimates of the future demand for water require estimation of the future population to be served. A *Per Capita Model* was used to forecast future demand; as the name of the model implies this analysis calculates the total production or consumption per capita for a historical period and applies the current year per capita consumption to the population projections for future periods. The study uses U.S. Census population data, U.S. Census population estimates, as well as estimates of population growth rates, to forecast populations at the three planning horizons. The estimated population growth rates were derived from population estimates provided by the Orange County Planning Department.[3] Forecast demand for water is expressed in terms of millions of gallons of water per day. The forecasts are based on a per resident (per capita) daily water use, which is expressed as gallons of water per capita per day. A fundamental assumption of this calculation is that the per capita demands will remain approximately constant over the next 10 years. Per capita demand was determined to be 118 gpd for water districts and 62 gpd for communities and individual wells. This per capita usage compared favorably with other communities on a regional basis.

Caution is an important guide when using projected data. Population projections have always been challenging – and previous projections for the Orange County region published over decades by various agencies have been notoriously inconsistent. As an example, archived research in the County Planning Department from 1970 estimated the 2010 population projection at 955,000 residents, more than double the current estimate. Any projections are also based on significant assumptions about status quo or changing conditions - market, zoning, demographics etc. Adjusting assumptions can notably change a projection. Projections also become less reliable in certain conditions. Estimating growth for small jurisdictions is one such condition, as is making any estimate out beyond more than a few years. Perhaps the greatest challenge to estimating future population growth in our region now is the highly unique and difficult economic conditions of the recent two years – in juxtaposition to the economically robust years preceding.

As such, this Plan is backed by research done – for transparency and comparison - using four (4) sets of population projections; the details of those projections are attached here. Each set has its own unique assumptions and its own limitations. The first set is based on the average growth rate for the recent ten (10) years since the 2000 Census, 2000-2009 as estimated and published by the U.S. Census Bureau. This projection factors in the historically strong growth years (some of the strongest in our history) and two years of softer growth. Unfortunately, several municipalities register overall negative growth on average in this set, making these estimates difficult to accept or use going forward. The second set is based on the most recent 2008-2009 US Census estimates and that one year average growth rate. This set assumes that the most recent and reliable year of information may be highly reflective – and conservative – in predicting growth in the upcoming years. The third set of projections is based on the New York Metropolitan Transportation Council model, which projects population based on historic building permit activity; the model was created prior to the incorporation of the villages of South Blooming Grove and Woodbury and does not have data for those places. The fourth set, researched in 2010, relies on all historic population data for Orange County including published 10-year US Census data going back, in some cases, more than 100 years. One key limitation of this projection is the lack of data for the village of Kiryas Joel, South Blooming Grove and Woodbury – all relatively new incorporated places.

See attached Worksheet

[3] Appendix A presents optional population projections completed in response to public comment on prior technical reports. This additional information is provided to show a range of projections based on varying assumptions.

Geographic Area	*Census Bureau Population Estimates*			*Projected population based on 2000-2009 average gross annual growth rate*				*Projected population based on 2008-2009 gross growth rate*				*Projected population based on OCTC Calculations of Historic Average Building Permit Activity*				*Projected population based on average population growth since 1894*			
	Estimates Base April 1, 2000	Estimate July 1, 2008	Estimate July 1, 2009	Rate	Projections July 1, 2013	July 1, 2018	July 1, 2020	Rate	Projections July 1, 2013	July 1, 2018	July 1, 2020	Rate	Projections July 1, 2013	July 1, 2018	July 1, 2020	Rate	Projections July 1, 2013	July 1, 2018	July 1, 2020
Orange County	**341,371**	**379,520**	**383,532**	**1.24%**	**402,833**	**428,331**	**438,977**	**1.06%**	**400,009**	**421,603**	**430,564**	**1.07%**	**400,213**	**422,087**	**431,168**	**1.24%**	**402,912**	**428,520**	**439,213**
Blooming Grove town	17,356	18,421	18,444	0.63%	18,911	19,511	19,756	0.12%	18,536	18,652	18,699	0.88%	19,102	19,957	20,310	2.58%	20,422	23,196	24,409
South Blooming Grove village	3,414	3,420	3,424	0.03%	3,428	3,433	3,435	0.12%	3,440	3,460	3,468	X	X	X	X	X	X	X	X
Washingtonville village	5,851	6,158	6,164	0.53%	6,297	6,467	6,537	0.10%	6,188	6,218	6,230	0.93%	6,397	6,700	6,825	4.29%	7,292	8,996	9,784
Chester town	12,140	13,466	13,534	1.15%	14,166	14,999	15,345	0.50%	13,809	14,162	14,305	1.47%	14,348	15,434	15,891	1.86%	14,569	15,976	16,575
Chester village	3,494	3,577	3,580	0.25%	3,615	3,660	3,678	0.08%	3,592	3,607	3,613	0.78%	3,693	3,839	3,899	2.21%	3,907	4,358	4,553
Cornwall town	12,310	12,829	12,855	0.44%	13,084	13,376	13,495	0.20%	12,960	13,091	13,145	0.90%	13,324	13,935	14,186	1.26%	13,515	14,388	14,753
Cornwall-on-Hudson village	3,058	3,067	3,072	0.05%	3,078	3,085	3,088	0.16%	3,092	3,117	3,128	0.32%	3,112	3,162	3,182	0.80%	3,171	3,300	3,353
Crawford town	7,875	9,402	9,438	1.98%	10,210	11,264	11,716	0.38%	9,583	9,768	9,843	1.80%	10,136	11,082	11,484	1.63%	10,069	10,916	11,275
Deerpark town	7,858	8,497	8,524	0.85%	8,817	9,197	9,353	0.32%	8,633	8,771	8,827	0.94%	8,849	9,273	9,448	0.77%	8,790	9,133	9,274
Goshen town	12,913	13,815	13,879	0.75%	14,299	14,842	15,065	0.46%	14,138	14,469	14,603	1.29%	14,609	15,576	15,981	1.03%	14,460	15,220	15,535
Goshen village	5,680	5,586	5,623	-0.10%	5,600	5,572	5,561	0.66%	5,573	5,967	6,047	0.19%	5,666	5,720	5,742	1.08%	5,870	6,194	6,328
Greenville town	3,800	4,524	4,553	1.98%	4,925	5,432	5,650	0.64%	4,671	4,823	4,885	1.81%	4,892	5,351	5,546	1.79%	4,888	5,341	5,534
Hamptonburgh town	4,686	5,666	5,705	2.17%	6,218	6,924	7,228	0.69%	5,864	6,068	6,152	1.76%	6,117	6,675	6,912	1.53%	6,062	6,540	6,742
Highlands town	12,482	12,934	12,947	0.37%	13,141	13,388	13,488	0.10%	12,999	13,065	13,091	0.19%	13,046	13,170	13,220	1.38%	13,677	14,647	15,054
Highland Falls village	3,678	3,712	3,714	0.10%	3,729	3,747	3,754	0.05%	3,722	3,732	3,736	0.18%	3,741	3,775	3,788	0.02%	3,717	3,721	3,722
Middletown city	*25,325*	*25,887*	*25,936*	*0.24%*	*26,187*	*26,505*	*26,633*	*0.19%*	*26,133*	*26,381*	*26,481*	*0.33%*	*26,280*	*26,717*	*26,893*	0.79%	26,765	27,839	28,281
Minisink town	3,585	4,481	4,510	2.58%	4,994	5,672	5,969	0.65%	4,628	4,780	4,842	1.90%	4,863	5,342	5,547	1.02%	4,697	4,941	5,043
Unionville village	536	564	566	0.56%	579	595	602	0.35%	574	584	588	0.53%	578	594	600	0.59%	579	597	604
Monroe town	31,407	42,233	44,195	4.07%	51,845	63,295	68,554	4.65%	52,998	66,506	72,829	1.55%	46,999	50,757	52,342	3.26%	50,246	58,988	62,896
Harriman village (MOT port.)*	1,660	1,653	1,706	0.28%	1,725	1,749	1,759	3.21%	1,936	2,266	2,414	0.11%	1,714	1,723	1,727	3.41%	1,951	2,307	2,467
Kiryas Joel village	13,138	21,646	23,414	7.82%	31,645	46,113	53,609	8.17%	32,053	47,463	55,533	3.10%	26,455	30,818	32,758	X	X	X	X
Monroe village	7,780	8,171	8,224	0.57%	8,413	8,656	8,755	0.65%	8,439	8,717	8,830	0.71%	8,460	8,765	8,890	3.24%	9,343	10,958	11,679
Montgomery town	20,891	24,395	24,602	1.78%	26,397	28,827	29,860	0.85%	25,448	26,546	26,998	1.29%	25,896	27,610	28,327	1.39%	25,999	27,856	28,636
Maybrook village	3,084	3,999	4,002	2.98%	4,500	5,211	5,526	0.08%	4,014	4,029	4,035	1.29%	4,213	4,491	4,608	1.79%	4,296	4,695	4,864
Montgomery village	3,636	4,722	4,890	3.45%	5,600	6,635	7,101	3.56%	5,624	6,698	7,183	1.66%	5,223	5,671	5,861	2.81%	5,463	6,275	6,633
Walden village	6,289	6,981	6,998	1.13%	7,319	7,741	7,916	0.24%	7,066	7,153	7,188	1.07%	7,302	7,701	7,867	0.64%	7,179	7,412	7,507
Mount Hope town	6,639	7,439	7,534	1.35%	7,949	8,499	8,730	1.28%	7,926	8,445	8,663	1.17%	7,893	8,365	8,562	1.74%	8,072	8,799	9,108
Otisville village	989	1,086	1,090	1.02%	1,135	1,194	1,219	0.37%	1,106	1,127	1,135	0.94%	1,132	1,186	1,208	0.20%	1,099	1,110	1,114
Newburgh city	*28,259*	*28,152*	*28,173*	*-0.03%*	*28,139*	*28,096*	*28,079*	*0.07%*	*28,257*	*28,363*	*28,405*	*0.09%*	*28,275*	*28,402*	*28,453*	*0.17%*	*28,365*	*28,607*	*28,704*
Newburgh town	27,568	30,980	31,265	1.34%	32,976	35,247	36,199	0.92%	32,431	33,951	34,578	1.21%	32,806	34,839	35,687	2.27%	34,202	38,264	40,021
New Windsor town	22,861	25,175	25,254	1.02%	26,328	27,735	28,319	0.31%	25,572	25,976	26,140	1.00%	26,279	27,620	28,175	2.79%	28,193	32,351	34,181
Port Jervis city	*8,860*	*9,126*	*9,136*	*0.31%*	*9,250*	*9,395*	*9,454*	*0.11%*	*9,176*	*9,226*	*9,247*	*0.19%*	*9,206*	*9,293*	*9,329*	*0.35%*	*9,265*	*9,428*	*9,494*
Tuxedo town	3,334	3,673	3,683	1.05%	3,840	4,045	4,130	0.27%	3,723	3,774	3,795	1.47%	3,904	4,200	4,324	0.69%	3,786	3,918	3,972
Tuxedo Park village	731	721	722	-0.12%	718	714	712	0.14%	726	731	733	0.39%	733	748	754	0.17%	727	733	736
Wallkill town	24,722	27,436	27,926	1.30%	29,402	31,357	32,175	1.79%	29,275	32,749	33,929	0.95%	29,002	30,406	30,987	2.48%	30,801	34,815	36,563
Warwick town	30,764	32,794	33,080	0.75%	34,087	35,390	35,925	0.87%	34,249	35,769	36,396	1.23%	34,738	36,927	37,841	1.68%	35,360	38,431	39,733
Florida village	2,589	2,816	2,820	0.89%	2,922	3,055	3,109	0.14%	2,836	2,856	2,864	0.92%	2,925	3,062	3,119	1.36%	2,977	3,185	3,272
Greenwood Lake village	3,411	3,417	3,419	0.02%	3,422	3,426	3,428	0.06%	3,427	3,437	3,441	0.30%	3,460	3,512	3,534	4.14%	4,021	4,926	5,342
Warwick village	6,404	6,715	6,942	0.84%	7,156	7,462	7,588	3.38%	7,711	9,105	9,731	0.60%	7,105	7,321	7,409	1.72%	7,345	7,999	8,276
Wawayanda town	6,273	7,440	7,506	1.97%	8,097	8,924	9,279	0.89%	7,842	8,196	8,343	1.45%	7,974	8,570	8,820	1.42%	7,967	8,549	8,794
Woodbury town	9,460	10,755	10,853	1.47%	11,491	12,363	12,730	0.91%	11,302	11,826	12,043	1.43%	11,477	12,321	12,676	2.00%	11,672	12,866	13,407
Harriman village (WBT port.)*	608	607	626	0.30%	631	641	644	3.13%	686	801	851	0.11%	628	631	633	3.41%	692	818	875
Woodbury village	8,855	8,911	8,976	0.14%	9,025	9,087	9,112	0.73%	9,241	9,583	9,723	X	X	X	X	X	X	X	X

* = the Village of Harriman is the only village in the County with a substantial portion of its land in more than one town. The Census Bureau apportioned the residents of Harriman to the Town in which they reside, and so the projected population for the Village is also apportioned by Town.

Note: OCTC projections were completed in 2006 before the Villages of South Blooming Grove and Woodbury were incorporated.

Note: Projections used historic populations since 1894 to determine average historic growth rate; sufficient data does not exist for Kiryas Joel, South Blooming Grove and Woodbury