1.16 WMA 3 - WATER SUPPLY AVAILABILITY

Introduction

The hydrologic cycle (see Figure 1.16.1) describes the natural movement of water from the atmosphere to the Earth's surface and into surface and ground water systems. The simplified “natural” water budget equation can be written as:

$P = I + ET + R$ where;

P = precipitation
I = infiltration below root level
ET = evapotranspiration
R= direct surface runoff

Managing water supply availability on a watershed basis requires that the water budget equation is expressed to account in more detail for "artificial" or man-made withdrawals of surface and ground water from the natural system, changes in storage of surface and groundwater reservoirs, and also the disposition of wastewater (effluent) (see Figure 1.16.2). Simplified, on an annualized basis, the modified water budget can be written as:

$$P + I_{GW} + I_{IW} + I_{SS} + I_{GS} = ET + O_{SW} + O_{GW} + O_C + O_D + O_{SS} + O_{GS}$$ where;

P = precipitation
I_{GW} = regional groundwater flow into the watershed
I_{IW} = imported water supply
I_{SS} = decreased surface water storage, i.e., lowering reservoirs, draining wetlands.
I_{GS} = decreased groundwater storage by depleting or mining groundwater

ET = evaporation from all surfaces plus plant transpiration
O_{SW} = total streamflow leaving the watershed
O_{GW} = groundwater flow out of the watershed
O_C = within watershed consumptive uses (excluding ET)
O_D = depletive use (transfer out of the watershed)
O_{SS} = increased surface water storage, i.e., raising reservoir levels, flooding wetlands
O_{GS} = increased groundwater storage, i.e., artificial recharge, recharge enhancement

The purpose of this task is to characterize the water supply-side artificial modifications to the water budget to characterize water supply availability related to the Watershed Management Area (WMA). The characterization and assessment contained herein provide baseline information and references on water supply availability for ongoing watershed planning. This information is relevant to the future development of the water budget for the Passaic Basin, to be undertaken by NJDEP.

Background

To ensure that New Jersey would be able to meet projected future water needs, the Water Supply Management Act and the Water Supply Bond Act (Bond Fund) were approved in 1981. These acts provided a management framework and a $350 million source of funding to evaluate existing water supply and plan accordingly for future growth. In 1982, NJDEP adopted the first New Jersey Statewide Water Supply Master Plan (NJSWSP), as required by the Water Supply Management Act. In 1996, the NJSWSP was completely revised and updated to replace the 1982 Plan.

To improve the NJDEP's ability to characterize and assess water supply availability, the 1996 Plan divides the state into twenty-three Regional Water Resource Planning Areas based upon watersheds. These watershed-planning areas are somewhat different in size and delineation than the current WMA's adopted by the State.

The NJSWSP and supporting documentation is a statewide characterization and assessment of water supply availability, and a substantial amount of the information in this report is drawn from these documents.

Concepts

There are several concepts related to water supply availability that will be presented throughout this report. An explanation of these concepts and the definitions of frequently used terms are as follows:

- **Diversion –** is the removal of either groundwater or surface water from the natural hydrologic cycle. The NJDEP Bureau of Water Allocation is responsible for granting the privilege to a person to divert over 100,000 gallons per day (gpd) of water for any purpose other than agricultural or horticultural use. The NJDEP maintains extensive databases on water usage. The ability to use full diversions is typically related to satisfying other criteria (e.g., surface water diversion can be limited based upon requirements to maintain a certain stream flow past the diversion – **passing flow**).
- **Depletive Water Use –** "surface or ground water withdrawn from a selected watershed and discharged in another watershed. Also referred by others as **out-of-basin transfers** (or inter-basin transfers) and wastewater and water exportations, depletive use has become a significant issue in New Jersey over the last several years as competition for water has increased."[1]
- **Safe Yield From Surface Sources –** means the yield maintainable by a water system continuously throughout a repetition of the most severe drought of record, after compliance with requirements of maintaining minimum passing flows, assuming no significant changes in upstream or upbasin depletive withdrawals.
- **Minimum Passing Flow –** surface water diversions are limited by requirements to maintain a certain stream flow, or passing flow, downstream of the water intake. The New Jersey Department's Bureau of Water Allocation has set these passing flow requirements. Where not specified, statutory minimum passing flow

is calculated as 125,000 gallons per square mile of contributing upstream unappropriated watershed for public water supplies.

- **Dependable Yield of Subsurface Sources –** means that yield of water from a subsurface source or sources available continuously during projected future conditions, including a repetition of the most severe drought of record, without creating undesirable effects. Undesirable effects may include adverse impact on other wells of a depth of 50 feet or more, increased risk of introducing or spreading saline water or polluted water in the aquifer or unacceptable reduction of surface flow of streams. Estimating dependable yield of subsurface sources is a complex undertaking, and for planning purposes is typically established as a percentage of the estimated groundwater recharge (i.e., natural or artificial recharge).

Characterization of Water Supply Availability in WMA 3

Types of Diversions and Diversion Summary

The NJDEP Bureau of Water Allocation is responsible for approving requested diversions, and maintains an extensive database of existing withdrawals of water from natural sources. This effort requires determining that new diversions do not adversely impact existing users or adversely impact the existing ecosystem.

The New Jersey Geological Survey (NJGS) has extensively researched the Bureau of Water Allocation's database to develop summaries of water diversion based upon selected use classifications[2]. The NJGS has indicated that there are known errors of assigning diversions to specific watersheds based upon: inaccurate location information; and combined withdrawals from different geographic locations provided as a single location. However, for general planning purposes, the diversion summary is very useful in assessing how water is used within the watershed.

The general use classifications are: public water supply; agriculture; irrigation; power generation; mining; industrial; and commercial. Table 1.16.1 (see following pages; third page of table has use codes) is a summary of specific water users and total water used, and is given as the average daily withdrawal in millions of gallons per year (MGY) in the time period between 1990 and 2000. Table 1.16.2 indicates the percentage of water withdrawn by use group (New Jersey only):

Table 1.16.2
Summary of Average Annual Water Withdrawals 1990-2000 by Use Group
(WMA 3 - New Jersey Only)

WMA 3: Use Groups	Amount (MGY)	Percent
Power Generation	0	0
Mining	0	0
Industrial	28	0.03
Commercial	5	0.005
Public Supply	88,758	99.9
Irrigation	31	0.03
Agricultural	10	001
Total	**88,832**	

Table 1.16.2 indicates that over 99 percent of the water withdrawn within WMA 3 was used for public supply purposes. Public water supply withdrawals include water that may ultimately be sold to industrial, commercial and other customers of water purveyors. The listed total withdrawals include water that is pumped to Wanaque Reservoir and/or Oradell Reservoir in WMA 5 for storage and later withdrawal under separate permits. In addition, diversions under permit 5099 (Public Use, Passaic Valley Water Commission) including pumping to Point View Reservoir, pumping from Two Bridges Pump Station to Little Falls, and diversion at Little Falls (WMA 6) are reported in records included in WMA 6.

On Table 1.16.1 the records indicate that private home wells have used an average of 1218 MGY between 1990 and 2000. The private home well records was compiled by NJGS using 1990 Census Data that includes information on the number of persons with private water system. A usage of 75 gpd was applied per person and the value was extrapolated proportionately based upon current populations.

Significant portions of WMA 3 watersheds are located within the State of New York (approximately 37 percent). The diversion information for the State of New York was not available in a GIS format. Of particular importance to the future calculation of the water budget of WMA 3 will be determination of the extent of depletive use of water in the New York State portion of the drainage area contributing to WMA 3.

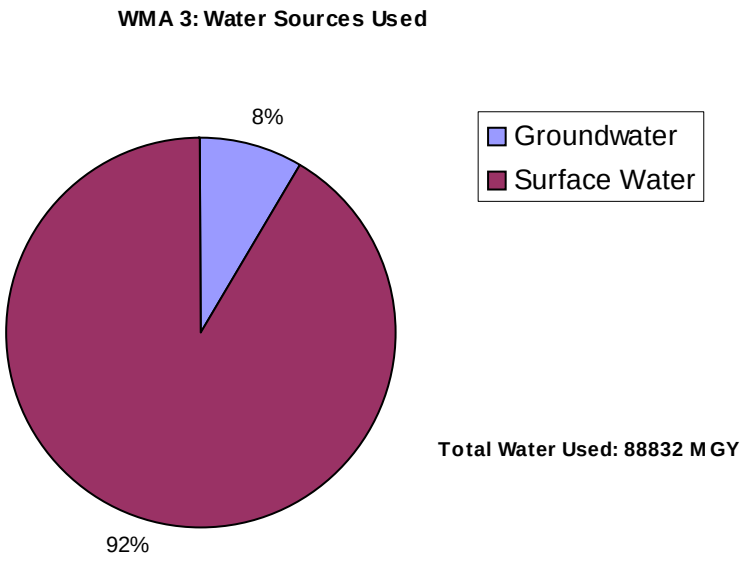
The primary potable water users within the New York portion of WMA 3 with Orange County are: Town of Tuxedo, Village of Tuxedo Park, Town of Warwick, Town of Monroe, Village of Monroe, Village of Kiryas Joel, Town of Woodbury, and Village of Harriman. Regional groundwater studies from the Orange County Water Authority were available for Town of Warwick, Town of Woodbury, Village of Tuxedo Park, Village of Harriman, Town of Monroe, Village of Monroe, and Village of Kiryas Joel. Summary information from these studies is provided in Tables 1.16.3 through 1.16.9 taken from the original studies. The tables indicate whether the source of supply is groundwater (G) or surface water (S) and provides summary information on the source and demands. The

tables indicate that these water systems have maximum demands that vary from 0.011 MGD to 1.1 MGD.

In Rockland County, the Town of Ramapo and the Town of Haverstraw have portions of their municipalities within WMA 3. In Rockland County, water supply is from the United Water Company. United Water New York draws about 80% of its water supply from wells throughout Rockland County. United Water also draws water from two surface sources -- Lake DeForest in Clarkstown and Cedar Pond Brook in Stony Point. In addition, it is estimated that there are an abundance of private well systems supplying residents and businesses within these New York municipalities.

Comparison of Ground Water and Surface Water Diversion

The following chart provides a comparison of ground water and surface water diversions, on average for the period between 1990 and 2000 (New Jersey only):



Potable Water Users and Sources

Diversion of raw water for potable water use is a large component of the water budget within a watershed, and therefore, is an integral consideration in watershed planning and management. Management of potable water use has additional complexities related to impacts of inter-basin transfers and depletive use on watersheds, diversion rights, and impacts on other water users. The following information characterizes these users and their sources for both surface water and ground water diversions. The majority of information on water sources was taken from the 1996 New Jersey Statewide Water Supply Plan (NJSWSP) – Task 2 Report "Water Supply Baseline Data Development and Analyses", and also from available Water Allocation Permits.

Surface Water Sources

WMA 3 is comprised of the following major river basins:

Subwatershed (Including NYS)	Area (sq. miles)
Wanaque River	115
Pequannock River	87
Ramapo River	152
Pompton River	24
Totals	378

North Jersey District Water Supply Commission

The North Jersey District Water Supply Commission (NJDWSC) operates Wanaque Reservoir (29.6 billion gallons) above the town of Pompton Lakes on the Wanaque River and the Wanaque South Project, including Monksville Reservoir, Wanaque South Pump Station and the Ramapo Pump Station. NJDWSC was created in 1916 by enactment of the State Legislature to help develop and operate water supply systems in New Jersey's 11 northernmost counties. The NJDWSC serves as agent or trustee representing the joint interests of municipalities that contract with the Commission to share in various water projects implemented by the Commission.

Beginning in 1920, the Wanaque North Project includes the original construction of Wanaque Reservoir and various improvements to raise the reservoir level. The NJDWSC, per Allocation Permit No. 5329, can divert:

> "the entire runoff of the watersheds, provided, however, that at all times the flow of the Wanaque River below the Raymond Dam shall be maintained at an amount not less than seven million gallons per day (10.83 cfs) plus such quantity of water up to three million gallons per day (4.64 cfs) is discharged from storage in Greenwood Lake for use other than the use of the NJDWSC, an amount equal to such draft from Greenwood Lake shall be discharged from the Wanaque Reservoir, and, in addition thereto, such amount as shall be required to make the total discharge from the reservoir at least ten million gallons per day (15.47 cfs)."

The Wanaque North Project also includes the Ramapo Pump Station (constructed in 1953 @ 100 MGD) that transfers raw water from the Ramapo River at Pompton Lake to the Wanaque Reservoir. As part of the Wanaque South project the pumping capacity and diversion limits were increased. There are two permits with diversion limits as follows:

Diversion Limits Ramapo River at Ramapo Pump Station

Permit No.	Permit Holder	Monthly Average Rate	Monthly Limit
5273	United Water NJ	25 MGD	775 MG
5274	NJDWSC	125 MGD	3875 MG

There is a 40 MGD passing flow requirement and other water quality constraints. No pumping is allowed between July 1st and August 31st.

The Wanaque South Project includes the construction of the Monksville Dam and Reservoir (7 billion gallons) in 1987. Integral to the Wanaque South Project was the construction of the Wanaque South Pump Station , which transfers water from the confluence of the Pompton and Passaic Rivers (Two Bridges) to the Wanaque Reservoir and/or to the Oradell Reservoir in WMA 5. There are two permits with diversion limits as follows:

Diversion Limits Pompton River at Wanaque South Pump Station (Two Bridges)

Permit No.	Permit Holder	Monthly Average Rate	Monthly Limit
5090	United Water	125 MGD	3875 MG
5094	NJDWSC	125 MGD	3875 MG

There is a 92.6 MGD passing flow requirement at the Wanaque South Pump Station. (Two Bridges site) and detailed water quality constraints. However, NJDWSC is allowed to pump the differential of flows between actual diversion by PVWC (total of diversion at Two Bridges and Little Falls (WMA 4)) and 75 MGD after passing 17.6 MGD. No pumping by NJDWSC is allowed between July 1st and August 31st. In addition, PVWC, as part of its Permit No. 5099 can divert up to 75 MGD at the Two Bridges site. The PVWC permit allows year round pumping at the Two Bridges site as long as certain downstream water quality criteria are maintained.

It is noted that the NJSWSP indicates that the safe yield from the Wanaque South Project is 79.0 MGD, and the safe yield from the Wanaque North Project is 94.0 MGD. According to the NJSWSP the total safe yield of the system, as currently constructed, is therefore 173 MGD.

In addition, the 173 MGD is currently completely allocated to the contracting municipalities as indicated in Table 1.16.10. Of this total, 133.5 MGD of finished water can be provided on an average daily basis by NJDWSC to contracting members (per their allotments) and up to the remaining 39.5 MGD can be provided on an average daily basis by NJDWSC to United Water NJ as raw water transferred to Oradell Reservoir.

Table 1.16.10
NJDWSC Contracting Municipalities and Allotments

Municipality	Wanaque North		Wanaque South	
	% Share	Allotment (MGD)	% Share	Allotment (MGD)
Newark	40.50	38.070	14.342	11.33
Paterson[a]	20.00	18.800	n/a	n/a
Kearny	12.00	11.280	2.177	1.72
Bayonne	n/a	n/a	13.291	10.50
Passaic[a]	11.00	10.340	n/a	n/a
Wayne	n/a	n/a	11.392	9.00
Bloomfield	4.00	3.760	3.481	2.75
Clifton[a]	6.75	6.345	n/a	n/a
Montclair	5.00	4.700	n/a	n/a
Nutley	n/a	n/a	3.798	3.00
Cedar Grove	n/a	n/a	1.519	1.20
Glen Ridge	0.75	0.705	n/a	n/a
United Water[b]	n/a	n/a	50.00	39.50
Total	***100***	***94***	***100***	***79***

[a] Represented by Passaic Valley Water Commission
[b] Receives untreated water through aqueduct to Oradell Reservoir
Note: From Annual Report of the Consulting Engineer, 2002 (Killam Associates)

City of Newark

The City of Newark owns a water supply system in northern New Jersey referred to as the Pequannock system that consists of reservoirs, watershed lands, and a water treatment plant. There are five reservoirs located on the Pequannock River and its tributaries, located in Passaic, Morris, and Sussex Counties. The Pequannock River flows to the Pompton River, which in turn joins the Passaic River. The Pequannock River is considered to be part of the Upper Passaic Basin. The reservoirs in the Pequannock system have a total useable storage of about 14 billion gallons. The current safe yield rating of the reservoir system is approximately 49 MGD.

The total drainage area (i.e. watershed) of the reservoirs is approximately 61 square miles, and encompasses portions of Passaic, Morris, and Sussex Counties. The City of Newark owns in excess of 80 percent of the lands in the watershed.

All water from the reservoirs eventually flows into the Charlotteburg Reservoir. The Pequannock Water Treatment Plant intake is at the Charlotteburg Dam. The plant itself is located on Route 23 in West Milford. The Pequannock Water Treatment Plant employs a direct filtration process utilizing high rate coagulation, filtration, and chemical feed processes.

The City of Newark supplies water on a wholesale basis to several other water systems. These customers are also referred to as "out of town" or "suburban" customers. The following municipalities receive all of their normal daily supply from Newark:

Township of Belleville
Township of Bloomfield

The following municipality receives supply from Newark on a daily basis that amounts to a substantial portion of their total daily supply:

City of Elizabeth

The following municipalities receive only a very small portion of their normal daily supply from Newark.

Township of Wayne
Township of Pequannock
City of East Orange
Township of Nutley

Newark also sells water on a daily basis to Elizabethtown Water Company to serve a very small portion of their service area, in Hillside, that cannot receive adequate pressure from Elizabethtown's adjacent distribution system zone. The Essex County Utilities Authority is also a wholesale customer, and buys water that is used for generation of steam at a power plant at the Essex County Hospital Center in Cedar Grove.

Passaic Valley Water Commission

PVWC owns and operates the Point View Reservoir, which is a 2.8 BG raw water reservoir that can be filled from the Pompton River, via a pump station, at a monthly average rate of 50 MGD (per Allocation Permit 5099). PVWC can fill this reservoir with the restriction of an 88 MGD passing flow in the river. PVWC can then release water from the reservoir back into the Pompton River during low flow conditions for use at the Little Falls Water Treatment Plant located in Totowa on the Passaic River. In addition, during July and August when the Wanaque South Aqueduct is not utilized by NJDWSC, PVWC can convey water from Point View Reservoir directly to the Two Bridges site, for transfer to Little Falls.

PVWC can pump water from the Wanaque South Pump Station (Two Bridges) at the confluence of the Pompton and Passaic River, via a pipeline, to the head of the Little Falls Treatment Plant. PVWC can divert a maximum daily rate of 75 MGD or a maximum of 2,325 million gallons during any month at this location. Per the water allocation permit, pumping at the Two Bridges location is restricted by a passing flow requirement of 17.6 MGD and additional water quality parameters.

Borough of Butler

The Borough of Butler owns and operates the Butler Reservoir (also known as the Kakeout Reservoir) located in Kinnelon Borough on Stone House Brook. Water is diverted and treated for use by Butler with an average diversion of approximately 0.7 MGD.

Evaluation of Surface Water Use for Potable Supply

Table 1.16.11 provides a summary of important statistical information for the various surface water users in WMA 3:

Table 1.16.11
Summary Statistics on Major Surface Water Diversions

Purveyor	Location	Safe Yield (MGD)	Allocation (MGD)	Diversion Avg. 1990-1999 (MGD)	Diversion Avg 1999 (MGD)	Reservoir Capacity (BG)	Interbasin Transfer (avg 90-99) (MGD)	Depletive Use (avg 90-99) (MGD)
PVWC	Pompton River (Point View Reservoir) (Permit 5099)	na	50	na	na	2.8	na	na
PVWC	Pompton River (Two Bridges) (Permit 5099)	na	75 (1)	47 (1)	47(1)	na	see note 1	see note 1
NJDWSC	Wanaque River (Permit 5329)	(2)	(2)	120	121 (4)	37(3)	-120	-120
NJDWSC and UNWNJ	Ramapo River (Permit 5274 and 5273)	(5)	(5)	16	24	na	0	0
NJDWSC and UWNJ	Pompton River (Two Bridges) (Permit 5094 and 5090)	(5)	(5)	35	53	na	na	na
City of Newark	Pequannock Watershed	49	49	47	47	14	-47	-47

na - not applicable/available
(1) Allocation Permit 5099 provides allocation that is shared between Pompton River at Two Bridges (Wanaque South Pump Station) in WMA 3 and the Passaic River intake (Little Falls) in WMA 4. Available information does not provide the diversion from Pompton River separately from Little Falls.
(2) From NJSWSP, total safe yield is 173 MGD. Allocation is based upon safe yield.
(3) Combined total of Wanaque and Monksville Reservoirs
(4) NJDWSC diversion 107.6 MGD; UWNJ diversion 13.4 MGD
(5) Water from these sources is pumped back to the Wanaque River or to Oradell Reservoir in WMA 5.
(6) Not listed is the Borough of Butler Kakeout Reservoir which is provides approximately 0.7 MGD to the surrounding community.

Review of Passing Flow Requirements

Minimum passing flow requirements for water purveyors are established in NJAC 7:19-4.6 (e), and also in the individual allocation permits. As noted in the following tables there are some discrepancies:

Table 1.16.12
Passing Flows

Purveyor	Gaging Station	Passing Flow per NJAC 7:19 (Cu. Ft./Sec)	Passing Flow per Permit (Cu. Ft./Sec)
Passaic Valley Water Commission	Pompton River at Pompton Plains	92.8	136 (2)
Passaic Valley Water Commission	Passaic River at Little Falls	89.0	----
Passaic Valley Water Commission	Passaic River at Two Bridges	27.2	27.2
NJDWSC	Wanaque River	15.5	10.8 to 15.5
NJDWSC	Ramapo River	61.9	61.9
NJDWSC	Two Bridges	143.3 (1)	143.3 (1)
City of Newark	Macopin	12.3	12.3

(1) 27.2 cfs when PVWC is also diverting 75 MGD at Two Bridges.
(2) Permit 5099

The code indicates that where passing flow is not specified, it will be fixed by the Department based on an amount equal to the average daily flow for the driest month from records, or in lieu thereof, 125,000 gallons for each square mile of unappropriated watershed above the point of diversion (in addition to flows from any appropriated watershed above the point of diversion).

The code also indicates (NJAC 7:19-4.6 (d), 1) that fees will be paid by purveyors at a minimum charge of $1.00 per million gallons for each million gallons below the passing flow requirement, when the purveyor is diverting water. The maximum charge of $10.00 per million gallons shall apply on those days when the passing flow below the point of diversion is zero.

Ground Water Sources

Detailed information of the ground water sources (aquifers) for WMA 3 is presented in Section 1.8 of this report. Section 1.8 also provides information of the anticipated yield from these aquifers, ranging from poor producing to prolific ground water sources.

Table 1.16.1 provides a summary of the average usage of ground water, by user, within WMA 3.

Evaluation of Ground Water Availability for Potable Supply

In general, ground water sources are developed for use locally within a watershed. There are instances where regional water purveyors will produce ground water that is transmitted over longer distances for consumption outside of the local area. In WMA 3, groundwater sources are used primarily locally. In New York, the United Water Company serves Rockland County. Some of this groundwater diverted from the Ramapo River Basin is exported to outside of the river basin.

From available reference material, it was determined that NJGS uses at least two methods for calculating the availability of groundwater within a geographic region (e.g. watershed). Both approaches first estimate ground water recharge in the area, and then calculate water availability as a percentage of recharge.

In the 1996 NJSWSP – Task 2 Report "Water Supply Baseline Data Development and Analyses", the groundwater availability calculation was based upon NJGS' methodology of estimating recharge based upon a recharge rate per physiographic province. In WMA 3 these physiographic provinces and their estimated recharge rates from the NJSWSP are as follows:

Physiographic Province	Annual Average Recharge (inches)
Highlands	18
Piedmont (Newark Basin) – glaciated	15

For the NJSWSP, the State was divided into Regional Water Resource Planning Areas (RWRPA). WMA 6 and WMA 3 were combined in that report as a single planning area designated RWRPA 4. It was estimated in that study, that the recharge and available groundwater in RWRPA 4 was 471 MGD and 94 MGD, respectively (based upon available groundwater as 20 percent of recharge).

Using available GIS datasets, the groundwater recharge and availability was recalculated specific to WMA 3 (including New York State) as follows:

Physiographic Province	Annual Average Recharge (inches)	Geographic Area (sq. miles)	Average Daily Recharge MGD)	Available Water (MGD)
Piedmont (glaciated)	15	67	48	9.6
Highlands	18	311	267	53.3
Total			315	62.9

In New Jersey, within WMA 3, the groundwater diversion is currently approximately 18.7 MGD. The New Jersey groundwater availability calculation (New Jersey only) yields 39 MGD, indicating reserve groundwater supply – based on regionalized planning thresholds rather than area-specific and within basin thresholds.

In New York, the availability would be 23.9 MGD, and based upon available ground water usage, there appears to be reserve ground water supply currently available. The information contained in the groundwater resource studies (from Orange County Water Authority) indicated small percentages of population growth over the next 20 years.

The second methodology for determining ground water availability as supported by NJGS[3], calculates ground water recharge based upon land use and soils types. This methodology may yield more significant answers since more specific criteria are used.

Ground water availability can also be estimated based on trending the water levels in the aquifers during pumping and non-pumping conditions. The Bureau of Water Allocation maintains a database on these levels. The Water Supply Management Act (NJAC 7:19-

6.3 (b) 1.) states "A progressive reduction in the potentiometric surface of an aquifer will be considered presumptive evidence that the dependable yield of a subsurface source is less than current withdrawals, subject to acceptable evidence to the contrary."

Assessment of Water Availability

Adequacy of Current Supplies for Current Demands

A summary of current surface water and ground water demands compared to surface water supply capacity and estimates of ground water availability are provided in the following table:

Table 1.16.13
WMA 3 Surface Supply and Demand Comparison (New Jersey only)

Water System	Available Surface Supply (MGD)	Current Surface Demand (MGD)	Surface Supply/Deficit (MGD)	Estimated Ground Supply (MGD)	Current Ground Demand (MGD)	Ground Supply/Deficit (MGD)
NJDWSC	133.5	121 (2)	+12.5			
PVWC	75 (1)	47	+28			
City of Newark	49	47	+2			
All Ground Water Systems				39	18.7	+20.3

(1) based upon allocation of 75 MGD.
(2) Year 1999

The table indicates that the PVWC current surface supply on an annual average basis is not fully utilized based upon their allocation amount from NJDEP. However, PVWC fully utilizes its allocation to meet peak period demands. Based on water quality and operational considerations, PVWC takes its allocation from either Two Bridges or Little Falls (WMA 4).

Table 1.16.13 indicates that NJDWSC is not fully utilized. However, as previously noted, NJDWSC's safe yield available at its water treatment plant of 133.5 MGD is allotted to the contracting municipalities that have the ability to take this water if necessary. Municipalities that currently (1999 data) are not taking their full allotment include: City of Newark and Kearny. The other municipalities are taking all or most of their allotment, and in 1999 Nutley actually exceeded their allotment by 40 percent. Also, United Water of New Jersey did not take their full allotment of 39.5 MGD of raw water from the Wanaque Reservoir in either 1998 or 1999, instead averaging approximately 16 MGD.

Table 1.16.13 indicates that the City of Newark is currently nearly maximizing their diversions based upon safe yield information. However, the City of Newark is not maximizing their take of the NJDWSC allotment. In 1999, the City of Newark only took approximately 66 percent (37 MGD) of their allotment of 56 MGD (including Bloomfield).

Adequacy of Current Supplies for Future Demands

Future demands can be estimated based upon population projections. In the NJSWSP Task 3 Report – Development and Projection of Water Demands and Comparison to Net Available Water, population projections were provided by Regional Water Resource Planning Area (RWRPA). The Rutgers University, Center for Urban Policy Research (CUPR) is cited as a source of population projections.

WMA 6 and WMA 3 combine to form RWRPA 4, and the population projections for RWRPA 4 were estimated by NJSWSP as follows:

RWRPA	Year 2000	2005	2010	2020	2030	2040
4	693013	698327	703627	711587	720378	729360

This table indicates a moderate growth of approximately 5.2 percent increase in population in the next 40 years.

Most of the surface water supplied from WMA 3 is used outside of the watershed in Bergen, Essex, Hudson and Passaic Counties. The following population forecasts from the New Jersey Division of Labor were available:

Table 1.16.14
Population Forecast (New Jersey Department of Labor)

County	Est. 1998	2005	2008	2010	2015
Bergen	875,200	905,600	918,800	928,800	953,500
Passaic	494,900	498,600	501,100	503,800	505,300
Essex	766,400	778,400	783,600	787,000	800,600
Total	2,136,500	2,182,600	2,203,500	2,219,600	2,259,400

This indicates a trend for increase in population of 5.7 percent by the Year 2015. These counties are dependent upon surface supply from PVWC, NJDWSC, and the City of Newark.

Proposed Projects to Provide Additional Water

The NJSWSP recommended consideration of capital projects such as new interconnections within the region and with adjacent planning areas (such as the Raritan Basin), sharing a Hudson River project with New York City (if initiated), increasing the size of existing storage facilities, constructing new storage facilities (including ASR systems in buried valley aquifers), and direct and indirect wastewater re-use. Among the management initiatives to be evaluated are programs aimed at modifying demand and

improving operations, such as water conservation, improved drought rule curves, depletive use reduction programs, and improved coordination among presently interconnected purveyors. In addition, it was recommended that a detailed simulation model be developed of the Passaic and Hackensack Rivers that evaluates the region's storage facilities' capability to withstand various drought conditions and changing demand scenarios. The model would include a means for assessing wastewater flows in the region in order to properly model available water resources[5].

Finished water has been transferred from the Raritan to the Passaic Basin for drought relief for NJDWSC, and in turn for NJAWC, Jersey City, PVWC and United Water NJ.

Conclusions

Surface water generated from runoff within WMA 3 is primarily used for potable supply outside of the WMA 3 basin, but within the Passaic River Basin. Residents within WMA 3 depend primarily upon groundwater for water supply.

The published safe yield of the combined Wanaque North Project and Wanaque South Project is 173 MGD. Of this amount, 133.5 MGD is allotted to contracting municipalities that receive finished water from NJDWSC. The remaining safe yield of 39.5 MGD is allotted to United Water NJ, is delivered as raw water, and constitutes an interbasin transfer from WMA 3 to WMA 5. Review of diversion records for 1990 through 1999 indicates that approximately 120 MGD of the aforementioned 133.5 MGD available from NJDWSC as finished water has actually been utilized on an annual average basis. However, should these municipalities begin to utilize their full allotments, there would be no excess supply capacity. In addition, the safe yield of the combined Passaic, Hackensack and Raritan basins is to be addressed through the NJ Statewide Water Supply Plan process. The Scope of Work of the "New Jersey Statewide Water Supply Plan, 2002 Revision" includes "analysis of the need to recalculate the safe yield of existing systems, due to changes in climate, differences in water accounting and management assumptions, and increases in consumptive water uses."

The ground water characterization and assessment indicates a variety of ground water sources that vary from low producing to prolific. Comparing current and projected ground water withdrawals to estimated ground water availability, there is evidence to suggest available ground water supply for future uses. However, the available groundwater may not be in the same location as the wells that are suffering from dropping static levels. The most prolific groundwater resources in WMA 3 are located along the Ramapo River and some of its tributaries, and in the Pompton River basin. High yielding surficial aquifers are sparse and bedrock is low yielding in the remainder of WMA 3. This is an area that requires significantly more investigation and improved methods of estimating the interrelationship between ground water and surface water availability.

Planning Issues

The NJSWSP Task 4 Report - Preliminary Development of Water Supply Initiatives (Chapter 5)[5] includes a section on issues related to the RWRPA's. The task report provides an excellent summarization of these issues, and should be referred to for additional information. A summary of these issues and their magnitude of importance, as indicated in the Task Report, is provided in the following table:

Table 1.16.15
NJSWSP - SIGNIFICANT PLANNING ISSUES FOR RWRPA 4

ISSUES	IMPORTANCE	EXISTING PROBLEM	POTENTIAL PROBLEM
Supply Contamination & Treatment Requirements	High	Medium	High
Salt Water Intrusion	Low	Low	Low
Protection & Augmentation of Aquifer Recharge	High	High	High
Impacts of Utilization of Shallow Aquifers	High	Medium	High
Baseflow Reductions to Reservoir Streams or Waterways	Medium	Low	High
Low Flow Augmentation	Medium	Low	Low
Passing Flow Requirements	High	Low	High
Depletive Use	High	High	High
Strict Enforcement of the Municipal Land Use Law	Low	Medium	Medium
Demographics	Low	Low	Low
Facility Sources	Medium	Medium	Medium
Source Over-Allocation	High	Medium	High
Regionalization	High	Low	High
Deficit Quantification	High	High	High

The information contained in the table is generally consistent with information provided in this report. Update and revision of this information will be accomplished as part of the NJ Statewide Water Supply Plan process. The table does indicate that aquifer recharge is a high priority existing problem, and this is related more to the groundwater use in WMA 6 (which is also part of RWRPA 4.)

Additional issues of concern that should be addressed in the watershed planning process include:

- Surface water system yields are dependent upon ground water systems for baseflow to the streams and this must be considered when planning new ground water sources to determine their impact on surface water systems. New ground water sources also impact adjacent, existing ground water sources.

- Innovation in the form of engineered environmental solutions must be reviewed. For example, direct ground water recharge using wastewater treatment plant

effluent must be evaluated. Direct ground water recharge must be evaluated considering the impact to downstream purveyors, both in terms of quantity of water and quality of water. Innovation through using "gray water" wastewater treatment plant effluent as a source of irrigation within the watershed (e.g., golf courses).

- The methodology for determining future ground water availability through estimates of recharge needs continued refinement. (This appears as "Deficit Quantification" in the above RPRWA 4 planning issues table).

- New developments must be engineered to minimize adverse impacts to ground water and surface water systems. New developments that require additional water sources at the same time reduce available water by increasing impervious area in the watershed and channeling stormwater runoff directly to streams instead of allowing natural recharge.

- The information that has been collected by various agencies that is useful to watershed planning must be continuously refined. For example, the Bureau of Water Allocation database must be updated with accurate coordinate locations of water withdrawals so this information can be incorporated into GIS analysis. This will also require that some permits that cover more than one geographic location be separated into the required individual permits. Furthermore, the Bureau should enforce reporting of withdrawals from the individual sources, and not as "combined" withdrawals that cover all withdrawals contained in the permit.

- GIS has become a very effective tool for watershed planning. Additional efforts are required to develop sophisticated GIS watershed models specific and calibrated to the individual watersheds.

References

[1] N.P. Zripko, A. Hasan, NJDEP, Depletive Water Use Project for Regional Water Resource Planning Areas of New Jersey, July, 1994

[2] N.J. Geological Survey Digital Geodata Series DGS01-2, September 2001

[3] N.J. Geological Survey Report GSR-32 (Charles and others, 1993)

[4] NJIT, R. Dresnack, E. Golub, F. Salek, Safe Yield Study of Proposed Project to Provide Addtional Water to Northeast New Jersey, July 1984

[5] New Jersey Department of Environmental Protection, 1996. New Jersey Statewide Water Supply Plan – with Appendices and Task Reports.