

**EIGHTH REPORT TO THE GOVERNOR AND THE GENERAL ASSEMBLY**

*Regarding the Progress of the*

**DELAWARE WATER SUPPLY COORDINATING COUNCIL**

Updated Water Supply and Demand Projections for Northern New Castle County

*March 8, 2006*

*Prepared by the*

Delaware Department of Natural Resources and Environmental Control

Delaware Geological Survey

University of Delaware, College of Human Services, Education, and Public Policy  
Institute for Public Administration – Water Resources Agency







STATE OF DELAWARE  
DEPARTMENT OF NATURAL RESOURCES  
AND ENVIRONMENTAL CONTROL

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March 6 2006

The Honorable Ruth Ann Minner  
Governor, State of Delaware  
Legislative Hall  
Dover, Delaware 19901

143<sup>d</sup> General Assembly  
Legislative Hall  
Dover, Delaware 19901

Dear Governor Minner and Members of the 143<sup>d</sup> General Assembly:

I have the distinct pleasure of forwarding to you the eighth progress report of the Delaware Water Supply Coordinating Council.

By far the single most important news item I can convey is that the utilities have developed nearly one and one-half billion gallons of new water. As required by the Water Supply Self Sufficiency Act of 2003, the Council has provided the Public Service Commission (PSC) with its determination of the projected demand for 2009. The PSC will use the projected demand to evaluate the adequacy of certification by the two jurisdictional utilities, Artesian Water Company and United Water Delaware. The PSC's evaluation will determine if these utilities possess sufficient sources of water to provide adequate supply to meet the projected demand in the drought sensitive area of New Castle County. The jurisdictional utilities have until July 1, 2006 to file their certifications with the PSC. The non-jurisdictional utilities, Wilmington, Newark, and New Castle have until July 1, 2006 to submit their 3-year consumer water conservation plan and certification of adequate water supply to the Council.

Crowning this feat is the completion of the City of Newark's new reservoir. The project provides over 300 million gallons of stored water and allows Newark to meet all demands. This culminates the completion of Delaware's first public water supply reservoir since 1931. Newark's reservoir is projected to be operational early this summer.

*Delaware's Good Nature depends on you!*

Artesian Water Company has recently activated four large wells in Pencader Hundred adding up to three and one-half million gallons per day of additional capacity to their system.

A project in development is the City of Wilmington's plans to increase the storage capacity of Hoopes reservoir, in conjunction with structural and aesthetic improvements. By elevating the reservoir spillway by two or three feet the City will be able to store between 125 million to 200 million gallons of additional supply.

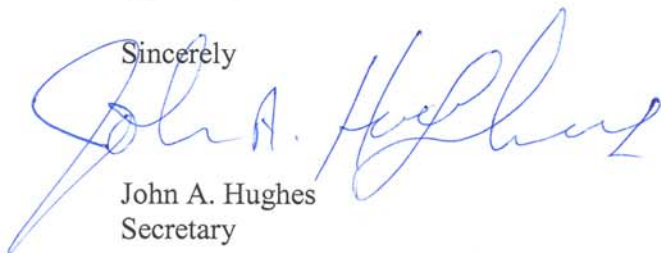
The City of New Castle continues to remain fully self-sufficient with surplus supplies available for transfer if necessary.

United Water Delaware has been able to site and install its long-planned exploratory well to evaluate aquifer recharge technology. This is the technology currently in use by Artesian Water Company. Land acquisition issues had held up this project but now that those issues are resolved, the project should move forward. Preliminary testing showing good results and United should be able to meet its goal of providing another 200 million gallons of storage capacity.

If these works go as planned they will shortly push the area's combined new water supply to more than two billion gallons. Northern New Castle County may be determined to be immune to the Council projected worst possible drought conditions. The Council and I look forward to further review of the certifications that are to be submitted to the PSC or to the Council.

Should you have questions, please do not hesitate to contact me or Kevin Donnelly at 739-9949.

Sincerely



John A. Hughes  
Secretary

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# 1. Executive Summary

This *Eighth Report to the Governor and General Assembly Regarding the Progress of the Delaware Water Supply Coordinating Council* provides updated water supply and demand estimates through 2020 for northern New Castle County to reflect the completion of over 1.8 billion gallons of water supply projects since the drought of 1999. This report also tracks the progress of the water purveyors in complying with HB 118, the Water Supply Self-Sufficiency Act. By law, the Water Supply Coordinating Council (WSCC) is charged with certifying the self sufficiency of the non-jurisdictional water purveyors, and the Public Service Commission (PSC) with certifying the self sufficiency of jurisdictional water utilities, in tri-annual reports to the Governor and General Assembly commencing in 2006. This is the eighth in a series of reports which began in 2000. Previous reports are available online at [www.wr.udel.edu](http://www.wr.udel.edu).

## New Water Supplies

With the filling of the 317-million gallon Newark Reservoir in February 2006, we are pleased to report that the Delaware WSCC has completed its mission of developing over one billion gallons of additional water supply and storage in northern New Castle County since the drought of 1999. As of February 2006, water purveyors have developed over 1,800 million gallons (mg) – exceeding the original projected deficit of 1,470 mg – of additional water supply to meet the drought of record based on water demands forecast through 2020.

To assure future supplies, the City of Wilmington is proceeding with plans to strengthen and raise the elevation of Hoopes Reservoir by two to three feet, which will add 150 to 220 mg of new water supply storage in northern New Castle County. With completion of the Hoopes Reservoir project in the next year or two, the WSCC will have developed over two billion gallons of new water supply storage in northern New Castle County since 1999, thus providing a *healthy surplus* of supply to meet peak demands during the next drought.

**Table 1.1. New water supply storage in northern New Castle County since the drought of 1999.**

<i>Sponsor</i>	<i>Project</i>	<i>Capacity in service as of Feb 2006 (mg)</i>
Artesian Water Company	New Wells North of C&D Canal	405
Artesian Water Company	Aquifer Storage and Recovery	130
City of Newark	Newark Reservoir	317
City of Newark	South Wellfield Iron Treatment Plant	75
United Water Delaware	Modify Tidal Capture Structure Plan	400
City of Wilmington	Hoopes Reservoir Deep Storage Plan	500
<b>Original Projected 2020 Deficit: 1,470 mg</b>		<b>1,827</b>
City of Wilmington	Raise Hoopes Reservoir Water Level by 2 – 3 ft	150 to 220 (pending)

## Delaware Water Supply Self Sufficiency Act

The water purveyors are complying with House Bill 118, the Delaware Water Supply Self Sufficiency Act, signed by Governor Minner in July 2003. HB 118 requires the WSCC to determine the projected water demand for each water utility in northern New Castle County for 2009 by March 1, 2006 and to

certify that the non-jurisdictional (municipal water purveyors) water utilities are self-sufficient. The jurisdictional water utilities (investor owned purveyors), which are subject to regulation by the PSC, must submit applications certifying their self-sufficiency to the PSC by July 1, 2006. The updated supply and demand estimates included in this report indicate that the water purveyors have implemented enough water supply storage since 1999 (over 1.8 bg) and that they have achieved water supply self sufficiency in accordance with the 2003 law.

**Table 1.2. Water supply and demand projections for northern New Castle County through 2009.**

<i>Purveyor</i>	<i>2009</i>		
	<i>Supply</i>	<i>Demand</i>	<i>Surplus</i>
Artesian	29.0	23.3	5.7
United Water Delaware	25.8	23.6	2.2
Wilmington	36.3	29.0	7.3
Newark	7.8	4.9	2.9
New Castle MSC	2.0	0.5	1.5
<b>Total</b>	<b>100.9</b>	<b>81.3</b>	<b>19.6</b>

### **Acknowledgements**

This report duly notes the policies of Governors Minner and Carper for elevating water supply as a priority at the highest level in State government. Furthermore, this report credits the contributions of Lt. Governor John Carney, Lee Ann Walling and Andrea Kreiner of Governor Minner’s Office, Jeffrey Bullock and Mark Headd of Governor Carper’s office, State Representative Michael Mulrooney as sponsor of the original WSCC legislation, State Representative Wayne Smith as sponsor of the Water Supply Self-Sufficiency Act, and Martin Wollaston of the University of Delaware, Institute for Public Administration – Water Resources Agency as the originator of the WSCC concept, for setting the governance wheels in motion for northern Delaware to achieve water supply self sufficiency. Special thanks to the WSCC work group who provided oversight of this report, namely: Joseph DiNunzio and Bruce Kraeuter from Artesian Water Company; Susan Skomorucha and Nancy Trushell from United Water Delaware; Kash Srinivasan and Sean Duffy from the City of Wilmington; Roy Simonson, Joe Dombrowski, and Bill Zimmerman from the City of Newark; Andrea Maucher from the Public Service Commission; Lorraine Fleming from the Delaware Nature Society; Victor Singer and Michael McDowell from Civic League for New Castle County; and Charles Jenner from the Delaware Green Industry.

Kevin Donnelly and Stewart Lovell from Delaware Department of Natural Resources and Environmental Control (DNREC), John Talley and Stefanie Baxter from the Delaware Geological Survey (DGS), and Kevin J. Vonck and Gerald Kauffman from the University of Delaware, Institute for Public Administration – Water Resources Agency (IPA-WRA) co-authored this report on behalf of the WSCC.

## 2. Water Supply Coordinating Council

In July 2000, Governor Carper signed House Bill 549 which created the Delaware Water Supply Coordinating Council (WSCC) and appointed the University of Delaware, Institute for Public Administration – Water Resources Agency as State Water Coordinator. HB 549 directed the WSCC to: 1) develop new water supplies in northern New Castle County, and 2) work cooperatively to manage water supplies more efficiently. HB 549 appointed DGS, DNREC, and the Water Coordinator to serve as advisors to the WSCC. HB 549 appointed the following members to the WSCC:

- Office of the Governor
- Secretary of the Delaware Department of Natural Resources & Environmental Control (Chair)
- Secretary of the Department of Public Safety
- Secretary of the Delaware Department of Agriculture
- Executive Director of the Public Service Commission
- Director of the Delaware Emergency Management Agency
- Director of the Delaware Geological Survey
- Director of the Delaware Division of Public Health
- Public Advocate
- Executive Director of the Delaware River Basin Commission
- New Castle County Executive
- Artesian Water Company
- City of Newark
- City of Wilmington
- New Castle Municipal Services Commission
- Tidewater Utilities, Inc.
- United Water Delaware
- New Castle County Chamber of Commerce
- Delaware State Chamber of Commerce
- Delaware Nursery and Landscape Association
- Delaware Professional Grounds Management Society
- Delaware State Golf Association
- Delaware Nature Society
- Coalition for Natural Stream Valleys
- New Castle County Civic League

In August 2003, Governor Minner signed HB 203, which reauthorized the WSCC through January 1, 2010, expanded the WSCC to include statewide representation, and appointed the DGS and IPA-WRA as voting members. The following members were added to the WSCC:

- Kent County
- Sussex County
- Public Water Supply Utility in Sussex County Association of Towns (SCAT)
- Public Water Supply Utility in League of Local Governments, Kent County
- Delaware Rural Water Association
- National Association of Water Companies, Delaware Chapter
- Local Chamber of Commerce in New Castle County



- Local Chamber of Commerce in Kent County
- Local Chamber of Commerce in Sussex County
- Delaware Farm Bureau
- Center for Inland Bays
- State Fire Marshal

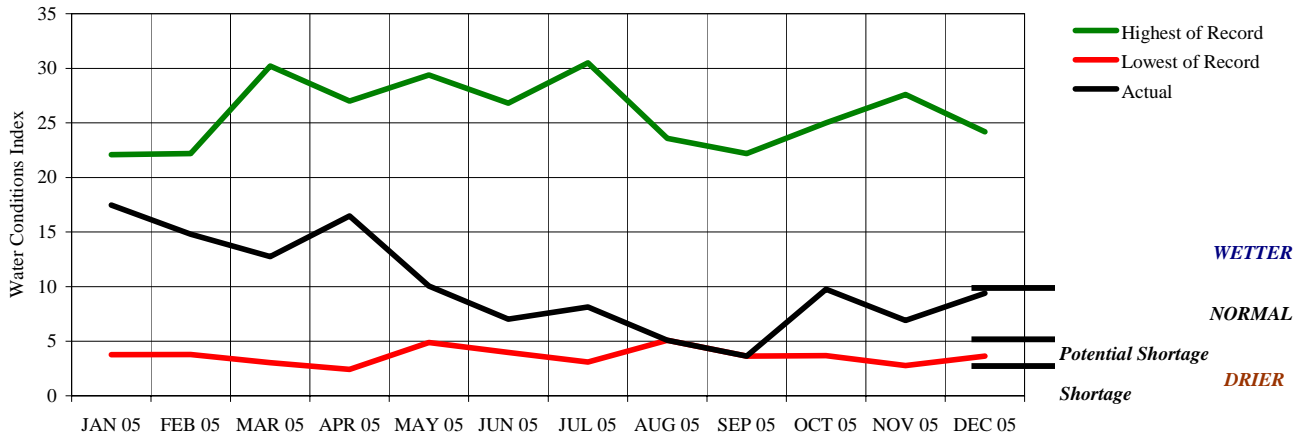
DNREC Secretary John Hughes and alternate Kevin Donnelly serve as Chair of the WSCC. The WSCC may add members and establish subcommittees to address specific issues. The Water Coordinator continues by resolution of the WSCC. The WSCC or its work groups met on the following dates:

2000	March 3	Carvel State Office Building, Wilmington, Del. (met under Executive Order 74)
	March 24	Carvel State Office Building, Wilmington, Del. (met under Executive Order 74)
	May 22	Delaware Geological Survey, Newark, Del. (met under Executive Order 74)
	July 31	New Castle County Chamber of Commerce, Churchman's Crossing, Del.
	October 4	Artesian Water Company, Churchman's Crossing, Del.
2001	January 10	United Water Delaware, Stanton, Del.
	March 14	Artesian Water Company, Churchman's Crossing, Del.
	June 14	United Water Delaware, Stanton, Del.
	October 4	Artesian Water Company, Churchman's Crossing, Del.
2002	February 5	United Water Delaware, Stanton, Del.
	April 17	Artesian Water Company, Churchman's Crossing, Del.
	July 10	Artesian Water Company, Churchman's Crossing, Del.
	September 11	Artesian Water Company, Churchman's Crossing, Del.
	October 17	Delaware DNREC, New Castle, Del.
	November 21	Artesian Water Company, Churchman's Crossing, Del.
	December 12	Artesian Water Company, Churchman's Crossing, Del.
2003	May 22	Artesian Water Company, Churchman's Crossing, Del.
	July 16	Artesian Water Company, Churchman's Crossing, Del.
	October 9	Artesian Water Company, Churchman's Crossing, Del.
	December 11	Artesian Water Company, Churchman's Crossing, Del.
2004	January 13	University of Delaware Water Resources Agency, Newark, Del.
	February 25	University of Delaware Water Resources Agency, Newark, Del.
	June 24	Delaware Technical & Community College – Terry Campus, Dover, Del.
	September 30	DNREC Lukens Building, New Castle, Del.
	October 21	University of Delaware Water Resources Agency, Newark, Del.
2005	March 3	University of Delaware Water Resources Agency, Newark, Del.
	April 29	DELDOT – Farmington/Felton Room, Dover, Del.
	November 21	University of Delaware Water Resources Agency, Newark, Del.
	December 6	University of Delaware Water Resources Agency, Newark, Del.
	December 8	Kent County Administration Building, Dover, Del.
2006	January 12	University of Delaware Water Resources Agency, Newark, Del.
	January 26	Kent County Administration Building, Dover, Del.

### 3. Delaware Geological Survey Water Conditions Update

**Delaware Geological Survey (DGS) Water Conditions Index (WCI):** The DGS Water Conditions Index for New Castle County has remained in the upper end of the “normal” range for October, November, and December 2005. The WCI for January 2006 will be in the “wetter” range.

**Figure 3.1. DGS Water Conditions Index, January – December 2005.**



**Precipitation:** Precipitation was significantly above average between October and December 2005, ranging from 187 percent of normal (18.28 in) at Greenwood to 139 percent of normal (13.46 in) at New Castle. The state recorded between 10 and 17 daily precipitation events with total amounts greater than 0.4 inches during this period. There have been about five days so far in January during which individual precipitation events have resulted in more than 0.5 inches of rainfall. There has been very little frost in the ground during this time, which is a condition conducive for ground-water recharge.

**Table 3.1. Precipitation during 2005.**

<i>Location</i>	<i>Total Precipitation</i>	<i>Normal Precipitation</i>	<i>Difference</i>	<i>% of Normal</i>
Wilmington (Porter Reservoir)	43.16"	45.48"	-2.32	95%
New Castle (NWS)	40.30"	42.81"	-2.51	94%
Dover	51.80"	46.28"	5.52	112%
Greenwood	48.75"	45.99"	2.76	106%
Lewes	53.98"	46.00"	7.98	117%
Georgetown	40.16"	45.34"	-5.18	89%

**Streamflows:** Streamflows have been in the normal to above normal range from October to December and will remain in the above normal to normal range for January. Excellent base flows on the White Clay Creek have enabled the City of Newark to continue to fill their reservoir with low-turbidity water.

**Table 3.2. Monthly mean streamflow discharges during 2005.**

Water Body	Years of Record	2005											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Brandywine Creek	57	AN	N	N	AN	N	N	N	N	BN	AN	N	N
Red Clay Creek	61	AN	N	N	AN*	N	N	N	N	N	AN	N	N
White Clay Creek	64	AN	N	AN	AN	N	N	AN	N	N	AN	N	N
Christina River	61	N	BN	N	AN	N	N	N	N	BN	AN	BN	N
St. Jones River	46	N	N	N	AN	AN	AN	AN	N	BN	AN	N	AN
Nanticoke River	61	N	N	N	AN	AN	AN	AN	N	N	AN	AN	AN

AN = above normal / N = normal / BN = below normal / \* highest of record

**Ground-water Levels:** Ground-water levels have risen seasonally during the October to January period with water-levels in several wells being in the above normal range. Thus, ground-water levels are very good for this time of the year.

**Table 3.3. Ground-water levels during 2005.**

Well (nearest municipality)	Years of Record	2005											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Bc43-01 (Hockessin)	40	AN	AN	AN	AN	N	N	N	AN	AN	AN*	AN	AN
Db24-10 (Newark)	46	AN	AN	AN	AN	N	N	N	N	N	N	N	N
Hb14-01 (Blackbird)	46	AN	AN	AN	AN	N	N	AN	AN	N	N	N	N
Jd42-03 (Camden)	43	N	BN	BN	N	N	N	N	N	N	-	-	N
Md22-01 (Williamsville)	45	-	BN	N	AN*	N	AN	N	N	N	BN	-	-
Mc51-01 (Adamsville)	45	N	N	N	N	N	N	N	N	N	N	N	AN
Ng11-01 (Milton)	43	N	N	N	AN	N	AN	AN	N	N	N	AN	AN
Nc45-01 (Bridgeville)	52	N	BN	BN	BN	N	N	AN	N	N	N	N	-
Qe44-01 (Trap Pond)	44	N	N	N	N	N	N	AN	AN	N	N	AN	AN

AN = above normal / N = normal / BN = below normal / \* highest of record

## 4. Northern New Castle County Public Water Demand in 2005

**Public Water Demand:** The peak daily demand for northern New Castle County (combined purveyors) in 2005 was 83.7 million gallons per day (mgd) on August 5. The peak water transfer through interconnections in 2005 was 3.3 mgd on September 11. In comparison, the peak daily demand in 2004 was 75.2 million gallons per day (mgd) on August 4, while the peak water transfer through interconnections was 5.2 mgd on August 13. The peak daily demand during the drought of 2002 was 82.7 mgd, recorded on July 10, 2002. The historic peak daily demand of 93.1 mgd was recorded on July 18, 1997.

**Table 4.1. Public water demand during 2005 in northern New Castle County.**

<i>Water Purveyor</i>	<i>Peak Daily Demand (mgd)</i>	<i>Date 2005</i>
City of Wilmington	30.0	September 10
Artesian Water Company	25.4	August 15
United Water Delaware	29.6	August 19
City of Newark	5.8	September 26
New Castle MSC	0.6	August 25

**Chloride Concentrations:** In early August 2005, reduced stream flows in the White Clay Creek triggered United Water Delaware's chloride monitoring plan as per its design. The goal of the chloride monitoring plan is to monitor increasing chloride levels in the White Clay Creek so that operational action can be taken to maintain chloride levels in the drinking water below the USEPA drinking water standard of 250 ppm. Chlorides in the Christina River at the Newport Bridge (approximately 3.5 miles below the intakes of the Stanton Water Treatment Plant) began to increase in early August and first exceeded the 250 ppm isochlor on August 13, 2005 and peaked at 950 ppm on October 6. Chlorides in the Christina River at the Churchmans Boat Ramp (approximately 4 miles below the intakes of the Stanton Water Treatment Plant) began to increase in mid August and first exceeded the 250 ppm isochlor on August 27, 2005 and peaked at 550 ppm on September 25. Chlorides in the White Clay Creek at the United Water Delaware Tidal Capture Structure (approximately one-half mile below the intakes) peaked at 110 ppm on August 22, 2005. Chlorides in the White Clay Creek at United Water Delaware's Stanton Water Treatment Plant did not exceed 68 ppm during the summer of 2005. Chloride concentrations returned to the normal background levels of 40-50 ppm after heavy rains during the second week of October 2005.

## 5. Water Supply and Demand Projections Through 2020

The December 2, 1999 Governor’s Water Supply Task Force (WSTF) report compiled estimates of public water supply and demand in northern New Castle County for drought conditions for the years 2000, 2010, and 2020. The estimates assumed a worst-case historic drought with environmental standards for minimum stream flows (7Q10) in effect along the Brandywine Creek and White Clay Creek. The 7Q10 flow is the average flow likely to occur for 7 days in a row once every 10 years. The 7Q10 flow is likely to be exceeded 98 percent of the time in any given year and is commonly designated as the minimum flow needed to protect the fishery. In 1999, there were minimum instream flow standards on White Clay Creek at Newark and Stanton and no flow standard on Brandywine Creek. The supply and demand curves forecasted a deficit of 17 mgd or 1.020 billion gallon deficit for a 60-day drought period in the year 2020 (Table 5.1)

**Table 5.1. Supply/demand estimates for northern New Castle County after the drought of 1999.**

<i>Scenario/Year</i>	<i>Supply (mgd)</i>	<i>Demand (mgd)</i>	<i>+/- (mgd)</i>	<i>Volume (mg)*</i>
2000	73.0	86.0	-13.0	-780
2010	73.0	88.0	-15.0	-900
2020	73.0	90.0	-17.0	-1,020

\* based on 60-day drought duration

The WSCC developed a series of water supply projects to close the projected 17.0 mgd gap between supply and demand in northern Delaware (north of the C&D Canal). In 1999, the water purveyors committed to an initial “A List” of options that had few environmental constraints, enjoyed community support, and could be implemented by the end of 2003.

**Table 5.2. Status of Updated Water Supply Projects for Northern New Castle County, Original “A” List .**

<i>Sponsor</i>	<i>Project</i>	<i>Targeted capacity Dec. 1999 (mg) / (mgd*)</i>	<i>Capacity in service Feb 2006 (mg) / (mgd**)</i>	<i>Status of completion</i>
City of Newark	Newark Reservoir	200 / 3.3	317 / 4.2	Complete. City filling reservoir at rate of 1 ft per day. As of Jan 20, 2006 the reservoir is 42 ft deep with 14 ft more to add. Reservoir is scheduled to be filled and on-line by end of May 2006.
City of Wilmington	Hoopes Reservoir Deep Storage Plan	500 / 8.3	500 / 6.7	Complete in 2001. Water quality survey by DGS indicates bottom 500 ft of reservoir is sufficient for drinking water with normal treatment.
Artesian Water Company	New Wells North of C&D Canal	120 / 2.0	405 / 5.4	Complete in 2005. Old County Rd, Artisans Village, Middle Run Crossing, and Chesapeake City Road wells added to service since 1999.
City of Newark	South Wellfield Iron Treatment Plant	60 / 1.0	75 / 1.0	Complete and on-line in November 2003.
Artesian Water Company	Aquifer Storage and Recovery	300 / 5.0	130 / 1.7	Complete. AWC stored and recovered 130 mg during 2005.
<b>Projected 2020 Deficit: 1,020 / 17</b>		<b>1,180 / 19.6</b>	<b>1,427 / 19.0</b>	

\* mgd based on 60 day drought period

\*\* mgd based on 75 day drought period.

The drought of 2002 replaced the drought of 1965-66 as the drought of record in northern Delaware. Because 2002 streamflows on the Brandywine Creek reached record low flows (thereby reducing safe yields), the WSCC reevaluated supply and demand projections for northern Delaware. The updated chart assumed that all of the projects on the 1999 WSCC "A List" (about 1 billion gallons) would be implemented. The WSCC adopted these updated supply and demand projections for northern Delaware on October 17, 2002. These projections assume a future environmental standard along the Brandywine Creek by 2020, a 7Q10 instream flow standard along the White Clay Creek at Stanton and Newark, and peak monthly water demands occurring during a drought lasting 75 days. The WSCC concluded that 262 to 450 mg of additional storage would be needed by 2020 to meet peak demands during a drought of record. The WSCC adopted these projections as the water supply necessary to accommodate the peak water demand of the projected population in 2020 without water restrictions, even with a recurrence of conditions similar to the drought of 2002, under these conservative assumptions. The following table summarizes the updated supply/demand projections.

**Table 5.3. Supply/demand estimates for northern New Castle County after the drought of 2002.**

<i>Scenario/Year</i>	<i>Supply (mgd)</i>		<i>Demand (mgd)</i>	<i>+/- (mgd)</i>		<i>Volume (mg)*</i>	
	<i>7Q50</i>	<i>7Q10</i>		<i>7Q50</i>	<i>7Q10</i>	<i>7Q50</i>	<i>7Q10</i>
2003	84.5	82.0	83.3	1.2	-1.3	90	-97
2010	84.5	82.0	86.3	-1.8	-4.3	-135	-322
2020	84.5	82.0	88.0	-3.5	-6.0	-262	-450

\* based on 75-day drought duration

At the November 21 and December 12, 2002 meetings, the WSCC identified a series of additional projects that could be undertaken to meet a projected 2020 deficit of 262 to 450 mg, depending on the assumption of minimum stream flow standards (7Q50 or 7Q10) that could be imposed along the Brandywine Creek by 2020 (as shown in Table 5.4). Members of the WSCC then nominated projects that each would sponsor and have the potential for groundbreaking on a fast-track status.

Each of the sponsors provided a report summarizing the status of their projects with a conceptual evaluation of project feasibility and volume (mg/mgd) based on the following criteria: engineering, environmental, regulatory, economic, community, and timing. The WSCC decided that the following options were most practical for a new "A List" to close the 262 to 450 mg gap between water supply and demand in northern Delaware projected for 2020:

**Figure 5.4. Status of updated water supply projects for northern New Castle County, new "A" list.**

<i>Sponsor</i>	<i>Project</i>	<i>Targeted capacity Jan 2003 (mg)</i>	<i>Capacity in service Feb 2006 mg / (mgd)*</i>	<i>Status</i>
City of Wilmington	Raise Water Level in Hoopes Reservoir by 1 foot to 5 feet	60-375	0 / 0	City plans to strengthen reservoir and raise water level by 2 to 3 feet providing up to 210 mg. US Army Corps of Engineers determined in 2005 that a permit is not needed.
Wilmington, United Water Delaware, DNREC	Increase Hoopes Pump Station Capacity	36-510	0 / 0	DNREC retained Parsons consultants in May 2005 to conduct study with supporting funds from the City of Wilmington and United Water Delaware.
Artesian Water Company	Aquifer Storage and Recovery	150	0 / 0	Completed preliminary feasibility study at Wilmington Manor Gardens and Artisans Village. Further action is dependent on identified need for additional supply.
United Water Delaware	Aquifer Storage and Recovery	180 to 225	0 / 0	Retained consultant to conduct testing near Delaware City and Smalleys Pond. Smalleys Pond site study completed, not feasible. Test well construction and subsequent testing at Delaware City location indicates good potential for ASR development.
United Water Delaware	Modify Tidal Capture Structure Operating Plan	75 to 500	400 / 5.3	DRBC docket decision in January 2005 replaced 7Q10 minimum flow standard with a standard based on protection of the intake from chloride with a minimum flow depth downstream.

\* based on a 75 day drought period.

## 6. Updated Water Supply and Demand Projections

With completion of all of the water supply projects on the original “A” list and several of the projects on the new “A” list since 1999, the WSCC has updated the water supply and demand projections for northern New Castle County through 2020. After review of historical data, the WSCC decided to modify the water demands originally used in the December 1999 Governor’s Water Supply Task Force Report and the January 2003 *Fifth Report* to the Governor and General Assembly because:

- 1) October 2005 projections by the Delaware Population Consortium indicate that the population in northern Delaware will increase by 3 percent from 2005 to 2020. Northern New Castle County is nearing full build-out. The original maximum monthly demand projections approved in the January 2003 *Fifth Report* amount to a 6 percent increase from 83.3 mgd in 2005 to 88.0 mgd by 2020.

**Table 6.1. Estimated population in northern New Castle County through 2020.**

<i>Year</i>	<i>Population</i>	<i>% Increase</i>
2005	482,609	---
2010	490,847	1.7%
2020	498,741	1.6%

Source: Delaware Population Consortium, October 2005.

**Table 6.2. Estimates of maximum monthly water demands in northern New Castle Co.**

<i>Year</i>	<i>Demand</i>	<i>% Increase</i>
2005	83.3	---
2010	86.3	3.6%
2020	88.0	2.0%

Sources: *Fifth Report to the Governor and General Assembly*, Jan. 2003 and *Governor’s Water Supply Task Force Report*, Dec. 1999.

- 2) Maximum monthly water demand records for 1999 through 2005 compiled by northern Delaware water purveyors indicate that actual maximum monthly demands are lower than the original estimated demands. For instance, the original estimated maximum monthly demand for 2005 was 83.3 mgd. The actual, recorded maximum monthly demand was 77 mgd in August 2005.

The 2005 base demands are selected as the historic peak monthly demand recorded for each purveyor since 2001. The 2005 base demand interconnection (2.0 mgd) is the mean of interconnections over a five-year period since 2001. The regional maximum monthly demand is calculated as the subtotal of the purveyor’s maximum monthly demand minus the mean interconnections.

**Table 6.3. Actual maximum monthly water demands recorded in northern New Castle County.**

<i>Purveyor</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2005 base demand</i>
City of Wilmington	29.1	25.5	23.8	25.1	26.4	29.1
Artesian Water Company	21.6	23.0	20.2	20.9	21.6	23.0
United Water Delaware	24.0	25.1	22.9	22.0	25.4	24.2*
City of Newark	4.8	4.3	4.0	3.6	4.1	4.8
New Castle Board of Water & Light	0.7	1.1	0.5	0.4	0.5	1.1
<b>subtotal</b>	80.2	79.0	71.2	69.1	77.7	83.4
Minus interconnections	- 2.7	- 3.5	- 1.7	- 1.3	- 0.9	- 2.0
<b>Total (mgd)</b>	<b>77.5</b>	<b>75.5</b>	<b>69.5</b>	<b>67.8</b>	<b>76.8</b>	<b>81.4</b>

\* To establish future water demands, United Water Delaware’s base demand is decreased by 0.7 mgd to reflect an industrial customer exceeding their contract maximum during 2005 and by 0.5 mgd to reflect an error in over reporting the Chester Water Authority interconnection. This results in an adjusted base demand for UWD of 24.2 mgd (25.4 – 0.7 – 0.5 = 24.2).



To avoid double counting, base demands were adjusted by subtracting interconnections as follows: Wilmington (0.5 mgd to AWC), United Water Delaware (0.9 mgd to Newark), and New Castle BWL (0.6 mgd to AWC).

Once the 2005 base demands were adjusted, they were projected out to 2010 and 2020 as tabulated in the following table at a rate similar to the Delaware Population Consortium projections.

**Table 6.4. Maximum monthly water demands projected to 2020 for northern New Castle County.**

<i>Purveyor</i>	<i>2005 base demand</i>	<i>% incr.</i>	<i>2010</i>	<i>% incr.</i>	<i>2020</i>
City of Wilmington	29.1 – 0.5 = 28.6	1.7 %	29.1	1.6 %	29.6
Artesian Water Company	23.0 – 0.0 = 23.0	1.7 %	23.4	1.6 %	23.8
United Water Delaware	24.2 – 0.9 = 23.3	1.7 %	23.7	1.6 %	24.1
City of Newark	4.8 – 0.0 = 4.8	1.7 %	4.9	1.6 %	5.0
New Castle Board of W & L	1.1 – 0.6 = 0.5	1.7 %	0.5	1.6 %	0.5
<b>Subtotal minus interconnections</b>	<b>82.2 - 2.0 = 80.2</b>	<b>1.7 %</b>	<b>81.6</b>	<b>1.6 %</b>	<b>83.0</b>

The following table summarizes the original maximum monthly demands estimated in January 2003 compared to actual demands recorded by the water purveyors as of 2005.

**Table 6.5. Maximum 2003 monthly water demands forecast compared to 2005 actual demands.**

<i>Purveyor</i>	<i>Forecasted in Jan 2003</i>			<i>Revised as of 2005</i>		
	<i>2005</i>	<i>2010</i>	<i>2020</i>	<i>2005</i>	<i>2010</i>	<i>2020</i>
City of Wilmington	30.3	31.0	31.2	28.6	29.1	29.6
Artesian Water Company	24.0	26.0	27.1	23.0	23.4	23.8
United Water Delaware	24.0	24.1	24.4	23.3	23.7	24.1
City of Newark	4.5	4.7	4.8	4.8	4.9	5.0
New Castle Board of W & L	0.5	0.5	0.5	0.5	0.5	0.5
<b>Subtotal minus interconnections</b>	<b>83.3</b>	<b>86.3</b>	<b>88.0</b>	<b>80.2</b>	<b>81.6</b>	<b>83.0</b>

In accordance with the recommendations of the December 1999 *Governor's Water Supply Task Force Report* and the January 2003 *Fifth Report to the Governor and General Assembly*, water supply and demand projections in northern New Castle County have been updated for existing and potential regulatory instream flow scenarios.

Scenario 1 is based on the existing regulatory standard where the White Clay Creek at Stanton (United Water Delaware) is under a depth of flow standard and the White Clay Creek at Newark (City of Newark) has a 7Q10 flow rate standard imposed by DRBC and DNREC.

Scenario 2 accounts for a hypothetical most conservative case concerning potential for a future 7Q10 instream flow standard along the Brandywine Creek at Wilmington by 2020 combined with the minimum depth of flow standard on the White Clay Creek for UWD and a 7Q10 instream flow standard on the White Clay Creek at Newark.

**Table 6.6. Scenario 1: Existing regulatory condition as of 2006.**

No 7Q10 instream flow standard along the Brandywine Creek at Wilmington. Instream standard with minimum flow depth and chloride provisions in effect along the White Clay Creek at Stanton and 7Q10 instream flow standard in effect at Newark.  
Maximum monthly demands recorded as of 2005.

<i>Purveyor</i>	<b>2005</b>			<b>2010</b>			<b>2020</b>		
	<i>Supply</i>	<i>Max Monthly Demand</i>	<i>Surplus/ Deficit +/-</i>	<i>Supply</i>	<i>Max Monthly Demand</i>	<i>Surplus/ Deficit +/-</i>	<i>Supply</i>	<i>Max Monthly Demand</i>	<i>Surplus/ Deficit +/-</i>
<b>Artesian</b>	<b>29.0</b>	<b>23.0</b>	<b>6.0</b>	<b>29.0</b>	<b>23.4</b>	<b>5.6</b>	<b>29.0</b>	<b>23.8</b>	<b>5.2</b>
Groundwater	24.3			24.3			24.3		
CWA Interconn.	3.0			3.0			3.0		
ASR	1.7			1.7			1.7		
<b>United Water DE</b>	<b>25.8</b>	<b>23.3</b>	<b>2.5</b>	<b>25.8</b>	<b>23.7</b>	<b>2.1</b>	<b>25.8</b>	<b>24.1</b>	<b>1.7</b>
Stanton WTP	19.3			19.3			19.3		
Hoopes Contract	2.7			2.7			2.7		
Christiana WTP	3.0			3.0			3.0		
ASR									
CWA Interconn.	0.8			0.8			0.8		
<b>Wilmington</b>	<b>36.3</b>	<b>28.6</b>	<b>7.7</b>	<b>36.3</b>	<b>29.1</b>	<b>7.2</b>	<b>36.3</b>	<b>29.6</b>	<b>6.7</b>
Brandywine Creek	15.0			15.0			15.0		
Hoopes Reservoir	21.3			21.3			21.3		
Raise Hoopes Res.									
<b>Newark</b>	<b>7.8</b>	<b>4.8</b>	<b>3.0</b>	<b>7.8</b>	<b>4.9</b>	<b>2.9</b>	<b>7.8</b>	<b>5.0</b>	<b>2.8</b>
White Clay WTP	0.0			0.0			0.0		
Newark Reservoir	4.0			4.0			4.0		
Groundwater	3.8			3.8			3.8		
<b>New Castle MSC</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>
<b>SUBTOTAL</b>	<b>100.9</b>	<b>80.2</b>	<b>20.7</b>	<b>100.9</b>	<b>81.6</b>	<b>19.3</b>	<b>100.9</b>	<b>83.0</b>	<b>17.9</b>

Water supply available during drought of record conditions (75 days) with existing regulatory condition:

- No minimum instream flow standards in effect along the Brandywine Creek at Wilmington.
- Minimum depth flow standard in effect along White Clay Creek at Stanton, 7Q10 passby in effect on White Clay Creek at Newark (14 mgd). The 7Q10 flow is the low flow likely to occur for 7 days in a row once every 10 years.
- Groundwater supplies permitted by DNREC allocation permit as per drought of record (2002) conditions.
- Transfers from Chester Water Authority are accounted for as per Delaware Water Supply Self Sufficiency Act of 2003.
- Useable capacity Hoopes Reservoir = 1800 mg over 75 days (24 mgd).
- Useable capacity Newark Reservoir = 300 mg over 75 days (4 mgd).
- Drought of record low streamflows observed during 2002 drought: Brandywine Creek = 21 mgd (8/21/02), White Clay Cr. at Stanton (w/o Hoopes Reservoir Releases) = 6.8 mgd (8/15/02).
- Maximum monthly demands recorded by water purveyors as of 2005, projected out to 2020 at rate similar to Delaware Population Consortium projections. Population increase 3 percent in northern New Castle County from 2005 to 2020.
- UWD Tidal Capture Structure provides 14 mgd plus 5.3 mgd from incoming tide 18 hours per day providing one foot minimum depth in creek. Hoopes Reservoir release reduces chlorides below 250 ppm at TCS during low flow (< 17 mgd). Contract with Wilmington provides up to 200 mg from Hoopes Reservoir to UWD or 2.7 mgd average over 75-day drought.

**Table 6.7. Scenario 2: Future regulatory condition (hypothetical most conservative scenario).**

7Q10 instream flow standard in effect on the Brandywine Creek at Wilmington. Instream standard with minimum flow depth and chloride provisions in effect along the White Clay Creek at Stanton and 7Q10 standard in effect at Newark.

Maximum monthly demands recorded as of 2005.

<i>Purveyor</i>	<b>2005</b>			<b>2010</b>			<b>2020</b>		
	<i>Supply</i>	<i>Max Monthly Demand</i>	<i>Surplus/ Deficit +/-</i>	<i>Supply</i>	<i>Max Monthly Demand</i>	<i>Surplus/ Deficit +/-</i>	<i>Supply</i>	<i>Max Monthly Demand</i>	<i>Surplus/ Deficit +/-</i>
<b>Artesian</b>	<b>29.0</b>	<b>23.0</b>	<b>6.0</b>	<b>29.0</b>	<b>23.4</b>	<b>5.6</b>	<b>29.0</b>	<b>23.8</b>	<b>5.2</b>
Groundwater	24.3			24.3			24.3		
CWA Interconn.	3.0			3.0			3.0		
ASR	1.7			1.7			1.7		
<b>United Water DE</b>	<b>23.1</b>	<b>23.3</b>	<b>- 0.2</b>	<b>23.1</b>	<b>23.7</b>	<b>- 0.6</b>	<b>23.1</b>	<b>24.1</b>	<b>- 1.0</b>
Stanton WTP	19.3			19.3			19.3		
Hoopes Contract	0.0			0.0			0.0		
Christina WTP	3.0			3.0			3.0		
ASR									
CWA Interconn.	0.8			0.8			0.8		
<b>Wilmington</b>	<b>29.5</b>	<b>28.6</b>	<b>0.9</b>	<b>29.5</b>	<b>29.1</b>	<b>0.4</b>	<b>29.5</b>	<b>29.6</b>	<b>- 0.1</b>
Brandywine Creek	5.5			5.5			5.5		
Hoopes Reservoir	24.0			24.0			24.0		
Raise Hoopes Res.									
<b>Newark</b>	<b>7.8</b>	<b>4.8</b>	<b>3.0</b>	<b>7.8</b>	<b>4.9</b>	<b>2.9</b>	<b>7.8</b>	<b>5.0</b>	<b>2.8</b>
White Clay WTP	0.0			0.0			0.0		
Newark Reservoir	4.0			4.0			4.0		
Groundwater	3.8			3.8			3.8		
<b>New Castle MSC</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>
<b>SUBTOTAL</b>	<b>91.4</b>	<b>80.2</b>	<b>11.2</b>	<b>91.4</b>	<b>81.6</b>	<b>9.8</b>	<b>91.4</b>	<b>83.0</b>	<b>8.4</b>

Water supply available during drought of record conditions (75 days) with existing regulatory condition:

- 7Q10 minimum instream flow standard in effect along the Brandywine Creek at Wilmington (49 mgd).
- Minimum depth flow standard in effect along White Clay Creek at Stanton, 7Q10 passby in effect on White Clay Creek at Newark (14mgd). The 7Q10 flow is the low flow likely to occur for 7 days in a row once every 10 years.
- Groundwater supplies permitted by DNREC allocation permit as per drought of record (2002) conditions.
- Transfers from Chester Water Authority are accounted for as per Delaware Water Supply Self Sufficiency Act of 2003.
- Useable capacity Hoopes Reservoir = 1800 mg over 75 days (24 mgd).
- Useable capacity Newark Reservoir = 300 mg over 75 days (4 mgd).
- Drought of record low streamflows observed during 2002 drought: Brandywine Creek = 21 mgd (8/21/02), White Clay Cr. at Stanton (w/o Hoopes Reservoir Releases) = 6.8 mgd (8/15/02).
- Maximum monthly demands recorded by water purveyors as of 2005, projected out to 2020 at rate similar to Delaware Population Consortium projections. Population increase 3 percent in northern New Castle County from 2005 to 2020.
- UWD Tidal Capture Structure provides 14 mgd plus 5.3 mgd from incoming tide 18 hours per day providing one foot minimum depth in creek. Hoopes Reservoir release reduces chlorides below 250 ppm at TCS during low flow (< 17 mgd). Contract with Wilmington provides up to 200 mg from Hoopes Reservoir to UWD or 2.7 mgd average over 75-day drought.

**Table 6.8. Updated water supply and demand projections for northern New Castle County utilizing baseline maximum monthly water demands recorded as of 2005.**

<i>Year/Scenario</i>	<i>Supply (mgd)</i>	<i>Demand (mgd)</i>	<i>Surplus / Deficit</i>	
			<i>mgd</i>	<i>mg*</i>
<b>2005</b>				
1. Existing: No 7Q10 passby on Brandywine Creek at Wilmington. 7Q10 passby on White Clay Creek at Newark.	100.9	80.2	20.7	1,552
2. Future: 7Q10 passby along Brandywine Creek and along White Clay Creek at Newark.	91.4	80.2	11.2	840
<b>2010</b>				
1. Existing: No 7Q10 passby on Brandywine Creek at Wilmington. 7Q10 passby on White Clay Creek at Newark	100.9	81.6	19.3	1,447
2. Future: 7Q10 passby along Brandywine Creek and along White Clay Creek at Newark.	91.4	81.6	9.8	735
<b>2020</b>				
1. Existing: No 7Q10 passby on Brandywine Creek at Wilmington. 7Q10 passby on White Clay Creek at Newark.	100.9	83.0	17.9	1,342
2. Future: 7Q10 passby along Brandywine Creek and along White Clay Creek at Newark.	91.4	83.0	8.4	630

\* Volume calculated assuming a 75-day drought period.  
7Q10 passby flow along the Brandywine Creek at Wilmington = 49 mgd.  
7Q10 passby flow along the White Clay Creek at Newark = 14 mgd.

These updated water supply and demand projections incorporate projects on the original and new "A" lists as implemented by February 2006, including the Newark Reservoir, Hoopes Reservoir Deep Storage, Newark South Wellfield Treatment Plant, Artesian Water Company New Wells North of C&D Canal, Artesian Water Company Aquifer Storage and Recovery wells, and United Water Delaware's modification of the Tidal Capture Structure Operating Plan. As of February 2006, water purveyors are complying with the 2003 Delaware Water Supply Self Sufficiency Act, which requires the purveyors to have sufficient in system water supplies to meet peak demands forecast for 2009.

With over 1.8 billion gallons of additional storage accumulated by the completion of the Newark Reservoir and other projects completed by Newark, Wilmington, Artesian Water Company, United Water Delaware, and New Castle Municipal Services Commission, northern New Castle County will have a healthy surplus and will be self sufficient with water supply for even the most conservative instream regulatory scenario 2 before the 2009 deadline set by the Delaware Water Supply Self Sufficiency Act.

For reference purposes, estimates of supply and demand through 2020 based on the original maximum monthly demands estimated in 1998 and utilized in the December 1999 and January 2003 reports are tabulated in Appendices A, B, and C.

## 7. Progress and Activities Since the Drought of 1999

### Artesian Water Company

- *New Wells:* In December 1999, AWC was granted an increased seasonal allocation of 0.7 mgd for its Old County Road wellfield. In late 2001, AWC placed in service a new 0.2 mgd well at Artisans Village to re-distribute pumpage in order to fully utilize its wellfield allocation. AWC has added two new wells at Middle Run Crossing in the Piedmont with an allocation of 1.0 mgd. The allocation permit for 3.5 mgd at Chesapeake City Road has been issued by DNREC after a technical and regulatory review period in coordination with the Maryland Department of the Environment. The total capacity provided by the new wells is 5.4 mgd.
- *Aquifer Storage and Recovery:* AWC completed eleven cycles of its Aquifer Storage and Recovery (ASR) testing program at Llangollen at a maximum rate of 2.0 mgd (120 mg over 60 days). Permanent underground injection control (UIC) and water allocation permits were issued for the Llangollen ASR well in 2004. AWC completed the first operational cycle under these permits in November 2004, and is currently injecting to store 135 mg for use during the summer of 2006 (1.7 mgd over a 75 day drought period). AWC completed ASR testing at the Wilmington Manor and Artisans Village sites. Even though the injected water migrated fairly rapidly at Artisans Village, AWC estimates potential yield of 37.5 mg over 75 days for each site (75 mg total). Pending future need for the supply, AWC has halted further activity.
- *Chesapeake and Delaware Canal Pipeline:* In 2004, AWC completed installation of two 20-inch diameter pipelines under the C&D Canal near the Summit Bridge to interconnect water systems on both sides of the canal for assurance of system reliability.

### City of Newark

- *Newark Reservoir:* Completion of a 317-mg reservoir will make the City self-sufficient. The General Assembly contributed \$3.8 million in funding for land acquisition costs. The project is 98 percent complete with the raceway renovated, intake pipeline in place, almost one million cubic yards of soil excavated, and 100 percent of the liner in place. Newark City Council voted to terminate the contract with the initial contractor in January 2004. A new contractor, George and Lynch, was hired by City Council in October 2004 at a cost of \$6 million. City crews performed clean-up and maintenance work during the winter of 2004-05 and construction resumed in March 2005. The City began filling the reservoir in November 2005 at a rate of one foot per day in accordance with dam safety instructions received from the design and construction engineer URS. As of Jan 20, 2006 the reservoir is 42 ft deep with 14 ft more to add. The City the reservoir to be operational by summer of 2006 with a ribbon-cutting to follow shortly thereafter.
- *Newark South Wellfield Iron Treatment Plant:* The City completed construction on the iron, manganese, and organics removal plant at its South Wellfield. The treatment plant was put into service in November 2003. This project increased water supply from the plant by 1.0 mgd.

### City of Wilmington

- *Hoopes Reservoir:* The City proposes to raise the water level in the reservoir two to three feet in conjunction with stability improvements to the dam to provide an additional 150 to 210 mg of water storage. In 2005, the City removed trees to halt root damage to the base of the dam and to facilitate refacing. The proposed work under Phase I (Improved Dam Safety) includes

demolition of the spillway bridge, raising of the spillway crest, installation of vertical post tensioned anchors, and a new terminal structure. The U.S. Army Corps of Engineers determined that a permit is not needed.

- *Hoopes Reservoir Operating Plan:* The City completed an operating plan for Hoopes Reservoir which was approved by the Secretary of DNREC in 2001 which indicates that the City would release from 3 to 5 mgd (500 mg total) of raw water as requested by other utilities provided the reservoir level was between elevation 220 feet (full) and 210 feet (-10 feet). Below an elevation of 210 feet, the City reserves the right to retain the remaining contents of the reservoir for its internal use. The City also recommended reservoir level indicators for the WSCC to use in the Drought Advisory Guidelines.
- *Brandywine Creek to Hoopes Reservoir Pumping Station:* In May 2005, DNREC, in partnership with project contributions from the City of Wilmington and United Water Delaware, retained a consultant (Parsons) to evaluate various pumping and infrastructure scenarios to increase the refill capacity for Hoopes Reservoir and develop an optimized operating plan. Two potential projects associated with this initiative may be a new dedicated pumping station and transmission line for Hoopes, and re-routing of the transmission line from Hoopes to the Porter Filter Plant to allow for gravity flow to Porter and elimination of the Old Mill Pumping Station.
- *United Water Delaware Contract:* On August 28, 2002, Wilmington City Council approved a contract for the sale of water from Hoopes Reservoir to United Water Delaware (UWD) that authorizes UWD to purchase up to 200 mg of raw water annually from the reservoir. The contract provides water from Hoopes Reservoir for release to the Red Clay Creek to supplement water at the UWD intake during low stream flow and/or during times when elevated chloride levels are present at the UWD intakes. Prior to March of every year, the contract requires UWD to pay an annual “reservation charge” for an estimated volume of water ranging from 50 mg to 200 mg. There is an additional “usage charge” for the actual volume of water released from Hoopes for UWD. In the event UWD requests the City to release more than 200 mg, and the City agrees, UWD shall pay the City an “excess release charge.”

### **New Castle Municipal Services Commission**

- *Wells:* With a supply of 1.7 mgd and a peak demand of 0.5 mgd, the New Castle MSC has excess capacity from its wells and can presently sell water to AWC through interconnections when requested.
- *Interconnection:* New Castle MSC completed construction of a new 1.0 mgd interconnection with AWC at the Riveredge Industrial Park in the summer of 2002.

### **United Water Delaware**

- *Chloride Monitoring:* In June 2000, UWD established a chloride monitoring plan to provide early warning of approaching chlorides at its intake on White Clay Creek. As a result of declining stream flows in 2002 and 2005, UWD implemented the plan which monitors chlorides at three stations along the tidal Christina River and White Clay Creek. The plan was designed to provide operational information and data to optimize the use of Hoopes Reservoir releases for blending to minimize chloride levels in drinking water supplies during low stream flows. Using the plan, UWD has been successful in meeting the USEPA standard (250 ppm) in treated water. The plan was valuable in tracking the encroachment of tidal chlorides in 2005 and as a result, Hoopes Reservoir releases were not required.

- *Aquifer Storage and Recovery*: Since 2001, UWD has conducted in depth evaluations of future use of ASR technology at two locations. Testing conducted in 2001 at the Christiana Water Treatment Plant determined that it would not be a feasible location for Aquifer Storage and Recovery. Recent testing conducted at a second location in UWD's River Road service area just north of the C & D Canal concluded good potential for a successful ASR facility. The River Road ASR facility has 180 to 225 mg as a targeted potential storage volume.
- *Christiana Water Treatment Plant Well*: UWD filed for and received an operating permit from DNREC for an existing well (0.3 mgd) at the Christiana Treatment Plant. This well is used for dilution during high chloride events in the Christina River.
- *Interconnections*: UWD signed an agreement with the City of Wilmington in October 2000 for the purchase of 3 mgd of finished water through existing interconnections. The Chatham interconnection was upgraded in 2001 and the Atlas interconnection upgrade was completed in 2002. UWD continues to evaluate the feasibility of additional interconnections with the City of Wilmington.
- *Tidal Capture Structure (TCS) Operating Plan*: UWD worked with DNREC to develop a new operating plan for the TCS that increases the water available to UWD while protecting the ecology and fishery in the tidal White Clay Creek. In January 2005, the Delaware River Basin Commission unanimously voted to approve the docket to replace the 7Q10 minimum flow standard with a standard based on minimum flow depth and chloride provisions. The revised TCS Operating Plan provides UWD with an additional 5.3 mgd during drought for a total of 400 mg of additional water supply as compared to 2002 drought conditions and operation. This number is derived from calculations performed by UWD and reviewed by the State Water Coordinator and were based on the January 2005 DRBC 7Q10 docket decision using 2002 actual operations as the baseline.

## **Interconnected System**

The water purveyors conducted hydraulic testing and modeling to increase the northern Delaware interconnected system capacity to move water during drought or other emergencies. As of December 2003, there were 25 interconnections in place, compared to 23 interconnections in place in 1999. Also, UWD increased the capacity of two interconnections with the City of Wilmington. The peak water transfer through interconnections in 2005 was 3.3 mgd on September 11.

## **Conservation Water Rates**

- *HB 118*: Governor Minner signed HB 118, the Water Supply Self-Sufficiency Act, in July of 2003. The law states that each water utility shall implement a water conservation rate structure for services provided to its residential customers in drought sensitive areas. It shall reflect either an inclining block rate structure or a seasonal rate structure.
- AWC continues its conservation water rate structure that has been in place since 1992.
- Newark increased its water rates (effective July 2001) to fund its proposed reservoir and water treatment plant improvements. The City temporarily discontinued its seasonal conservation water rate structure (in place since 1999) when citizens approved the increase in water rates.
- New Castle Municipal Services Commission instituted a conservation water rate structure in 2001.
- In April 2004, UWD filed an application with the Delaware Public Service Commission to adopt water conservation oriented rates. The Public Service Commission (PSC) approved this request in October 2004, and the new rates went into effect in January 2005.

- The City of Wilmington gathered data from IPA-WRA and other agencies to determine the feasibility of adopting conservation water rates. In February 2005, Wilmington City Council approved a resolution adopting conservation water rates effective July 2005.

### **Northern New Castle County Ground-water Modeling Study**

The DNREC Division of Water Resources signed a contract on May 23, 2000 with the US Army Corps of Engineers to conduct a study, the results of which would provide estimates of the long-term safe yield of ground-water for supply in northern New Castle County. The ground-water modeling area is in the portion of the Coastal Plain that extends north-south from Wilmington to Middletown, Delaware and east-west from New Jersey across New Castle County into Maryland. DNREC and Artesian Water Company recently provided hands-on assistance to the Corps, including field reconnaissance work, to correct gross discrepancies that were discovered in the model's observation well database. DGS developed and provided the Corps with the hydrostratigraphic framework in which the model is based. The corrections have been made and the Corps is preparing to produce model runs shortly after completing the ongoing final calibration task. This oft-delayed study should conclude this year since the duration of the remaining tasks is two months. However, due to the current very slow pace of progress, an exact completion date remains elusive.

### **Governance**

- *SB 370*: In July 2000, Governor Carper signed SB 370, which transferred the jurisdiction for issuing water supply franchise areas, called Certificates of Public Convenience and Necessity (CPCNs), from DNREC to the PSC effective July 1, 2001. On June 5, 2001 the PSC adopted regulations governing the award of CPCNs to public and investor-owned water purveyors statewide.
- *PSC Order No. 6068*: On November 19, 2002, the PSC issued Commission Order No. 6068 which opened an investigation into the water supply available to Artesian Water Company and United Water Delaware: (a) during the drought between March 5 to October 11, 2002, and (b) over the next five years. Pursuant to the order, AWC and UWD were required to submit reports listing available supplies and estimates of peak demand. The reports were filed in January of 2003. The order also directed the PSC staff to issue a report to the PSC Commissioners at the conclusion of its investigation. Subsequently, the PSC contracted with a consulting firm, Parsons, to conduct the investigation. The Parsons report, dated February 2004, concluded that the utilities complied with their responsibilities during the drought of 2002 and have the ability to "provide efficient, sufficient, and adequate" supply for customers within northern New Castle County during future drought conditions.
- *HB 118*: Governor Minner signed HB 118, the Water Supply Self-Sufficiency Act, in July of 2003. The law established a goal of water supply self-sufficiency in northern Delaware by 2010. In March 2005, AWC filed an application for certification of water self-sufficiency with the Public Service Commission (PSC). The Commission is treating the filing as an interim filing, which looks at AWC self-sufficiency through 2006.

### **Glenville Reservoir**

The Glenville residential subdivision (in Stanton south of Delaware Route 4) sustained significant flood-related damage during several storms, most recently from the remnants of Tropical Storm Henri



in mid-September of 2003. The reservoir proposal was suggested to address two significant problems: 1) Glenville residents' desire that the government purchase their properties to allow them to move out of the flood-prone area; and 2) the need to increase reserve water supplies in northern Delaware. The proposal was evaluated on multiple layers, including engineering, environmental, regulatory, economic, and timing factors, as well as community support. This project is no longer under consideration because of the excessive cost of construction relative to the yield. The State of Delaware and New Castle County have bought and removed the flood-prone homes from the Glenville neighborhood and plan to restore the floodplain to wetland habitat.

### **Bread and Cheese Island Reservoir**

DelDOT, DNREC, the U.S. Army Corps of Engineers, and New Castle Conservation District have taken the lead on this project and are currently discussing options for stormwater management and wetlands mitigation on privately owned land on Bread and Cheese Island near Churchmans Marsh. DelDOT's consultant, RKK, presented in September, 2005 two conceptual designs for an upland reservoir with a maximum capacity of 450 mg. A 550 mg reservoir design was rejected as unfeasible due to the cost for the amount of fill material that would have to be imported to the site. At 450 mg, a reservoir would require 80 acres of land and 20 acres of wetlands would be lost. Replacement of filled wetlands would most likely require 1:1 mitigation. No further investigation of this project is planned at this time.

### **Drought Operating Guidelines and Plan**

In the June 24, 2005 Seventh Report to the Governor and General Assembly, the WSCC included an adopted new Drought Operating Plan (DOP) for water purveyors in northern Delaware. This DOP includes Drought Operating Guidelines that incorporate a three-phase drought advisory system (approved in January 2003 by the WSCC). The DOP provides plans – submitted by the purveyors – to utilize surface supplies, ground-water supplies, and interconnections in the event of drought.

As a fortuitous test, the Drought Operating Guidelines and Plan were satisfactorily utilized by DNREC and WSCC during a series of teleconference calls to monitor declining water conditions in northern New Castle County during a dry period between August and October 2005. Following the DOP and guidelines, the criteria indicated the water conditions in northern Delaware were nearing the verge of drought watch but fortunately heavy rains in October 2005 raised stream flow levels back to normal conditions. At the December 8, 2005 WSCC meeting, the members agreed the DOP worked well during the summer 2005 “minidrought” and little modification is needed except maybe to add a 6-month precipitation deficit criteria in addition to the 12-month criteria already utilized.

### **Water Use Recommendations and Restrictions for Three-Phase Drought Operating Plan**

Following the drought emergency of 1999, the DNREC Division of Water Resources, IPA-WRA, and DGS worked with representatives of the Delaware Green Industry to revise rules for water use during droughts. Those rules (approved by the Office of the Governor) were useful in moderating the economic impacts of the mandatory restrictions necessitated by the extreme drought conditions of 2002. That drought of record prompted further collaborative efforts to refine the rules. In the June 24, 2005 *Seventh Report to the Governor and General Assembly*, the WSCC included the approved new language for water use recommendations and restrictions in future droughts.

## **APPENDICES**

*The following tables in Appendices A, B, and C are published for reference purposes and summarize maximum monthly demand projections originally estimated by Consultant Merna Hurd in 1998 and utilized in the December 1999 Governor's Water Supply Task Force Report and the January 2003 Fifth Report to the Governor and General Assembly. Please refer to pages 11 and 12 of this report for updated and current demand projections utilizing maximum monthly demands actually recorded by the water purveyors between 2001 and 2005.*

## Appendix A

### Scenario 1: Existing regulatory condition prior to 2005

No 7Q10 instream flow standard along the Brandywine Creek at Wilmington. Instream standard in effect along White Clay Creek at Stanton, 7Q10 instream flow standard in effect at Newark.

Original maximum monthly demands estimated in 1998  
and utilized in December 1999 and January 2003 reports.

Purveyor	2005			2010			2020		
	Supply	Max Monthly Demand	Surplus/Deficit +/-	Supply	Max Monthly Demand	Surplus/Deficit +/-	Supply	Max Monthly Demand	Surplus/Deficit +/-
<b>Artesian</b>	<b>29.0</b>	<b>24.0</b>	<b>5.0</b>	<b>29.0</b>	<b>26.0</b>	<b>3.0</b>	<b>29.0</b>	<b>27.1</b>	<b>1.9</b>
Groundwater	24.3			24.3			24.3		
CWA Interconn.	3.0			3.0			3.0		
ASR	1.7			1.7			1.7		
<b>United Water DE</b>	<b>25.8</b>	<b>24.0</b>	<b>1.8</b>	<b>25.8</b>	<b>24.1</b>	<b>1.7</b>	<b>25.8</b>	<b>24.4</b>	<b>1.4</b>
Stanton WTP	19.3			19.3			19.3		
Hoopes Contract	2.7			2.7			2.7		
Christiana WTP	3.0			3.0			3.0		
ASR									
CWA Interconn.	0.8			0.8			0.8		
<b>Wilmington</b>	<b>36.3</b>	<b>30.3</b>	<b>6.0</b>	<b>36.3</b>	<b>31.0</b>	<b>5.3</b>	<b>36.3</b>	<b>31.2</b>	<b>5.1</b>
Brandywine Creek	15.0			15.0			15.0		
Hoopes Reservoir	21.3			19.0			19.0		
Raise Hoopes Res.									
<b>Newark</b>	<b>7.8</b>	<b>4.5</b>	<b>3.3</b>	<b>7.8</b>	<b>4.7</b>	<b>3.1</b>	<b>7.8</b>	<b>4.8</b>	<b>3.0</b>
White Clay WTP	0.0			0.0			0.0		
Newark Reservoir	4.0			4.0			4.0		
Groundwater	3.8			3.8			3.8		
<b>New Castle MSC</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>
<b>SUBTOTAL</b>	<b>100.9</b>	<b>83.3</b>	<b>17.6</b>	<b>100.9</b>	<b>86.3</b>	<b>14.6</b>	<b>100.9</b>	<b>88.0</b>	<b>12.9</b>

Water supply available during drought of record conditions (75 days) with existing regulatory condition:

- No minimum instream flow standards in effect along the Brandywine Creek at Wilmington.
- Minimum depth flow standard in effect along White Clay Creek at Stanton, 7Q10 passby in effect on White Clay Creek at Newark (14mgd). The 7Q10 flow is the low flow likely to occur for 7 days in a row once every 10 years.
- Groundwater supplies permitted by DNREC allocation permit as per drought of record (2002) conditions.
- Transfers from Chester Water Authority are accounted for as per Delaware Water Supply Self Sufficiency Act of 2003.
- Useable capacity Hoopes Reservoir = 1800 mg over 75 days (24 mgd).
- Useable capacity Newark Reservoir = 300 mg over 75 days (4 mgd).
- Drought of record low streamflows observed during 2002 drought: Brandywine Creek = 21 mgd (8/21/02), White Clay Cr. at Stanton (w/o Hoopes Reservoir Releases) = 6.8 mgd (8/15/02).
- Maximum monthly demand projections per Merna Hurd report to DNREC, January 1998 and January 1999 *Governor's Water Supply Task Force Report*, and January 2003 *Fifth Report to the Governor and General Assembly*.
- UWD Tidal Capture Structure provides 14 mgd plus 5.3 mgd from incoming tide 18 hours per day providing one foot minimum depth in creek. Hoopes Reservoir release reduces chlorides below 250 ppm at TCS during low flow (< 17 mgd). Contract with Wilmington provides up to 200 mg from Hoopes Reservoir to UWD or 2.7 mgd average over 75-day drought.

## Appendix B

### Scenario 2: Future regulatory condition (hypothetical most conservative scenario)

7Q10 instream flow standard in effect on the Brandywine Creek at Wilmington. Instream standard in effect along the White Clay Creek at Stanton, 7Q10 standard in effect at Newark.

Original maximum monthly demands estimated in 1998

and utilized in December 1999 and January 2003 reports.

Purveyor	2005			2010			2020		
	Supply	Max Monthly Demand	Surplus/Deficit +/-	Supply	Max Monthly Demand	Surplus/Deficit +/-	Supply	Max Monthly Demand	Surplus/Deficit +/-
<b>Artesian</b>	<b>29.0</b>	<b>24.0</b>	<b>5.0</b>	<b>29.0</b>	<b>26.0</b>	<b>3.0</b>	<b>29.0</b>	<b>27.1</b>	<b>1.9</b>
Groundwater	24.3			24.3			24.3		
CWA Interconn.	3.0			3.0			3.0		
ASR	1.7			1.7			1.7		
<b>United Water DE</b>	<b>23.1</b>	<b>24.0</b>	<b>-0.9</b>	<b>23.1</b>	<b>24.1</b>	<b>-1.0</b>	<b>23.1</b>	<b>24.4</b>	<b>-1.3</b>
Stanton WTP	19.3			19.3			19.3		
Hoopes Contract	0.0			0.0			0.0		
Christina WTP	3.0			3.0			3.0		
ASR									
CWA Interconn.	0.8			0.8			0.8		
<b>Wilmington</b>	<b>29.5</b>	<b>30.3</b>	<b>-0.8</b>	<b>29.5</b>	<b>31.0</b>	<b>-1.5</b>	<b>29.5</b>	<b>31.2</b>	<b>-1.7</b>
Brandywine Creek	5.5			5.5			5.5		
Hoopes Reservoir	24.0			24.0			24.0		
Raise Hoopes Res.									
<b>Newark</b>	<b>7.8</b>	<b>4.5</b>	<b>3.3</b>	<b>7.8</b>	<b>4.7</b>	<b>3.1</b>	<b>7.8</b>	<b>4.8</b>	<b>3.0</b>
White Clay WTP	0.0			0.0			0.0		
Newark Reservoir	4.0			4.0			4.0		
Groundwater	3.8			3.8			3.8		
<b>New Castle MSC</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>	<b>2.0</b>	<b>0.5</b>	<b>1.5</b>
<b>SUBTOTAL</b>	<b>91.4</b>	<b>83.3</b>	<b>8.1</b>	<b>91.4</b>	<b>86.3</b>	<b>5.1</b>	<b>91.4</b>	<b>88.0</b>	<b>3.4</b>

Water supply available during drought of record conditions (75 days) with existing regulatory condition:

- 7Q10 minimum instream flow standard in effect along the Brandywine Creek at Wilmington (49 mgd).
- Minimum depth flow standard in effect along: White Clay Creek at Stanton, 7Q10 passby in effect on White Clay Creek at Newark (14mgd). The 7Q10 flow is the low flow likely to occur for 7 days in a row once every 10 years.
- Groundwater supplies permitted by DNREC allocation permit as per drought of record (2002) conditions.
- Transfers from Chester Water Authority are accounted for as per Delaware Water Supply Self Sufficiency Act of 2003.
- Useable capacity Hoopes Reservoir = 1800 mg over 75 days (24 mgd).
- Useable capacity Newark Reservoir = 300 mg over 75 days (4 mgd).
- Drought of record low streamflows observed during 2002 drought: Brandywine Creek = 21 mgd (8/21/02), White Clay Cr. at Stanton (w/o Hoopes Reservoir Releases) = 6.8 mgd (8/15/02).
- Maximum monthly demand projections per Merna Hurd report to DNREC, January 1998, January 1999 *Governor's Water Supply Task Force Report*, and January 2003 *Fifth Report to the Governor and General Assembly*.
- UWD Tidal Capture Structure provides 14 mgd plus 5.3 mgd from incoming tide 18 hours per day providing one foot minimum depth in creek. Hoopes Reservoir release reduces chlorides below 250 ppm at TCS during low flow (< 17 mgd). Contract with Wilmington provides up to 200 mg from Hoopes Reservoir to UWD or 2.7 mgd average over 75-day drought.

## Appendix C

### Water supply and demand projections for northern New Castle County

Original maximum monthly demands estimated in 1998 and utilized in December 1999 and January 2003 reports.

<i>Year/Scenario</i>	<i>Supply (mgd)</i>	<i>Demand (mgd)</i>	<i>Surplus / Deficit</i>	
			<i>mgd</i>	<i>mg*</i>
<b>2005</b>				
1. Existing: No 7Q10 passby on Brandywine Creek at Wilmington. 7Q10 passby on White Clay Creek at Newark.	100.9	83.3	17.6	1,320
2. Future: 7Q10 passby along Brandywine Creek and along White Clay Creek at Newark.	91.4	83.3	8.1	607
<b>2010</b>				
1. Existing: No 7Q10 passby on Brandywine Creek at Wilmington. 7Q10 passby on White Clay Creek at Newark	100.9	86.3	14.6	1,095
2. Future: 7Q10 passby along Brandywine Creek and along White Clay Creek at Newark.	91.4	86.3	5.1	382
<b>2020</b>				
1. Existing: No 7Q10 passby on Brandywine Creek at Wilmington. 7Q10 passby on White Clay Creek at Newark.	100.9	88.0	12.9	967
2. Future: 7Q10 passby along Brandywine Creek and along White Clay Creek at Newark.	91.4	88.0	3.4	255

\* Volume calculated assuming a 75-day drought period.

## Appendix D

### Newark Reservoir filling



Newark Reservoir, looking northeast, December 2005.



Newark Reservoir, looking south, December 2005.

## Appendix E

### Northern New Castle County public water supply well allocations

Owner	Wellfield	Source	Quantity (mg)	
			Day	
Artesian	Airport Industrial Park	Potomac Aquifer	0.720	
	Artisans Village	Potomac Aquifer	3.024	
	Caravel Farms	Potomac Aquifer	0.360	
	Castle Hills	Potomac Aquifer	1.368	
	Collins Park	Potomac Aquifer	0.576	
	Eastern Estates	Potomac Aquifer	1.290	
	Fairwinds	Potomac Aquifer	2.000	
	Glendale	Columbia	0.500	
	Glendale	Potomac Aquifer	1.301	
	Greater Wilmington Airport	Potomac Aquifer	0.864	
	Hockessin	Cockeysville	3.000	
	Jefferson Farms	Potomac Aquifer	1.296	
	Llangollen	Potomac Aquifer	2.218	
	Midvale	Potomac Aquifer	0.576	
	Old County Road	Potomac Aquifer	2.450	
	Wilmington Manor Grounds	Columbia	0.492	
	<i>Wells as of December 1999</i>			
	AVERAGE DAILY			22.035
	Old County Road	Potomac Aquifer	0.700	
	Artisans Village	Potomac Aquifer	0.200	
	Middle Run Crossing	Cockeysville	1.000	
	Chesapeake City Road	Potomac Aquifer	3.500	
	<i>Wells added since December 1999</i>			
AVERAGE DAILY			5.400	
<b>SUBTOTAL</b>			<b>27.435</b>	
City of Newark	South Wellfield	Columbia	1.600	
	South Wellfield	Potomac Aquifer	1.400	
	Laird Tract	Wissahickon Schist	1.800	
	<b>SUBTOTAL</b>			<b>4.800</b>
City of New Castle	All Wells	Potomac Aquifer	1.670	
	<b>SUBTOTAL</b>			<b>1.670</b>
<b>TOTAL</b>			<b>33.91</b>	

## Appendix F

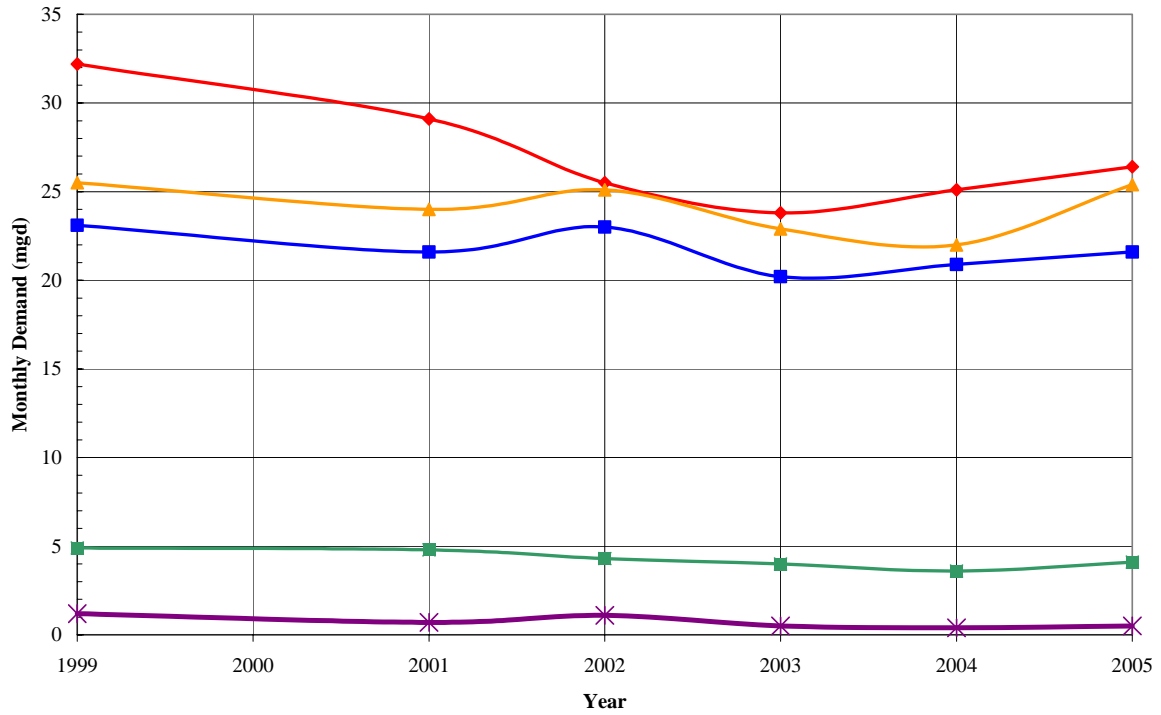
### Maximum monthly water demands for northern New Castle County (1999-2005)

<i>Purveyor</i>	<i>1999</i>	<i>2001</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>
<b>June (mgd)</b>						
City of Wilmington		26.2	24.3	21.5	23.0	25.0
Artesian Water Co.		20.5	20.9	18.5	20.9	21.6
United Water Delaware		21.9	24.3	22.5	21.2	24.0
City of Newark		3.8	4.1	3.5	3.5	4.0
New Castle Board of Water & Light		0.4	0.4	0.4	0.4	0.4
<b>Subtotal</b>		<b>72.7</b>	<b>74</b>	<b>66.4</b>	<b>69.1</b>	<b>74.9</b>
<i>minus Delaware Interconnections</i>		<i>-1.7</i>	<i>-1.8</i>	<i>-1.7</i>	<i>-1.3</i>	<i>-2.8</i>
<b>TOTAL</b>		<b>71.9</b>	<b>72.2</b>	<b>64.7</b>	<b>67.8</b>	<b>72.1</b>
<b>July(mgd)</b>						
City of Wilmington	32.2	26.9	25.5	23.8	23.4	25.7
Artesian Water Co.	23.1	21.1	23.0	20.2	19.3	21.1
United Water Delaware	25.5	23.4	25.1	22.9	22.0	24.9
City of Newark	4.9	4.3	4.3	3.8	3.5	4.0
New Castle Board of Water & Light	1.2	0.5	1.1	0.5	0.4	0.4
<b>Subtotal</b>	<b>87.0</b>	<b>76.2</b>	<b>79.0</b>	<b>71.2</b>	<b>68.6</b>	<b>76.1</b>
<i>minus Delaware Interconnections</i>	<i>-4.3</i>	<i>-1.5</i>	<i>-3.5</i>	<i>-1.7</i>	<i>-0.8</i>	<i>-2.5</i>
<b>TOTAL</b>	<b>82.6</b>	<b>74.8</b>	<b>75.5</b>	<b>69.5</b>	<b>67.8</b>	<b>73.6</b>
<b>August (mgd)</b>						
City of Wilmington	27.8	29.1	24.4	23.3	25.1	26.4
Artesian Water Co.	17.8	21.6	19.8	19.2	18.2	21.3
United Water Delaware	20.6	24.0	23.8	21.2	21.3	25.4
City of Newark	3.9	4.8	4.2	4.0	3.6	4.1
New Castle Board of Water & Light	0.6	0.7	1.0	0.4	0.4	0.5
<b>Subtotal</b>	<b>70.7</b>	<b>80.2</b>	<b>73.3</b>	<b>68.2</b>	<b>68.5</b>	<b>77.7</b>
<i>minus Delaware Interconnections</i>	<i>-2.8</i>	<i>-2.7</i>	<i>-4.6</i>	<i>-1.1</i>	<i>-1.5</i>	<i>-0.9</i>
<b>TOTAL</b>	<b>67.8</b>	<b>77.5</b>	<b>68.7</b>	<b>67.1</b>	<b>67.0</b>	<b>76.8</b>

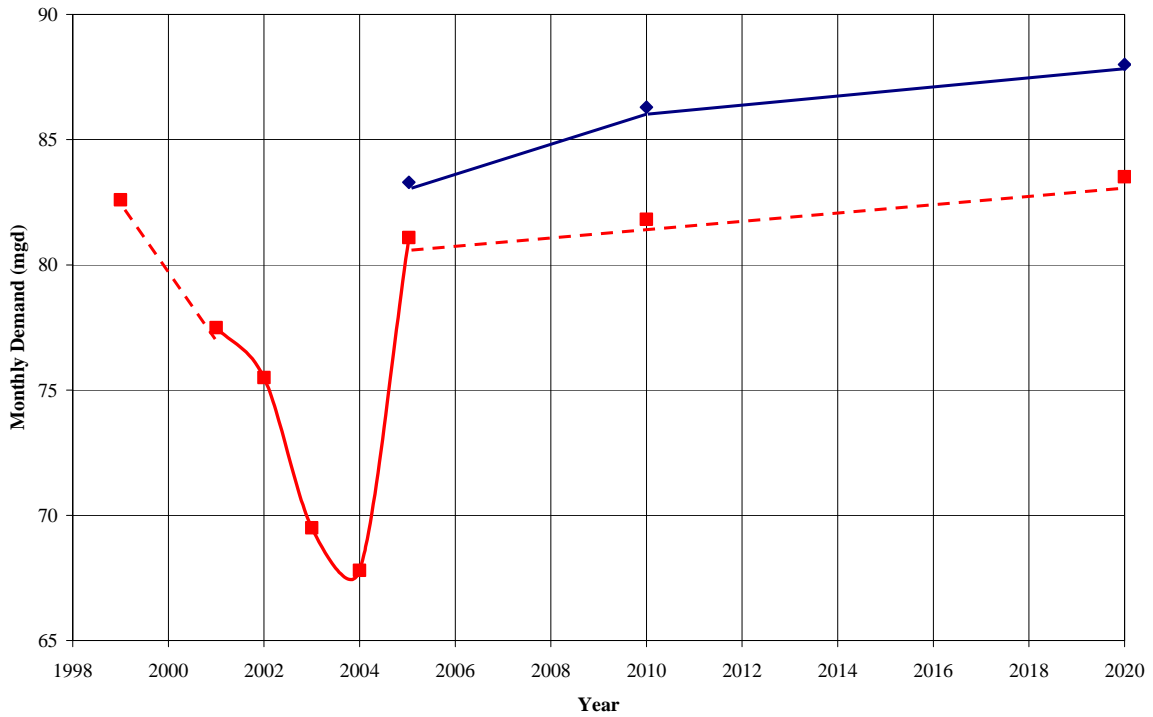


## Appendix G

### Maximum monthly water demands for northern New Castle County



◆ City of Wilmington   
 ■ Artesian Water Co.   
 ▲ United Water Delaware   
 ■ City of Newark   
 ✱ New Castle Board of W & L



◆ Original Estimated Demands (January 2003)   
 ■ Actual / Projected Demands (January 2005)

# Appendix H

## Daily water demands recorded in northern New Castle County during 2005

**PUBLIC WATER PRODUCTION AND DEMAND REPORT**

Northern New Castle County

Jul-05

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	AVG
<b>City of Wilmington</b>	25.52	25.39	24.58	25.7	26.98	26.18	22.3	24.0	22.6	25.1	26.7	24.7	25.3	25.6	23.6	23.9	26.93	25.73	27.68	27.52	28.33	26.5	24.77	26.9	28.2	27.5	25.7	24.3	26.5	24.4	25.7	
* Brandywine Filter Plt.	8.7	9.0	8.9	9.1	9.0	8.8	8.1	7.8	7.8	8.2	8.3	7.9	7.8	7.7	7.7	7.8	8.6	9.1	8.5	8.4	8.9	8.3	7.9	8.0	8.1	7.8	7.8	8.0	8.9	7.8		
* Porter Filter Plant	16.8	16.4	15.6	16.6	17.8	17.2	17.4	14.2	16.2	14.8	16.9	18.4	16.8	17.5	18.0	15.9	16.1	18.4	16.7	19.2	19.1	19.4	18.2	16.8	18.9	20.0	19.7	17.9	16.3	17.6	16.6	
<b>Artesian Water Co.</b>	23.4	21.2	21.9	22.2	23.3	20.4	20.0	19.8	17.3	18.2	19.1	21.3	22.1	22.5	21.9	21.3	18.9	18.5	20.9	20.4	21.1	21.2	21.0	24.5	22.1	22.3	21.9	22.1	21.8	20.9	21.2	21.1
* Wells (North)	18.0	17.5	16.6	16.9	18.3	15.3	15.3	12.8	13.6	14.6	16.8	17.6	17.93	17.49	16.78	14.35	13.75	16.33	15.72	16.45	16.51	16.71	17.58	17.56	17.66	17.21	17.53	17.08	16.25	16.46		
ASR	1.12	0.75	0.96	1.00	0.93	0.96	0.99	1.00	1.00	0.99	0.86	0.94	0.98	0.94	0.98	0.98	0.98	0.98	0.98	0.98	0.95	0.98	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96		
* CWA (PA) Intercon.	3.59	2.21	3.55	3.60	3.40	3.45	3.57	3.53	3.50	3.53	3.52	3.63	3.56	3.56	3.49	3.55	3.54	3.75	3.64	3.69	3.66	3.73	2.78	5.29	3.60	3.67	3.75	3.63	3.74	3.64	3.75	
* New Castle Intercon.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
* Wilmington Intercon.	0.69	0.71	0.71	0.64	0.67	0.66	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.53	0.66	0.00	0.00	0.00	0.00	0.00	0.00		
Wells (South)																																
<b>United Water Delaware</b>	24.8	24.6	24.7	24.8	24.4	24.6	24.4	23.7	25.0	25.0	26.9	23.9	23.5	23.7	24.1	23.7	25.3	25.9	25.0	25.3	25.1	26.9	26.5	26.7	26.8	25.1	24.5	23.6	25.8	24.0	25.3	24.9
* White Clay Cr./Stanton	23.8	23.6	23.7	23.8	23.4	23.6	23.4	22.7	24.0	24.0	23.6	22.6	21.2	22.4	22.8	22.4	24.0	24.6	23.7	24.0	23.8	25.6	25.2	25.4	25.8	24.1	23.5	22.6	24.8	23.0	24.3	
- Hoopes Release	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Raw Chlorides(Stanton F	56	42	40	48	39.5	35	42.33	41	30	32	53	37	38	40	41	35	34	37	36	47	62	40	37	47	42	51	31	39	35	38	41	
.newport bridge	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
.churchman's	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
.tcs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
* Christina River WTP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
* CWA (PA) Intercon.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
* Artesian Intercon.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
* Wilmington Intercon.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
<b>City of Newark</b>	4.1	3.3	3.5	5.4	4.1	3.1	4.6	3.4	3.0	4.3	4.0	4.1	4.3	3.5	4.5	3.8	2.8	4.0	4.8	3.9	4.1	4.5	3.8	4.4	5.0	3.6	4.1	3.1	4.8	3.6	3.4	4.0
* White Clay Cr. WTP	2.0	1.6	1.6	1.5	1.7	1.1	0.8	0.0	0.0	0.7	1.7	1.9	1.8	1.8	1.9	1.7	0.0	0.0	0.6	1.6	1.9	1.7	0.8	0.7	1.7	1.6	1.7	0.0	1.2	1.6	1.4	
* Wells	1.5	1.4	1.3	2.0	1.4	1.7	2.1	2.1	1.7	2.1	1.7	1.7	1.7	1.7	1.7	1.5	1.5	2.0	2.2	1.8	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.2	1.6	1.6	1.6	
* United Intercon.	0.6	0.3	0.6	1.9	1.0	0.3	1.7	1.3	1.3	1.5	0.6	0.5	0.8	0.0	0.9	0.6	1.3	2.0	2.0	0.5	0.5	1.1	1.3	2.0	1.6	0.3	0.8	1.9	2.0	0.4	0.4	
* Artesian Intercon.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
<b>New Castle Bd. of W &amp; I</b>	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.3	0.3	0.4	0.5	0.5	0.3	0.4	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.3	4.0
* Wells	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.3	0.3	0.4	0.5	0.5	0.3	0.4	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.3	
<b>Subtotal</b>	78.2	74.9	75.0	78.5	79.1	74.7	75.7	69.6	69.7	70.3	75.4	76.4	75.1	75.5	76.4	72.8	71.1	75.6	76.9	77.7	78.2	81.4	78.3	80.7	81.2	79.6	78.5	75.1	77.2	75.4	74.5	76.1
- Del. Interconnections	-1.3	-1.0	-1.3	-2.5	-1.7	-1.0	-1.8	-1.3	-1.3	-1.5	-0.6	-0.5	-0.8	0.0	-0.9	-0.6	-1.3	-2.0	-2.0	-0.5	-0.5	-1.1	-1.8	-2.7	-1.6	-0.3	-0.8	-1.9	-2.0	-0.4	-1.2	
<b>TOTAL</b>	76.9	73.9	73.7	75.9	77.4	73.8	73.8	68.3	68.4	68.8	74.8	75.9	74.3	75.5	75.5	72.2	69.8	73.6	74.9	77.2	77.7	80.3	76.4	78.1	79.6	79.3	77.7	73.2	75.2	75.0	74.1	74.9

Note: Water demand data provided by the public water purveyors and compiled by the University of Delaware, Institute for Public Administration, Water Resources Agency.

**PUBLIC WATER PRODUCTION AND DEMAND REPORT**  
**Northern New Castle County**  
**Aug-05**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	AVG
City of Wilmington	26.42	27.29	28.02	28.8	29.32	27.8	25.83	27.4	23.4	27.2	23.5	26.6	29.2	27.0	27.0	25.5	24.9	26.63	26.83	24.06	26.75	25.93	25.54	27.05	26.3	28.8	24.1	23.0	26.0	25.4	26.8	26.4
* Brandywine Filter Plt.	7.94	8.02	7.83	8.37	7.99	8.09	7.80	8.26	7.95	8.22	4.32	8.00	7.95	8.23	7.80	7.95	8.35	8.42	9.00	8.91	8.66	8.74	5.04	8.35	8.05	9.80	6.41	7.20	7.82	7.96	8.11	
* Porter Filter Plant	18.48	19.27	20.20	20.38	21.32	19.72	18.04	19.14	15.41	18.97	19.17	18.63	21.24	18.74	19.24	17.59	16.50	18.21	17.83	15.16	18.09	17.19	20.50	18.70	18.21	18.96	17.74	15.78	18.18	17.46	18.72	

Artesian Water Co.	21.5	22.0	21.7	22.8	23.0	22.1	22.4	23.1	20.0	21.2	21.2	21.5	21.7	21.5	25.4	22.1	18.6	19.0	20.8	21.1	21.0	19.6	21.2	21.0	22.4	22.2	22.6	20.1	18.3	19.9	20.1	21.3
* Wells (North)	16.85	17.41	17.10	18.19	18.25	17.47	17.75	18.43	15.73	16.49	16.38	16.86	17.13	16.86	20.72	18.40	14.36	14.74	16.44	16.25	15.82	14.79	16.60	16.29	17.70	17.54	17.90	15.62	13.53	15.13	15.51	
ASR	0.93	0.94	0.97	0.94	1.01	0.96	0.96	0.96	0.70	0.96	1.12	0.92	0.97	0.93	0.95	0.53	0.00	0.00	0.14	0.96	0.96	0.95	0.95	0.96	0.95	0.97	0.95	0.95	0.95	0.95	0.95	
* CWA (PA) Intercon.	3.71	3.65	3.67	3.65	3.74	3.69	3.73	3.69	3.58	3.73	3.70	3.71	3.56	3.66	3.71	3.21	3.49	3.53	3.47	3.46	3.65	3.82	3.62	3.80	3.74	3.70	3.72	3.57	3.77	3.77	3.60	
* New Castle Intercon.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
* Wilmington Intercon.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

Wells (South)

United Water Delaware	26.0	25.5	25.2	25.9	27.4	24.5	24.4	27.4	24.7	24.5	25.0	25.1	24.8	26.2	26.5	27.1	24.4	25.8	29.6	27.3	24.2	23.9	22.3	24.4	23.9	26.0	25.3	24.3	24.4	25.1	25.5	25.4
* White Clay Cr./Stantc	25.0	24.5	24.2	24.9	23.0	23.5	23.4	24.9	23.7	23.2	23.7	23.8	23.5	21.7	22.0	22.5	19.5	21.0	24.3	23.0	20.9	22.6	21.0	23.1	21.9	25.0	24.3	23.3	23.4	24.1	24.5	
- Hoopes Release	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Raw Chlorides(Stanton F	38	44	37	50	57	45	32	50	39	35	49	44	42	47	43	43	45	40	40	55	68	41	34	45	47	46	51	49	52	45	49	
.newport bridge	0	0	0	0	0	0	0	190	135	190	160	204	260	170	195	270	240	200	240	353	430	330	248	330	310	330	377	405	400	450	0	
.churchman's	0	0	0	0	0	0	0	0	0	0	0	120	110	122	130	120	115	120	187	220	215	138	210	180	200	269	240	220	270	0	0	
.tcs	0	0	0	0	0	0	0	0	0	0	0	0	40	40	42	40	40	39	40	45	45	110	37	40	40	45	43	42	55	51	0	
* Chrisina River WTP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	3.2	3.2	3.3	3.6	3.5	4.0	3.0	2.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
* CWA (PA) Intercon.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
* Artesian Intercon.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
* Wilmington Intercon.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

City of Newark	3.5	4.4	4.5	4.5	4.3	3.7	3.8	3.5	3.5	3.4	5.6	4.3	4.7	3.9	4.6	3.3	3.4	3.6	3.4	3.6	4.9	5.4	4.2	3.3	3.7	4.0	5.4	4.0	4.6	3.9	4.2	4.1
* White Clay Cr. WTP	1.6	1.9	1.9	2.0	1.8	1.7	1.8	1.8	1.7	1.6	1.6	1.9	1.9	1.8	1.9	1.7	1.8	1.9	1.7	1.9	1.8	1.3	2.4	1.7	2.0	1.6	1.8	1.6	1.7	1.6	1.8	
* Wells	1.5	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	1.6	1.6	1.6	1.7	1.5	1.6	1.6	1.4	1.6	1.7	
* United Intercon.	0.4	0.8	0.9	0.8	0.8	0.3	0.3	0.0	0.1	0.1	2.3	0.7	1.1	0.5	1.1	0.0	0.0	0.0	0.0	0.0	1.4	2.5	0.2	0.0	0.0	0.9	2.0	0.8	1.5	0.7	0.7	
* Artesian Intercon.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

New Castle Bd. of W & I	0.4	0.5	0.5	0.5	0.5	0.4	0.3	0.4	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.5	0.5	0.3	0.4	0.3	0.3	0.5	0.5	0.6	0.4	0.4	0.4	0.4	0.5	0.5	0.4
* Wells	0.4	0.5	0.5	0.5	0.5	0.4	0.3	0.4	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.3	0.4	0.3	0.3	0.5	0.5	0.6	0.4	0.4	0.4	0.4	0.5	0.5	0.4

Subtotal	77.8	79.7	80.0	82.4	84.5	78.6	76.8	81.8	72.0	76.7	75.7	78.0	80.7	78.9	84.0	78.6	71.7	75.5	80.9	76.5	77.1	75.1	73.7	76.3	76.9	81.3	77.9	71.8	73.6	74.8	77.1	77.6
- Del. Interconnections	-0.4	-0.8	-0.9	-0.8	-0.8	-0.3	-0.3	0.0	-0.1	-0.1	-2.3	-0.7	-1.1	-0.5	-1.1	0.0	-0.7	-0.7	-0.5	-1.9	-2.5	-0.2	0.0	0.0	-0.9	-2.0	-0.8	-1.5	-0.7	-0.7	-0.8	

TOTAL	77.4	78.9	79.1	81.6	83.7	78.3	76.5	81.8	71.9	76.6	73.4	77.3	79.6	78.4	82.9	78.6	71.0	74.8	80.1	76.0	75.2	72.6	73.5	76.3	76.9	80.4	75.9	71.0	72.1	74.1	76.4	76.8
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Note: Water demand data provided by the public water purveyors and compiled by the University of Delaware, Institute for Public Administration, Water Resources Agency.





# Appendix I

## Chloride concentrations recorded in the White Clay Creek and Christina River during 2005

**Chlorides, August-October 2005**

