

State of Delaware

Drought Management

DRBC – Water Management Advisory Committee

Trenton, New Jersey

October 27, 2016

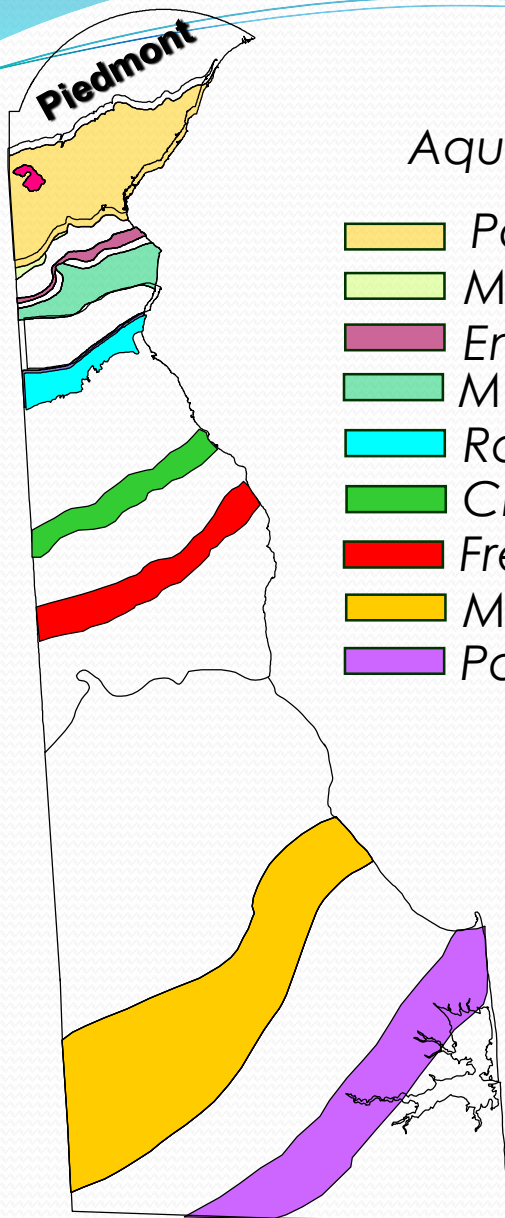
John T. Barndt, P.G

Department of Natural Resources and Environmental
Control

Division of Water

Presented to an advisory committee of the DRBC.

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Aquifers

- Potomac
- Magothy
- Englishtown
- Mt. Laurel
- Rancocas
- Cheswold
- Frederica
- Manokin
- Pokomoke

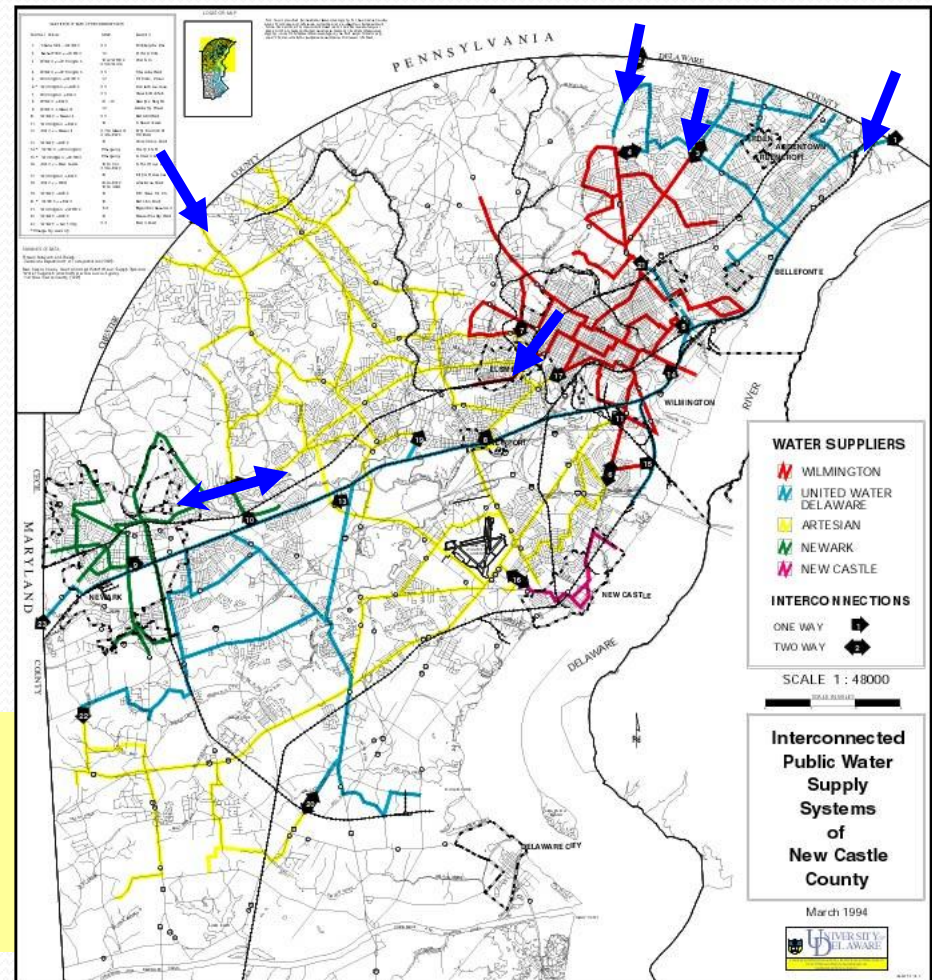
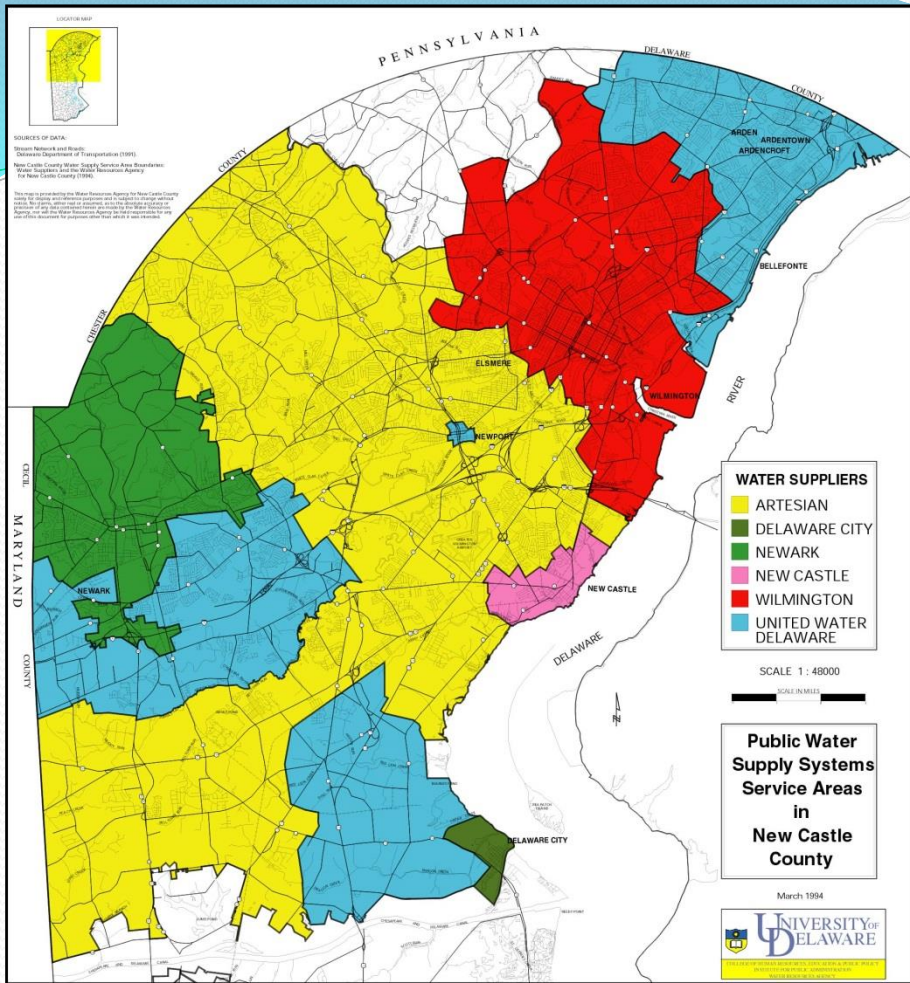
Piedmont Province – Primarily reliant on freshwater streams – Brandywine Creek, Red Clay Creek, White Clay Creek

Coastal Plain Province – Exclusively reliant on groundwater aquifers – Aquifer use varies from the Fall line to Fenwick Island

Northern Delaware Focus

- The Piedmont Province communities rely primarily on surface streams and reservoirs for Drinking Water
- Major public water systems include the City of Wilmington, City of Newark, and the SUEZ Water
- These systems are always the first to feel impacts of low water availability as streamflow's decline such as has occurred this year
- Communities elsewhere rely on groundwater aquifers which are less impacted by short term dry periods

New Castle County Public Water Supply System Service Areas



New Castle County Public Water Supply System Interconnections

Agencies

- DNREC/DGS/UD-WRA
- Water Supply Coordinating Council (WSCC)
- Governors Drought Advisory Committee (GDAC)
- Governor

Creation of the Delaware Water Supply Coordinating Council

- WSCC originally created in 1999 by Executive Order.
- WSCC now in Delaware Statute and later with Council additions such as the State Climatologist; recently WSCC reauthorized to January 31, 2022
- Largely focused on addressing Water Supply issues in Northern New Castle County including a role in addressing droughts
- Prepares periodic reports to the Governor and General Assembly (see <http://www.dnrec.delaware.gov/Admin/Pages/WSCC.aspx>)

Water Supply Coordinating Council

- *Office of the Governor* *
- *DNREC (Chair)* *
- *Public Safety* *
- *Agriculture* *
- *Public Service Commission* *
- Emergency Management
- *DGS* *
- State Climatologist
- Public Advocate
- UD-WRA
- DRBC, Director
- *Division of Public Health* *
- New Castle County
- Artesian Water
- City of Newark
- City of Wilmington
- Delaware Farm Bureau
- Center for Inland Bays
- *State Fire Marshal* *
- New Castle Water
- Tidewater Utilities
- SUEZ (United Water Delaware)
- NCC Chamber of Commerce
- Delaware Chamber of Commerce
- Nursery and Landscape Assoc.
- Grounds Management Assoc.
- State Golf Assoc.
- Delaware Nature Society
- Coalition of Natural Stream Valleys
- New Castle Civic League
- Kent County
- Sussex County
- SCAT Water Utility Member
- Kent County Water Utility Member
- DRWA
- National Assoc. Water Utilities
- Chamber of Commerce - Kent, Sussex, NCC

* *Organizations also on GDAC*

Delaware Drought Advisory Committee

- The Drought Advisory was created by Executive order and convened to advise the Governor on Drought Declarations for either a Drought Warning or Drought Emergency:
 - i. Governor's Chief of Staff (chairman)
 - ii. Secretary of DNREC
 - iii. Secretary of Public Safety
 - iv. Chairman of Public Service Commission
 - v. Director of the Delaware Geological Survey
 - vi. State Fire Marshal
 - vii. Secretary of the Department of Agriculture
 - viii. Secretary of the Department of Health and Social Services

Generally How it Works

- The Delaware Geological Survey tracks primary drought indicators including USGS's stream flows, DRBC Main stem salt line, and DGS's well water elevations
- As indicators move towards any drought category, the DGS, DNREC, and WRA meet weekly to review the status; others such as water purveyors and state climatologist may be asked to participate as conditions warrant
- These three provide updates to DNREC/Governors Office, DGS, and the WSCC as needed, based on these indicators
- As warranted, the WSCC is convened to discuss the status of the indicators and determine if a Drought Watch should be recommended
- Governors Drought Advisory Committee convened to determine additional Declarations and address water conservation measures

Drought Status – All stages require a declaration by the Governor

- Drought Watch – Voluntary Conservation (recommended by the WSCC); This was added after the 2002 Drought Warning and Emergency
- Drought Warning - ‘Enhanced’ Voluntary Conservation (recommended by the GDAC)
- Drought Emergency – Mandatory Restrictions (recommended by the GDAC)
- All three stages require a declaration by the Governor

Specific outlined conservation measures under these declarations are found on <http://www.dnrec.delaware.gov/Admin/Pages/WSCC.aspx>

Northern Delaware Drought Advisory Guidelines

- Described in detail in WSCC Sixth & Seventh Reports (2004, 2005)
- Precipitation averages (12 and 6 month)
- Stream flow 30 day moving average – Brandywine Creek, White Clay Creek – Stanton, White Clay Creek – Newark
- Groundwater elevation (Db24-18)
- Chlorides at Newport and Stanton stations
- Hoopes Reservoir Capacity
- Newark Reservoir Capacity
- Other Monitored Indicators – ASR, Octoraro Reservoir, March Creek Reservoir, Chlorides on Delaware River, NYC DRB Reservoir

Northern Delaware Drought Advisory Guidelines

Reported by the Drought Advisory Guidelines Subcommittee (DAGS), which is composed of the Delaware Department of Natural Resources and Environmental Control, Delaware Geological Survey, and University of Delaware Water Resources Agency with input from the water purveyors and representatives from the landscaping industry. These drought operating guidelines are designed to provide guidance to the Delaware Water Supply Coordinating Council (WSCC) and the Governor's Drought Advisory Committee (GDAC). Responsibility for providing technical guidance for a move up to or down from Drought Watch is with the WSCC. Responsibility for providing technical guidance for a move up to or down from Drought Warning or Emergency is with the GDAC. Final declaration of drought advisories rests with the Governor.

Indicators	Drought Watch Voluntary Conservation	Drought Warning Voluntary Conservation	Drought Emergency Mandatory Restrictions	Status Sept. 28, 2016
Precipitation Wilmington Airport 12-month	-6.00" to -8.99"	-9.00" to -11.99"	>-12.00"	-2.87" (deficit increased by 0.48")
Precipitation Wilmington Airport 6-month	-3.00" to -4.50"	-4.50" to -6.00"	>-6.00"	-1.90" (deficit increased by 0.49")
Brandywine Creek (30-day moving avg)	85 mgd	70 mgd	48 mgd	75.5 mgd (flow increased by 2.9 mgd)
White Clay Creek - Stanton (30-day moving avg)	42 mgd	37 mgd	31 mgd	33.1 mgd (flow increased by 1.0 mgd)
White Clay Creek - Newark (30-day moving avg)	19 mgd	16 mgd	13 mgd	14.3 mgd (no change)
Well Db24-18	14 - 14.99 (fbls)	15 - 15.99 (fbls)	16 (fbls)	13.81 (fbls) (gw level declined by 0.44 ft)
Water Conditions Index	4.0-5.0	3.0-3.99	<3.00	4.35 (Index increased by .22)
Chlorides	WCC ≤ 37 mgd for 5 consecutive days at SUEZ Stanton Intake	Cl > 250 ppm for 3 days at Christina River at Newport	Cl > 250 ppm for 3 days at UWD Stanton Intake	Monitoring 512 ppm (Cl decreased by 163 ppm)
Hoopes Reservoir (City of Wilmington)	-10 ft (68% capacity)	-12 ft (64% capacity)	-15 ft (57% capacity)	-3.7 ft (9/19/2016)
Newark Reservoir	-10 ft (70% capacity)	-17 ft (52% capacity)	-27 ft (28% capacity)	-11.0 ft (9/16/2016)
Monitored				
Aquifer Storage and Recovery	Monitor Status	Monitor Status	Monitor Status	SUEZ: .102mg (9/6/2016) AWC: 49 mg (9/19/2016)
Octoraro Reservoir (Chester Water Authority)	Monitor Status	Monitor Status	Monitor Status	

Marsh Creek Reservoir	Monitor Status	Monitor Status	Monitor Status	PA DCNR releasing ~7.8 mgd into Brandywine Creek
Chlorides on the Delaware River 9/22/2016	Monitor Status	Monitor Status	Monitor Status	Normal RM: 76 Current RM: 82 (Commodore Barry Bridge)
DRBC Lower Basin Drought Criteria	Monitor Status	Monitor Status	Monitor Status	
NYC DRB Reservoirs (DRBC 9/23/2016)	Monitor Status	Monitor Status	Monitor Status	Storage 180.3 bg or 63 bg above drought watch

fbis = feet below land surface
mg = million gallons
mgd = million gallons per day
RM = River Mile
bg = billion gallons

Delaware Geological Survey:

<http://www.dgs.udel.edu>

U.S. Geological Survey Streamflows:

<http://waterdata.usgs.gov/de/nwis/current/?type=flow>

Delaware River Basin Commission:

<http://www.state.nj.us/drbc>

Delaware Environmental Observing System

<http://www.deos.udel.edu>

Delaware Geological Survey

State of Delaware
University of Delaware • Delaware Geological Survey Building
Newark, Delaware 19716-7501



Kent County Hydrologic Conditions – September 28, 2016

PRECIPITATION

Dover – Running surplus/deficit

12-month: -3.60" 6-month: -2.00" 5-month: +0.13"

STREAMFLOW

St. Jones at Dover – 30-day moving average for August 31 through September 28

10.4 MGD Status: Normal

GROUNDWATER

Mc51-01a – September 2016

15.1 ft below land surface Status: Below Normal

Sussex County Hydrologic Conditions – September 28, 2016

PRECIPITATION

Georgetown - Running surplus/deficit

12-month: +6.60" 6-month: +4.32" 5-month: +3.97"

STREAMFLOW

Nanticoke River at Bridgeville - 30-day moving average for August 31 through September 28

24 MGD Status: Normal

GROUNDWATER

Qe44-01 – September 2016

10.8 ft below land surface Status: Normal

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

As Amended and Approved by the Delaware Water Supply Coordinating Council, September 17, 2014.

Water Use Recommendations for Drought Watch

Lawn and Turf Watering (including residential, commercial, institutional, and government uses)

- Use of potable water for lawns and turf should be minimized and performed in a conservative manner.

Landscape Plant Watering (including residential, commercial, institutional, and government uses)

- Use of potable water for outdoor landscape plants (including groundcover, flowers, shrubs, and trees) should be minimized and performed in a conservative manner.

Golf Courses and Athletic Fields

- Use of potable water for turf and landscape plants should be minimized.
- All outdoor watering should be performed by efficient means in a conservative manner.
- A facility-specific drought management plan should be developed or updated in preparation for a drought emergency.
- Recommendation: Where a source of non-potable water exists at the location of use it should be used in lieu of potable water, in a conservative manner.

Miscellaneous Uses

- Water should be served in public establishments only at the customer's request.

Water Use Recommendations for Drought Warning

Lawn and Turf Watering (including residential, commercial, institutional, and government uses)

- Use of potable water for “established” lawns and turf should be avoided. Watering of “newly-planted” turf should be limited to between the hours of 5 p.m. and 9 a.m. by any efficient means.
- Recommendation: Where a source of non-potable water exists at the location of use it should be used in lieu of potable water in a conservative manner.
- “Established” means planted for one year or more. “Newly-planted” means planted for less than one year.

Landscape Plant Watering (including residential, commercial, institutional, and government uses)

- Use of potable water for “established” landscape plants (including groundcover, flowers, shrubs, and trees), should be avoided.
- Use of potable water for watering of landscape plants should be limited to those which are newly-planted. These plants should be watered either manually or with soaker hoses.
- Irrigation bags or similar devices are recommended for trees and other individual plants.
- Nursery stock should be watered by any efficient means.
- Recommendation: Where a source of non-potable water exists at the location of use it should be used in lieu of potable water in a conservative manner.
- “Established” means planted for one year or more. “Newly-planted” means planted for less than one year.

Golf Courses and Athletic Fields

- Use of potable water should be limited to between the hours of 5 p.m. and 9 a.m. for tees, greens, and fairways to prevent damage.

- Watering of grass or clay courts and athletic fields should be limited to between the hours of 5 p.m. and 9 a.m.
- Water conservation measures and the use of drought best management practices should be used to reduce water use.
- All facilities’ drought management plans shall be finalized, submitted to DNREC, and readied for implementation.
- Recommendation: Where a source of non-potable water exists at the location of use it should be used in lieu of potable water and may be applied to any part of the facility in a conservative manner.

Miscellaneous Uses

- Water shall be served in public establishments only at the customer’s request.
- Use of potable water for washing private vehicles is permitted only by the use of a bucket and a hose with a flow-control nozzle.
- The use of potable water for washing paved surfaces is prohibited, except for sanitation.
- Watering required in earthworks projects for erosion and sediment control shall be done under plans approved by the prevailing governmental agency.

NOTICE: Individual water providers have the authority to impose more restrictive limits for demand management purposes.

Emergency Restrictions

- Lawn and Turf Watering
- Landscape Plant Watering
- Golf Courses and Athletic Fields
- Miscellaneous Uses e.g. eating establishments, vehicle washing, pools, etc

Mandatory Water Use Restrictions for Drought Emergency

Lawn and Turf Watering (including residential, commercial, institutional, and government uses)

- The use of potable water for watering of "established" lawns and turf is prohibited.
- The following uses of potable water are permitted, only to the minimum extent necessary to prevent damage:
 - Use of potable water for "newly-planted" turf areas shall be limited to between the hours of 5 p.m. and 9 a.m. by any efficient means and in a conservative manner.
 - Landscaping work over 10,000 square feet, under contract as of the declaration of drought emergency, may be watered by any efficient means and in a conservative manner.
 - Pesticides may be watered-in within 2 days of application using the recommended rate and only between the hours of 5 p.m. and 9 a.m.
 - Newly-installed irrigation systems may be tested by the contractor up to 10 minutes per zone and a sign on the premises shall be displayed stating testing is occurring.
 - Where a source of non-potable water exists at the location of use it must be used in lieu of potable water in a conservative manner.
 - Diversions from sources of public water supply for non-potable uses may be restricted.
- "Established" means planted for one year or more. "Newly-planted" means planted for less than one year.

Landscape Plant Watering (including residential, commercial, institutional, and government uses)

- The use of potable water for watering of "established" landscape plants is prohibited.
- The following uses of potable water are permitted, only to the minimum extent necessary to prevent damage:
 - "Newly-planted" landscape plants may only be watered manually or with soaker hoses, and only between the hours of 5 p.m. and 9 a.m. with the user in attendance.
 - Pesticides may be watered-in within 2 days of application using the recommended rate, and only between the hours of 5 p.m. and 9 a.m.
 - Newly-installed irrigation systems may be tested by the contractor up to 10 minutes per zone and a sign on the premises shall be displayed stating testing is occurring.

- Nursery stock may be watered by any efficient means for only 2 periods per day totaling no more 6 hours, with no more than 10 minutes of syringing of stressed plants between the hours of 12 noon and 3 p.m. ["Syringing" is the application of light amounts of water for the purpose of: (1) preventing wilt; (2) reducing transpiration; (3) cooling turf (and/or other plants).]
- Where a source of non-potable water exists at the location of use it must be used in lieu of potable water in a conservative manner.
- Diversions from sources of public water supply for non-potable uses may be restricted.
- Exceptions:
 - Self-supplied public gardens may be watered conservatively by any efficient means and only to prevent damage.
 - Irrigation bags or similar devices may be used for trees and other individual plants.
 - Commercial watering is permitted beyond one year after planting if required by the applicable contract.
- "Established" means planted for one year or more. "Newly-planted" means planted for less than one year.

Golf Courses and Athletic Fields

- All facilities' drought management plans as submitted to DNREC shall be implemented.
- Use of potable water is allowed between the hours of 5 p.m. and 9 a.m. and only to prevent damage to tees and greens.
- Watering of grass or clay courts and athletic fields is allowed only between the hours of 5 p.m. and 9 a.m. to maintain playability.
- Where a source of non-potable water exists at the location of use it must be used in lieu of potable water and may be applied to any part of the facility in a conservative manner.
- Diversions from sources of public water supply for non-potable uses may be restricted.
- Exception: Daytime syringing for heat sensitive grasses is permitted to prevent damage. ["Syringing" is the application of light amounts of water for the purpose of: (1) preventing wilt; (2) reducing transpiration; (3) cooling turf (and/or other plants).]

Miscellaneous Uses

- Water shall be served in public establishments only at the customer's request.
- The use of potable water for non-commercial washing of private vehicles is prohibited.
- The use of potable water for washing paved surfaces is prohibited, except for sanitation.
- Opening of hydrants or flushing of water mains is prohibited, except for public protection purposes and shall be performed only by authorized personnel.
- The use of potable water for filling of swimming pools is prohibited except for filling of therapeutic pools or to prevent structural damage to new pools.
- The use of potable water for topping off swimming pools is permitted only to the extent necessary to maintain proper filtration.
- The use of potable water for fountains and ornamental pools is prohibited unless they are supporting fish or plants.
- Watering required in earthworks projects for erosion and sediment control shall be done under plans approved by the prevailing governmental agency.
- Where a source of non-potable water exists at the location of use it must be used, when appropriate, in lieu of potable water in a conservative manner.
- Diversions from sources of public water supply for non-potable uses may be restricted.
- Exception: Use of potable water is allowed for the production of food, fiber, nursery stock, sod, flowers, livestock, and poultry.

NOTICE: Individual water providers have the authority to impose more restrictive limits for demand management purposes.

Highlights of Drought Operating Plan

- Described in the 7th WSCC Report dated 2005 (see previous link) and includes the steps taken under a Drought Watch, Warning, and Emergency for the following:
 1. Artesian Water Company
 2. SUEZ (formerly United Water Delaware)
 3. City of Wilmington
 4. City of Newark
 5. New Castle Municipal Services Commission

Drought Operating Plan Example - SUEZ

- Annual **reservations of water from Hoopes Reservoir** for release during extended dry periods
- **Weekly demands reported** to WRA during dry periods
- **Tidal Control Structure** use during low stream flow when heads at Stanton intake is needed (Fall limits to protect migrating fish)
- **Tidal Control Structure use to pool freshwater** as stream flows continue to decline
- **Chloride monitoring program** begins when stream flow at Stanton drops to 37 mgd or below for 5 consecutive days
- Purchased water **releases from Hoopes Reservoir** by Wilmington as needed to reduce chlorides at Stanton
- Possible activation of **Christiana Water Treatment Plant**
- Options to **purchase treated water** from interconnected systems will be evaluated

Figure 1. Increase in water supply in northern New Castle County, Delaware since drought of 1999.

Water Supply Storage Since Drought of 1999 Northern New Castle County, Delaware

Increase Hoopes
Reservoir Storage,
(Wilmington)
150 mg

New Wells North of
C&D Canal (Artesian)
405 mg

Hoopes
Reservoir

Deep Storage
(Wilmington)
500 mg

Aquifer Storage and
Recovery (Artesian)
130 mg

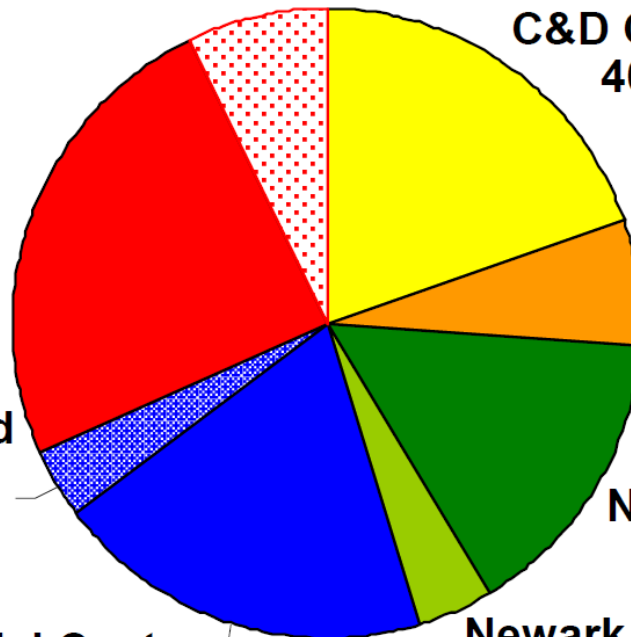
Aquifer Storage and
Recovery (SUEZ)
75 mg

Newark Reservoir
317 mg

75 mg

Tidal Capture
Structure (SUEZ)
400 mg

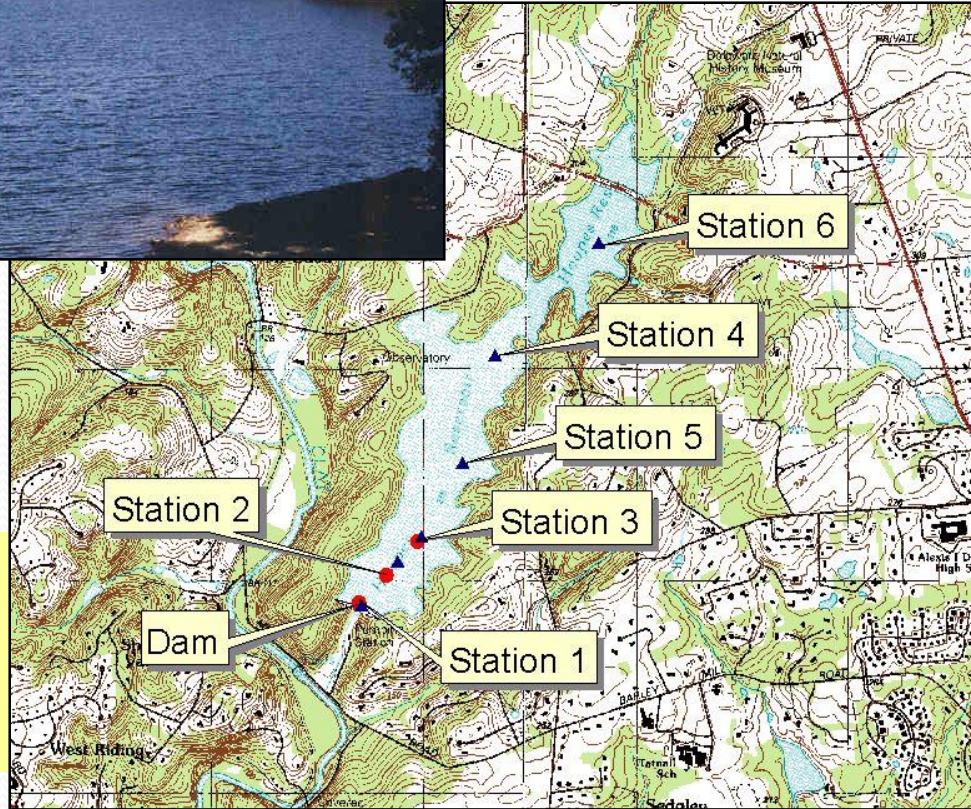
Newark South
Wellfield Treatment
Plant
75 mg





Deep
storage: 500
mg

Hoopes
Reservoir





Newark
Reservoir



UWD TCS: 400mg

Artesian Water – Llangollen ASR Facility Location



Google earth feet 200 meters 90 ▲






Summary Delaware Drought Management

- Delaware has aligned drought declarations consistent with elsewhere in the DRBC
- The WSCC is composed of all relevant entities needed to provide recommendations (DRBC is a key active participant in these meetings and deliberations)
- The Water Supply Coordinating Council meets quarterly or as needed and evaluates Drought-related guidelines
- The “Guidelines” are meant to assist the WSCC, GDAC, and Governor in reacting to changing water supply conditions
- The GDAC brings the major State agencies together for planning the various drought declarations and associated management steps

Northern New Castle County Comparison of Years 2007, 2012, and 2016

12-mo Precip (NWS +Porter)			6-mo Precip (NWS +Porter)			Db24-18 (ft bls)			Index						
	2007	2012	2016		2007	2012	2016		2007	2012	2016		2007	2012	2016
Jan	7.35	12.25	0.87	Jan	4.89	14.14	-3.45	Jan	11.23	10.6	13.5	Jan	11.8	17.64	6.41
Feb	7.24	11.49	3.36	Feb	5.05	2.38	0.36	Feb	11.56	10.6	12.3	Feb	9.51	9.51	13.08
Mar	11.19	7.88	0.00	Mar	2.76	-2.57	-0.98	Mar	11.28	10.95	11.2	Mar	13.84	6.9	8.58
Apr	14.75	5.42	-1.73	Apr	4.64	-4.74	-2.65	Apr	10.16	11.45	11.41	Apr	17.8	6.12	6.83
May	13.96	4.35	3.95	May	0.50	-7.16	1.30	May	9.3	12.2	11.7	May	10.65	5.32	9.36
Jun	6.47	5.17	-4.77	Jun	1.55	-7.41	-0.87	Jun	10.43	12.7	11.5	Jun	9.28	4.75	6.42
Jul	4.08	4.82	-1.85	Jul	-0.81	-9.32	1.61	Jul	11.4	13.5	12.1	Jul	7.6	3.28	7.3
Aug	5.96	-6.17	-0.91	Aug	0.91	-8.55	-1.27	Aug	12.44	14.14	12.65	Aug	7.25	3.57	5.48
Sep	-0.12	-6.59	-2.39	Sep	-2.88	-4.03	-1.41	Sep	13.23	14.7	13.81	Sep	4.38	5.79	4.35
Oct	-0.05	-4.20	?	Oct	-4.69	0.54	?	Oct	14.03	15.24	?	Oct	6.09	10.75	?

Brandywine (mgd)			WCC at Stanton (mgd)			WCC at Newark (mgd)					
	2007	2012	2016		2007	2012	2016		2007	2012	2016
Jan	355	485	241	Jan	211.7	119.6		Jan	101.3	53.2	
Feb	248	347	712	Feb	145.4	292.6		Feb	69.2	139.4	
Mar	639	301	352	Mar	119.4	134.8		Mar	58.5	60.7	
Apr	864	264	259	Apr	111.9	100.3		Apr	54.2	47.4	
May	399	247	310	May	88.5	144.2		May	42.4	60.9	
Jun	275	199	172	Jun	71	82.2		Jun	33.8	33.9	
Jul	213	101	160	Jul	61	42.5	91.2	Jul	25.1	17.8	31
Aug	157	101	110	Aug	65.2	44.2	41.6	Aug	24.8	16.8	17.5
Sep	80	159	75.5	Sep	31	65.6	33.1	Sep	12.7	20	14.3
Oct	195	381	?	Oct	90.6	197.4	?	Oct	34.6	69.1	?

 Drought Watch
 Drought Warning
 Drought Emergency

Recent Precip. Map for Delaware

