

Hydrologic Summary 2004-2005

2004: An Active Second Half Includes an Unwelcome Visit from Ivan

A drier than normal weather pattern persisted throughout much of the Delaware River Basin during the early months of 2004. Observed precipitation for the basin above Trenton, N.J. from January through July 11 was 3.85 inches below normal, while precipitation for Wilmington, Del. was 3.16 inches above normal. Reflecting this trend, streamflows throughout the basin were in the below-normal to normal range from February through June. The New York City (NYC) reservoirs in the upper Delaware River Basin began 2004 brimming with storage due to the abundance of precipitation that fell during 2003. Storage gradually declined through early March, but remained above the long-term median. A gradual melting of the snowpack above the reservoirs began a seasonal increase in storage and by early April, the NYC Delaware Basin reservoirs had refilled and were spilling excess water into the tributaries below.

The second half of 2004 proved an active time for intense weather systems in the Delaware River Basin with some near misses and, unfortunately, several direct hits.

- **July 12-13:** A slow moving system dropped rainfall averaging four to six inches on the lower basin. Portions of southcentral New Jersey were the hardest hit as more than a foot of rain fell in some localities. Tabernacle, N.J. received a staggering 13.2 inches of rain during what was determined to be a one-in-one-thousand year storm event for that Burlington County municipality.
- **August 1:** Heavy rainfall returned to portions of the lower basin. Two Delaware County, Pa. communities – Upper Darby and Darby Borough – bore the brunt of the storm, receiving more than five inches of rain.
- **August 12-14:** A strong storm system and two tropical storms were predicted to drench the basin over a three-day period. During the evening of Aug. 12, storms rolled through the basin producing more than seven inches of rain over the headwaters of the Schuylkill River. On Aug. 13, forecasters were anticipating the arrival of Tropical Storm Bonnie. With the basin's streams and rivers already brimming from the storms the night before, there was a potential for serious flooding. Fortunately, Bonnie only affected the very southern portion of the basin with moderate rainfall. On Aug. 14, the basin was gearing up for yet another potential soggy blow from Tropical Storm Charley, which had already devastated portions of Florida as a category four hurricane. However, the majority of the basin was spared from Charley's wind and rain when the storm tracked further east than expected.
- **September 17-18:** The near misses of tropical activity finally caught up with the basin when the remnants of Tropical Storm Ivan, interacting with a cold front that dropped into the region, produced tremendous rainfall amounts across northeast Pennsylvania and southern New York. Most of the basin upstream of Trenton received three to five inches of rain in a 12-hour period, with some isolated areas receiving as much as seven or eight inches. Much of the heavier rain occurred

Sampling of DRBC Flood-Related Activities During 2004 and 2005:

- Thanks to a \$10,000 flood hazard education and outreach grant awarded by the N.J. Emergency Management Office in 2004, DRBC staff improved and expanded the flood information appearing on the commission's web site at http://www.nj.gov/drbc/Flood_Website/floodinf.htm.
- DRBC Executive Director Carol R. Collier served on the N.J. Flood Mitigation Task Force created by Acting Governor Richard Codey following the April 2005 flood. Other DRBC staff participated on the technical, finance, and public outreach subcommittees. (Editor's note: The final task force report was released by Governor Jon Corzine in August 2006.)
- DRBC and PPL Corporation cosponsored a May 2005 informational workshop for public officials in Hawley, Pa. The purpose of the workshop, attended by about 75 persons, was to review the facts regarding the April 2005 flood and to provide a forum for discussions regarding reservoir operations, flood warning, and mitigation.
- DRBC staff participated in flood-focused public information meetings during 2005 hosted by Pa. State Rep. David Steil (R-Bucks) in Yardley on June 2 and by U.S. Rep. Charles Dent (R-Pa.) in Easton on August 2.

in the mountainous regions of the basin in the Poconos and Catskills, while many areas in the southern half of the watershed received an inch or less. This rain fell on soils already saturated by the wet summer, including Tropical Storm Frances just a week before, creating a “parking lot” runoff effect over a very large portion of the basin’s drainage area. Even before the rains from Ivan arrived, the Delaware River at Montague, N.J. and Trenton was flowing at 298 percent and 265 percent of normal, respectively, for the first half of September.

The flooding on the main stem Delaware River was the worst since August 1955 when the basin was hit by the remnants of two hurricanes, Connie and Diane, in one week. Flood damages were sustained up and down the main stem and its tributaries, resulting in presidential disaster declarations for portions of Pennsylvania, New Jersey, and New York. New warning products and other tools that were developed or upgraded since the last time major flooding occurred along the Delaware in January 1996, such as the National Weather Service’s Advanced Hydrologic Prediction Service (AHPS), helped to provide the necessary lead time to get hundreds of people out of harm’s way.

- **September 28:** The remnants of Tropical Storm Jeanne brought four to eight inches of rain to the Philadelphia metropolitan area, impacting portions of Delaware, Pennsylvania, and New Jersey. The heavy precipitation caused widespread, rapid urban and small stream flooding during the evening hours, making roadways hazardous and evacuations difficult.

The majority of counties within the basin reported normal to above-normal precipitation over the entire year, with annual departures ranging from 3.6 inches below normal in Sussex County, Del. to 15.5 inches above normal in Lackawanna County, Pa. Annual observed precipitation at selected stations above Trenton was 53.38 inches, or 8.49 inches above normal, while 56.75 inches (13.94 inches above normal) fell in Wilmington.

With the exception of a brief period in July, storage in the NYC Delaware Basin reservoirs remained above the long-term median for the second half of 2004 and combined storage ended the year the same as it began – well above the long-term median. Over the period June 17–July 17, approximately 10.6 billion gallons (bg) of water was released from these reservoirs in order to meet the minimum flow target at Montague as required by the 1954 U.S. Supreme Court decree.

No releases were required during

2004 from the Beltzville Reservoir (located on a tributary of the Lehigh River) and Blue Marsh Reservoir (located on a tributary of the Schuylkill River) to meet the minimum flow target at Trenton. Moreover, no releases were required from the Merrill Creek Reservoir, located near Phillipsburg, N.J., to replace evaporative water losses resulting from power generation in the basin under certain drought conditions.

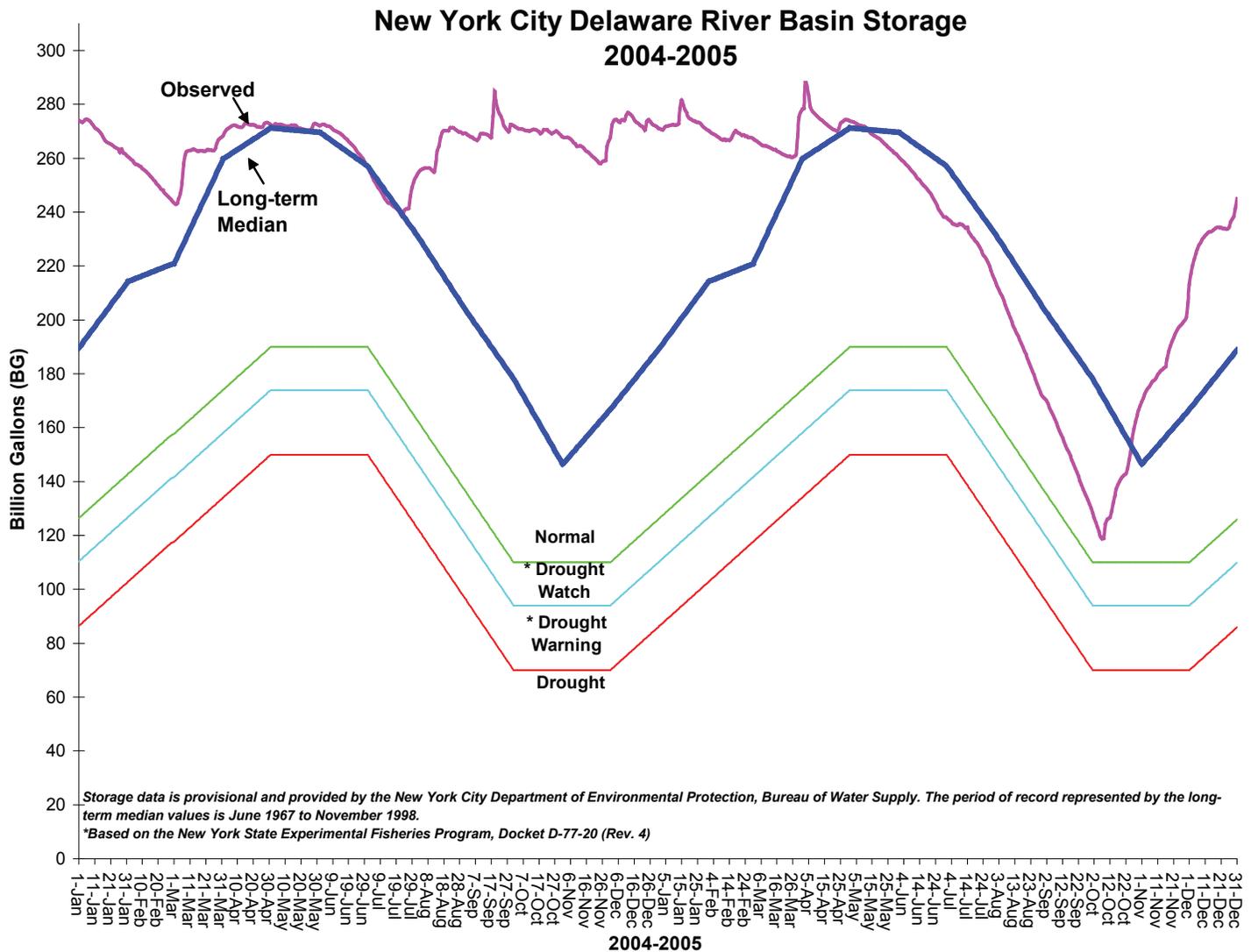
2005: A Year of Severe Flooding and a Drought Close Call

For the third year in a row, the NYC Delaware Basin reservoirs began with above-normal storage (270.990 bg, or 100.1% of usable capacity, and 81.427 bg above the long-term median).

Two early spring rainstorms in 2005 – the first on March 28–29 and the second on April 2–3 – combined with snow melt to cause major flooding on the main stem Delaware.



Photo showing April 4, 2005 flooding in New Hope, Pennsylvania and Lambertville, New Jersey. (Photo courtesy of John Jenks/USGS- NJ)



This graph shows the observed combined water storage in the NYC Delaware Basin reservoirs (Cannonsville, Pepacton, and Neversink) during 2004 and 2005, as well as the long-term median and drought rating curves. The declining actual storage line was very close to crossing the green drought watch curve in October 2005 before rebounding.

The first of these two storms brought more than two inches of rain to the western and northern portions of the basin. Warm temperatures accompanied the rain and melted roughly half of the two to four inches of water equivalent that had been stored in the snow lying in the northern watersheds of the basin. Less than a week after the first storm,

the second rain event dropped an additional two to three inches of rain over the Delaware River's headwaters in New York's Catskill Mountains, melting nearly all of the remaining snow pack. Three to five inches of rain also soaked the middle portion of the basin. In total, the upper portions of the basin received five to seven inches of rain in addition to the two

to four inches of water released during the snow melt. The rest of the basin received four to eight inches of rain during the weeklong period.

The basinwide scale of this event produced flood crests on the main stem Delaware River exceeding those reached during the remnants of Tropical Storm Ivan only six-and-a-half months earlier. Once again, the

basin endured evacuations, bridge and road closures, and extensive damage. On April 3, the Delaware River at Montague crested at 31.69 feet (ft), the third highest on record. On April 4, the Delaware River at Trenton reached 25.33 ft, the fourth highest recorded crest. Impacted counties in Pennsylvania, New Jersey, and New York again received federal disaster declarations by President Bush.

As the April 2005 flooding victims assessed damages and moved into the cleanup phase, Mother Nature reminded the basin how quickly we can move from one extreme to another. The rains of late March and early April combined with snowmelt to boost storage in the NYC Delaware Basin reservoirs to a recorded high of 288.588 bg on April 3. However, a drier than normal May caused reservoir storage levels to decline along with streamflows at many locations throughout the basin. By mid May, NYC Delaware Basin reservoir storage had dropped below the long-term median and the first directed releases were required on May 23 in order to meet the minimum flow target at Montague. Late spring and summer rainfall deficits, especially during August and September, caused storage to drop sharply away from the median. Mounting precipitation deficits took their toll on the basin's hydrology as ground water levels declined and continued releases were required from both the NYC and lower basin reservoirs to augment Delaware River flows. From May 23 through October 9, just over 70 bg was released from the NYC Delaware Basin reservoirs to meet the minimum flow target at Montague. In addition, nearly 1.5 bg was released from the lower basin reservoirs (Blue Marsh and Beltzville) between August 5 and September 20 to meet the Trenton minimum flow

target. No releases were required from Merrill Creek Reservoir during 2005.

In response to the dry conditions, New Jersey officials issued a statewide drought watch on September 13, urging residents to voluntarily conserve water. The DRBC's drought operating program is automatically triggered by declining storage in the three NYC Delaware Basin reservoirs through the use of a drought rating curve (*please refer to the graph on the facing page*). By the end of September, it was estimated that we were only

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several weeks away from a basinwide drought watch if the dry conditions persisted.

However, relief came on October 7-8 with the arrival of the remnants of Tropical Storm Tammy, which produced rainfall in the four to eight inch range for much of the basin, with locally higher amounts of eight to 12 inches estimated by dopplar radar. New Jersey ended its statewide drought watch on October 12. By month's end, streamflows and ground water levels had dramatically improved

throughout the entire basin.

Despite the very dry periods during 2005, the majority of basin counties reported normal to above-normal annual precipitation over the entire year, with departures ranging from 1.50 inches below normal in Cape May County, N.J. to 9.40 inches above normal in Sussex County, N.J. Annual observed precipitation at selected stations above Trenton was 51.12 inches, or 6.23 inches above normal, and 40.30 inches, or 2.51 inches below normal, at Wilmington.

The upper and lower basin reservoirs rebounded following the ample rainfall that resumed in October. Storage in the NYC Delaware Basin reservoirs continued to increase and remained above the long-term median during the normal recharge period of fall and early winter. The year closed with the three NYC Delaware Basin reservoirs holding about 245 bg (90.5% of usable storage), or 56 bg above the long-term median storage for December 31.

Uncontrolled spills from the three NYC Delaware Basin reservoirs that occurred when they were over 100% capacity during 2005 totaled about 197 bg compared to approximately 219 bg during 2004 and nearly 371 bg in 2003. The hydrology of 2005 showed that annual totals and averages can be misleading given the extremes that occurred during the year.

More detailed information about the basin's hydrologic conditions, including a comprehensive flooding section, can be found on the DRBC web site at <http://www.nj.gov/drbc/hydro.htm>.