March 2024

2023 Annual Hydrologic Conditions Report

Technical Report No. 2024-1

Managing, Protecting and Improving
the Water Resources of the
Delaware River Basin since 1961

Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

ACKNOWLEDGEMENTS

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SUGGESTED CITATION

Delaware River Basin Commission (2024). *Annual Hydrologic Conditions Report for 2023*. (DRBC Report No. 2024-1.)

LIST OF ACRONYMS/ABBREVIATIONS

ACIS	Applied Climate Information System
AHPS	Advanced Hydrologic Prediction Service
DRB	Delaware River Basin
DRBC	Delaware River Basin Commission
NCEP	National Center for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
USGS	United States Geological Survey

DEFINITIONS

Stage – The level of the water above an arbitrary point in the river (commonly measured in feet)

Crest – The peak river level during a flood at a specific location. Used synonymously with "flood peak."

Water Level – The surface level of a body of water

Liquid Water Equivalent - The amount of water that results from melting any form of frozen precipitation (e.g., snow, sleet, or ice), including any liquid precipitation.

Action Stage – The stage which, when reached by a rising stream, represents the level where emergency managers prepare for possible significant hydrologic activity. The action taken varies for each gage location.

Minor Flood – Minimal or no property damage, but possibly some public threat. Examples of conditions that would be considered minor flooding include water over banks and in yards; no building flooded, but some water may be under buildings built on stilts (elevated); water overtopping roads, but not very deep or fast flowing; inconvenience or nuisance flooding.

Moderate Flood – Some inundation of structures, evacuations of people and/or transfer of property to higher elevations (e.g., move cars, water rescues from flooded streets). During a moderate flood, water is deep enough over the road to make driving unsafe.

Major Flood – Extensive inundation of structures and roads occurs. Significant evacuation and/or transfer of property to higher elevations are necessary. Multiple Homes flooded, moved off foundations. Extreme erosion occurs.

Reported flood locations: The flooding events summarized in this report are based on information provided by the Middle Atlantic River Forecast Center. The locations referenced are flood forecast and reporting locations from the Advanced Hydrologic Prediction Service website. Flooding may have occurred at other locations in the basin. The impacts of flash flooding are not detailed herein.

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HYDROLOGIC CONDITIONS IN 2023

The summarized components of the hydrologic cycle under observation include precipitation, streamflow, storage, groundwater, and the salt front location. Much of 2023 was relatively normal, however dry periods occurred in May, October, and November. In June, Pennsylvania counties were placed in drought watch and were removed at different times as conditions improved. The year ended with above normal precipitation in December, resulting in significant flooding in lower basin tributaries. Groundwater levels were below normal for most of the year but improved by December. The salt front was between RM 59 and RM 72 during the year until mid-December, when higher flows moved the salt front below RM 54, below which its location is not calculated. The most upstream location of the salt front was RM 71.8 on November 22.

1. PRECIPITATION

The precipitation in the Delaware River Basin (DRB) was analyzed with available individual station reports, radar-based estimates, and satellite information. Figure 1 shows a spatial representation of the total precipitation based on data from the Advanced Hydrologic Prediction Service (AHPS). Figure 2 shows the departures from normal precipitation in the basin over the past year.

The highest amounts of precipitation in 2023 were observed in the upper basin near the Catskill Mountains in New York, ranging from 55 to 65 inches. In addition, large amounts of precipitation, ranging from 55 to 65 inches, occurred in Bucks County, PA, and Mercer and Burington counties in the lower basin. Areas near the Delaware Bay received precipitation amounts between 45 and 55 inches. Slightly below average precipitation also occurred in Schuylkill, Berks, Chester, and Delaware Counties in Pennsylvania and in Southern New Jersey, with amounts ranging from 40 to 50 inches. Reported values include the liquid equivalent precipitation[i].

Table 1 presents the annual, normal, and maximum precipitation, based on data from 1990 to 2021, for ten stations located within or close to the Delaware River Basin (DRB). The departure from normal and the rank for each station based on the number of years of data is also presented. The highest amount of precipitation, 58.84 inches (8.62 inches above normal) was reported at Mount Pocono, PA. Below-normal precipitation occurred at four of the stations. The lowest amount of precipitation, 42.23 inches (1.88 inches below normal) occurred at Philadelphia, PA. In some sections of the Upper Basin and in the Lower Basin, locations reported 20 inches more than the normal precipitation. Portions of Western Pennsylvania within the DRB received 16 less than the

average precipitation for the year. Burlington County, New Jersey also experienced below average precipitation (Figure 2).

The monthly precipitation at nine locations within the basin is presented in Figure 3, indicating the variation in amounts throughout the year. The wetter months were July and December. Two high volume events in December caused wipe spread tributary flooding in the lower basin (Table B-3Table B-4). The drier months were February, March, May, and October. Dry conditions resulted in a declared drought watch from June through the end of the year. Observed, normal, and maximum precipitation amounts are presented by station in Appendix A.

Table 1. Total Annual Precipitation at select weather stations in the DRB. Note: The normal precipitation is based on a precipitation average between 1990-2021[1].

Station	Number of Years Reporting	2023 Precipitation Total (inches)	Normal Precipitation (inches)	Departure (inches)	Annual Rank (Lower = Wetter)	Max Annual Precipitation (inches)
Callicoon, NY	12	54.00	50.22	3.78	6	75.18 (2011)
Mount Pocono, PA	22	58.84	50.22	8.62	16	82.69 (2011)
Sussex, NJ[2]	83	44.97	48.73	-3.76	59	77.12 (2011)
Allentown, PA	83	46.43	47.36	-0.93	49	71.72 (2011)
Trenton, NJ	25	44.97	45.47	-0.50	17	62.96 (2018)
Reading, PA	27	46.56	45.21	1.35	33	68.08 (2018)
Philadelphia, PA	83	42.23	44.11	-1.88	43	64.33 (2011)
Millville, NJ	79	46.01	43.37	2.64	40	55.19 (1996)
Wilmington, DE	74	52.13	45.33	6.80	66	61.37 (2018)

[1] Source: The Applied Climate Information System (ACIS).

[2] Note: The December 2023 data for Sussex, NJ is missing. The nearby station Sussex Airport reported 6.6 inches for the month.

2. TOTAL SEASONAL SNOWFALL 2022 – 2023

Winter precipitation stored in snowpack does not contribute to streamflow until it melts, in the spring. Figure 4 shows snowfall in the DRB for the 2022-2023 winter season. The Northern parts of the basin received more than 50 inches of snow, with some areas in the mountainous terrain receiving greater than 80 inches. The middle part of the basin received between 10-45 inches. The lower half of the basin, below Trenton, received between 0 and 5 inches of snow. As of December 31, Philadelphia was in a snow drought with 700 days since its last snowfall event of greater than one inch.

3. STREAMFLOW

The daily time series and a comparison of the monthly average with normal flows are presented in Figure 5 for four selected locations in the DRB, including Montague and Trenton on the Delaware River, Bethlehem on the Lehigh River, and Philadelphia on the Schuylkill. High flows occurred in January, as early snowmelt reached the river as runoff. July, August, and September experienced high flows because of several storm systems. Monthly flows were approximately 150 to 200 percent of normal during these two months, except for Schuylkill River with the monthly precipitation below normal in August. December was particularly a wet month at all four stations with flows ranging between 200 to 250 percent above normal. For much of the year, the four stations either reported very high flows or very low flows with May as the only month with near normal flows.

Low flows occurred in February, March, and April because the snowpack below normal and less snowmelt than normal contributed to spring runoff. Drier conditions developed again in June and September due to below-average precipitation. The flow rates during February, March, and November were approximately 75 percent of the normal at all four locations. Flows were much lower in April (approximately 30 percent of the normal) as the result of below-normal precipitation. the flows in the Schuylkill River tended to be much lower than normal throughout the year except for January, July, September, and October.

4. RESERVOIR STORAGE AND RELEASES

Reservoir releases are used to augment river flows for multiple purposes. Releases from Cannonsville, Pepacton, and Neversink in the upper basin are made to meet the Montague Flow Objective and maintain the tailwater fishery. Releases from Beltzville and Blue Marsh in the lower

basin are used to support the Trenton Flow Objective, which was established to maintain freshwater flows in the estuary. Flow conditions in 2023 did not necessitate the need for reservoir releases in 2023 in either the upper or lower basin.

4.1 UPPER BASIN

Three of the four largest reservoirs in the basin, Cannonsville, Pepacton, and Neversink, were constructed by New York City's water supply system. The combined storage of New York City reservoirs is important because it is used to determine drought status in the basin as it relates to out-of-basin diversions and flow objectives (Delaware River Basin Water Code, 18 CFR Part 410). Combined storage in the three New York City (NYC) reservoirs is presented as a daily time series in Figure 6. At the beginning of the year, the combined storage was approximately 233 BG, or 87.2 percent. Reservoir levels were normal in January and continued to increase until May. From March 24 through April 10, the reservoirs spilled 6 BG and in May 19.4 BG for a total of 25.4 BG spilled in 2023. (Figure 7).

Reservoir levels began decreasing in May due to higher water demands and conservation releases along with lower precipitation. During the summer months, the combined storage decreased until July. Heavy rain events occurred mid-July allowing the reservoirs to recover and fall above the normal range. The lowest combined storage of 228.8 BG (85.4 percent, 53 BG above the drought watch curve), occurred on July 1st. The end-of-year combined storage was approximately 267.8 BG (100.1 percent).

Any releases made from the three NYC Delaware River Basin (DRB) reservoirs were made in accordance with the 2017 Flexible Flow Management Program (FFMP). Thermal mitigation releases were made for 3 days in July, and for 2 days in September when water temperatures were in danger of exceeding 25 degrees Celsius at Lordville, N.Y. The amount of water used for thermal releases was 0.15 BG (234 cfs-days).

4.2 LOWER BASIN

The DRBC pays for water supply storage in Beltzville Reservoir (located on the Pohopoco Creek, a tributary of the Lehigh River) and Blue Marsh Reservoir (located on the Tulpehocken Creek, a tributary of the Schuylkill River) for use to augment flows in the Delaware River in support of the Trenton Equivalent Flow Objective (TEFO). Throughout the whole year normal pool storage was maintained except for a couple of peaks due to high rainfall events (Figure 8). Almost 2 BG of storage was added to the pool during the mid-December storm.

Blue Marsh reservoir has a seasonal recreation pool. The reservoir storage is increased in mid-March to create the recreation pool and released in mid-October to bring the storage back to the normal winter pool, to create additional flood control space for spring runoff. The increase and decrease in storage for the recreation pool is apparent in Figure 9. A temporary increase of 3.5 BG in the storage occurred after the mid-December storm (3.3 inches of precipitation) resulting in the reservoir elevation exceeding the recreation pool level for two days. Although the pool returned to winter levels within a week, it was one foot above the winter pool at the end of the year due to another storm event (1.5 inches of precipitation).

Merrill Creek Reservoir, located in Phillipsburg, N.J., was constructed by thermoelectric power utilities for the replacement of their consumptive use during periods when the DRBC drought management plan is in effect. Releases from the Merrill Creek during drought conditions allow the power generators to continue withdrawal water to produce power during drought conditions. The drought management plan was not in effect during 2023 and no releases were required for consumptive use replacement from Merrill Creek reservoir.

5. GROUNDWATER

Groundwater conditions are characterized using thirteen representative wells in the basin states. The individual wells were selected based on their geographic locations and availability of data. The range of conditions (normal, drought watch, drought warning, drought) is defined by each well's respective period of record and represents a comparison to the value for the same day in past years. Groundwater level wells were close to the normal range at the beginning of the year. Wells in New Jersey started the year below normal and remained well below normal until December when groundwater levels began to rebound. Beginning in March, some wells in Pennsylvania experienced a decrease in groundwater levels through August and were either normal or below normal for most of the year. By the end of the year, wells in Pennsylvania, New York, New Jersey, and Delaware were in the normal range. A detailed description of the groundwater conditions for each state is summarized below.

5.1 NEW YORK

The USGS groundwater well at Woodbourne, New York is used to represent the groundwater levels in the upper Basin (Figure 10). Groundwater levels increased above the normal range in response to storms in May, July, August, October, and December. The peak levels occurred in mid-December after another large storm event. During mid-May, groundwater levels decreased and were below

normal in June and during the beginning of July. However, by mid-July groundwater levels recovered, fluctuating between normal to above normal through the end of the year.

5.2 PENNSYLVANIA

Water levels at the wells were normal for the first two months of the year because of average precipitation during previous months and adequate snowpack (Figure 11). The water levels for all wells decreased from April through June due to below normal precipitation. wells in Bucks, Delaware and Monroe counties experienced an increase in groundwater levels during May due to multiple precipitation events. Groundwater levels decreased in June and July when conditions were dry. Wells in Lehigh, Chester, Wayne, Monroe, Lebanon, Carbon, and Schuylkill counties were all at drought warning status during this time. Beginning in August, precipitation became normal and groundwater levels increased. However, another dry period in October and November caused the water levels to decrease. Wells in Lebanon, Chester, and Delaware Counties increased drought watch statue. At the end of the year, water levels were above the normal range or near the normal range.

5.3 NEW JERSEY

Two USGS county observation wells represent groundwater conditions in New Jersey: Burlington and Cumberland Counties, New Jersey. At both wells, water levels were in a drought watch for the first three months of the year. The Cumberland County well fluctuated in and between Drought Watch and Drought Emergency status until December. Water levels in the wells reached the drought emergency status in mid-November but returned to the normal range by mid-December. In May, groundwater levels rebounded slightly and the wells in Burlington County improved to a Drought Watch Status. The water levels in the Burlington County well were between Drought Warning and Drought Watch in June and remained there until mid-November when levels were in the Drought Emergency range, but only for a short period before recovering to Drought Watch status. By the end of the year, the water level in the Cumberland County well was Normal and the water level in the Burlington County well was in Drought Warning Status (Figure 12).

5.4 DELAWARE

Groundwater levels in Delaware are determined with wells maintained by the Delaware Geological Survey (DGS) in New Castle County. Water levels were below the normal range from January – July (except for two short periods in late January and February). By August, the well levels had returned to the normal range and remained normal through December. (Figure 13).

6. SALT FRONT

The salt front is defined as the seven-day average of the 250 parts-per-million isochlor. The salt front is used by DRBC as an indicator of salinity intrusion in the Delaware Estuary for reservoir operations. In dry and drought conditions, reservoir releases are made to meet the Trenton Flow Objective, which was established for salinity repulsion in 1983 (Delaware River Basin Water Code). The location of the salt front moves downstream or upstream along the main stem Delaware River as streamflow increases or decreases, respectively. The long-term median monthly locations range from river mile 67 (RM 67) in April (two miles downstream of the Delaware Memorial Bridge) to RM 76 in September (two miles downstream of the Pennsylvania-Delaware State boundary).

In January of 2023, the salt front was at RM 69 (near the Delaware Memorial Bridge). It remained near the normal range until May, when the salt front moved below RM 60. By June, the salt front was above RM 65 and remained between RM 65 and RM 72, through November. At the end of the year, the salt front was below RM 54 due to heavy rains that occurred in December. The salt front was at its most upstream location on November 22 at RM 71.8. The time series for the salt front location is shown in Figure 14.

7. HYDROLOGIC EVENTS

7.1 DROUGHT

Due to dry conditions, decreasing groundwater levels, among other indicators, the June 6, 2023, U.S. Drought Monitor classified much of PA and northern DE as experiencing moderate drought conditions, and the remainder of the basin as abnormal dry. On June 15[3], Pennsylvania issued a statewide drought watch. Figure 15 shows the drought status map for all counties in the Basin, based on the conditions as defined by each of the basin states. No drought watches were declared in the other basin states. With the higher rainfall over the summer, conditions improved. On August 24, Pennsylvania lifted the drought watch for all but Berks, Bucks, Chester, Lehigh, Montgomery,

[3] PADEP 6/15/2023 Press release:
https://www.dep.pa.gov/Business/Water/PlanningConservation/Drought/pages/default.aspx

and Northampton Counties[4]. On October 20th, Pennsylvania lifted the drought watch for Berks, Chester, and Lehigh Counties, but Bucks, Montgomery, Northampton Counties remained in Drought Watch through the end of the year.[5] Implementation of DRBC's drought management plan was not needed because the combine storage in the NYC reservoirs did not decrease to the drought watch level. As of December 22, Bucks, Montgomery, and Northampton counties remained in a drought watch[6] but were returned to normal status on January 26, 2024[7].

7.2 FLOODING

Several high-volume precipitation events occurred in 2023, resulting in minor and moderate flooding along tributaries in the Basin. In particular, the Neshaminy Creek at Langhorne saw minor flooding and moderate flooding during the April 30-May 6, December 11, December 18-25, and December 28- January 1 events (Table B-3Table B-4). During the December 18-25 event, the following tributaries experienced minor flooding: Beaver Kill, North Branch Rancocas, Bush Kill, Assunpink Creek, West Branch Delaware River, Schuylkill River, Brandywine Creek, and the White Clay Creek. Moderate flooding occurred along the Brandywine Creek at Chadds Ford, Perkiomen Creek at Graterford, Neshaminy Creek at Langhorne, Red Clay Creek at Wooddale, and the Christina River at Coochs Bridge. From December 28- January 1, the following tributaries experienced minor flooding: Brandywine Creek at Chadds Ford, Neshaminy Creek at Langhorne, Schuylkill River at Norristown, and the Schuylkill River at Philadelphia. Two tributaries experienced moderate flooding: Perkiomen Creek at Graterford and the Christina River at Coochs Bridge.

8. SUMMARY

The hydrologic conditions in the Delaware River Basin for 2023 were characterized by a mix of dry weather stretches and periods of heavy rainfall, especially at the end of the year. Flows were below normal during the late winter and early spring due to a few snow and rain events. Reservoir releases

[4] PADEP 8/24/2023 Press release: https://www.dep.pa.gov/Business/Water/PlanningConservation/Drought/pages/default.aspx

[5] PADEP 10/20/2023 Press release: https://www.dep.pa.gov/Business/Water/PlanningConservation/Drought/pages/default.aspx

[6] PADEP 12/22/2023 Press release: https://www.ahs.dep.pa.gov/NewsRoomPublic/articleviewer.aspx?id=22382&typeid=1

[7] PADEP 1/26/2024 Press release: https://www.ahs.dep.pa.gov/NewsRoomPublic/articleviewer.aspx?id=22401&typeid=1

were made from upper basin reservoirs for thermal mitigation in for a few days in early July due to dry conditions, low flow, and warmer temperatures. Significant rainfall events occurred in July and in December. Flooding occurred in lower basin tributaries due to heavy precipitation and associated runoff after the December storms. Groundwater levels fluctuated throughout the year in all four basin states. In June, all counties in Pennsylvania were placed in a drought watch, due to dry conditions, before recovering in December. The maximum location of the salt front was RM 71.8 on November 2nd. Conditions returned to normal by the end of the calendar year.

FIGURES

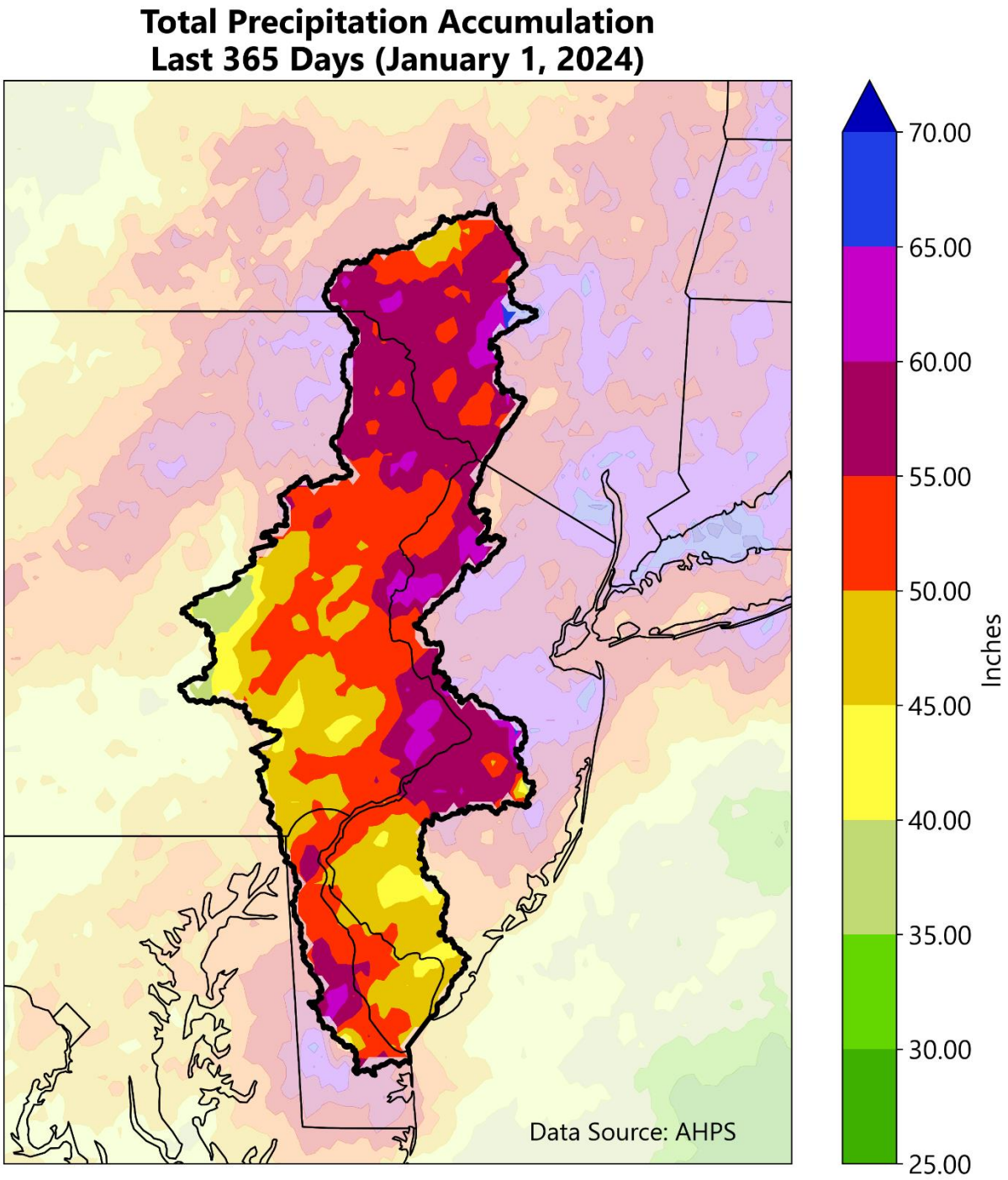


Figure 1: Annual Precipitation in 2023.

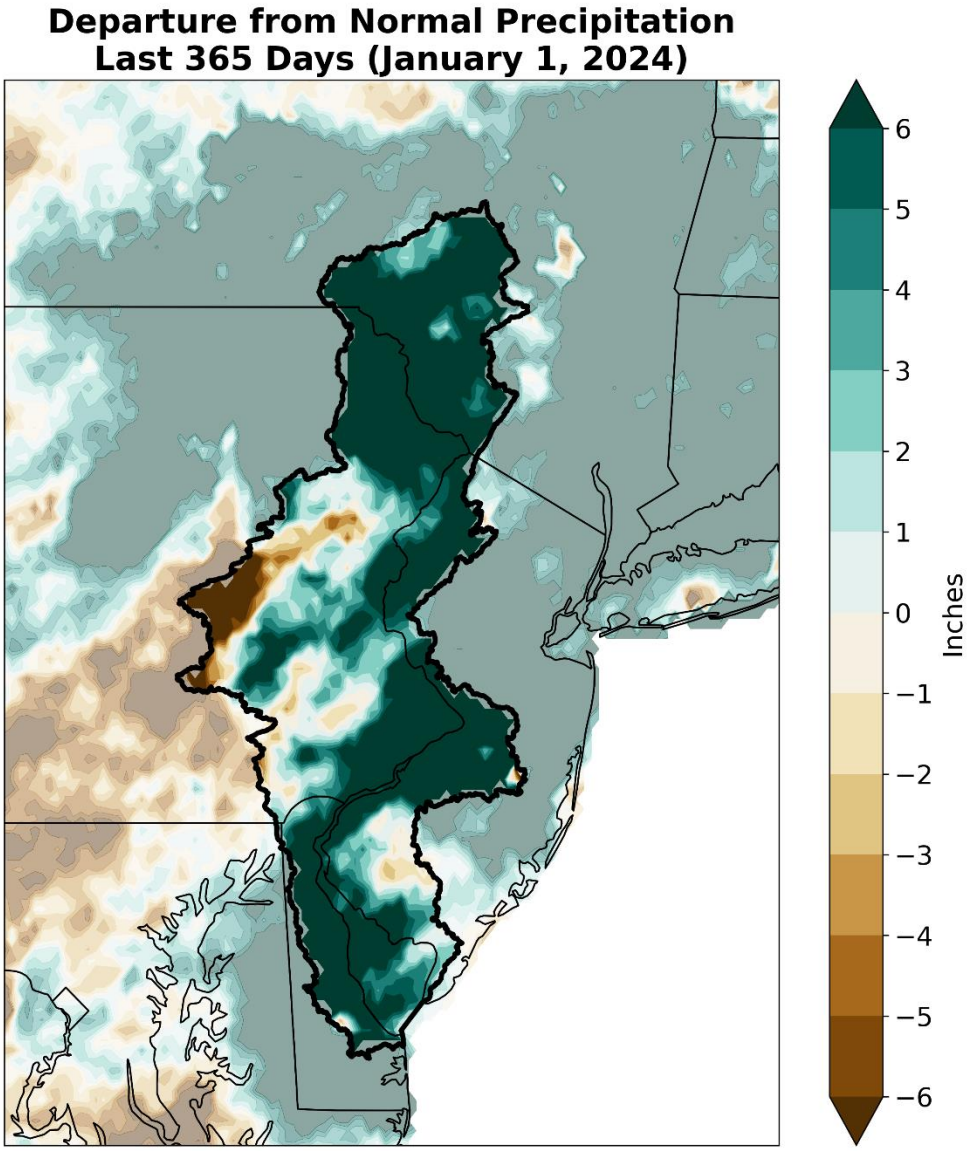


Figure 2: Departure from normal precipitation in the last 365 days.

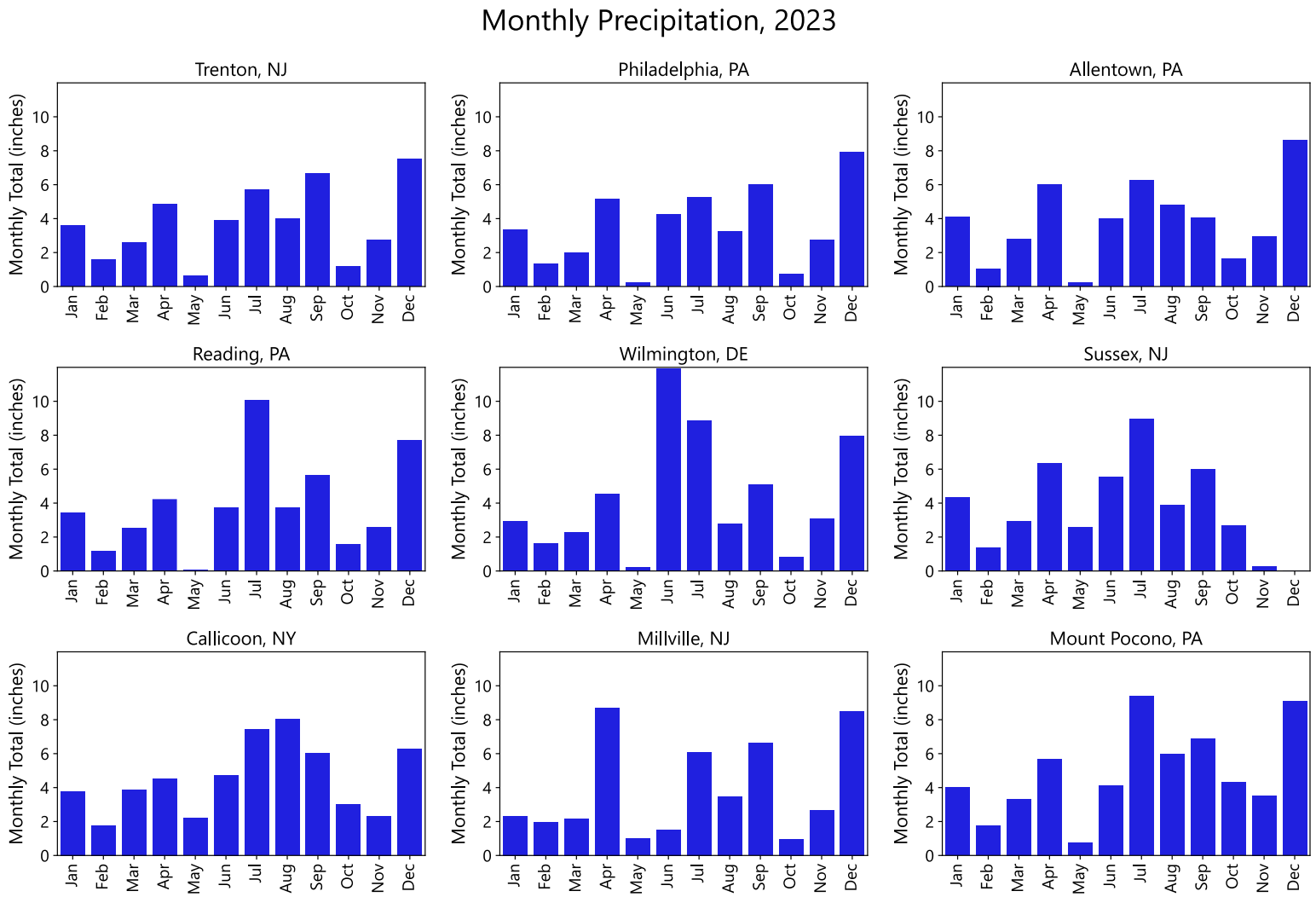


Figure 3: Monthly Precipitation at Nine Regional Weather Stations. Note: The December 2023 data for Sussex, NJ is missing. The nearby station Sussex Airport reported 6.6 inches for the month.

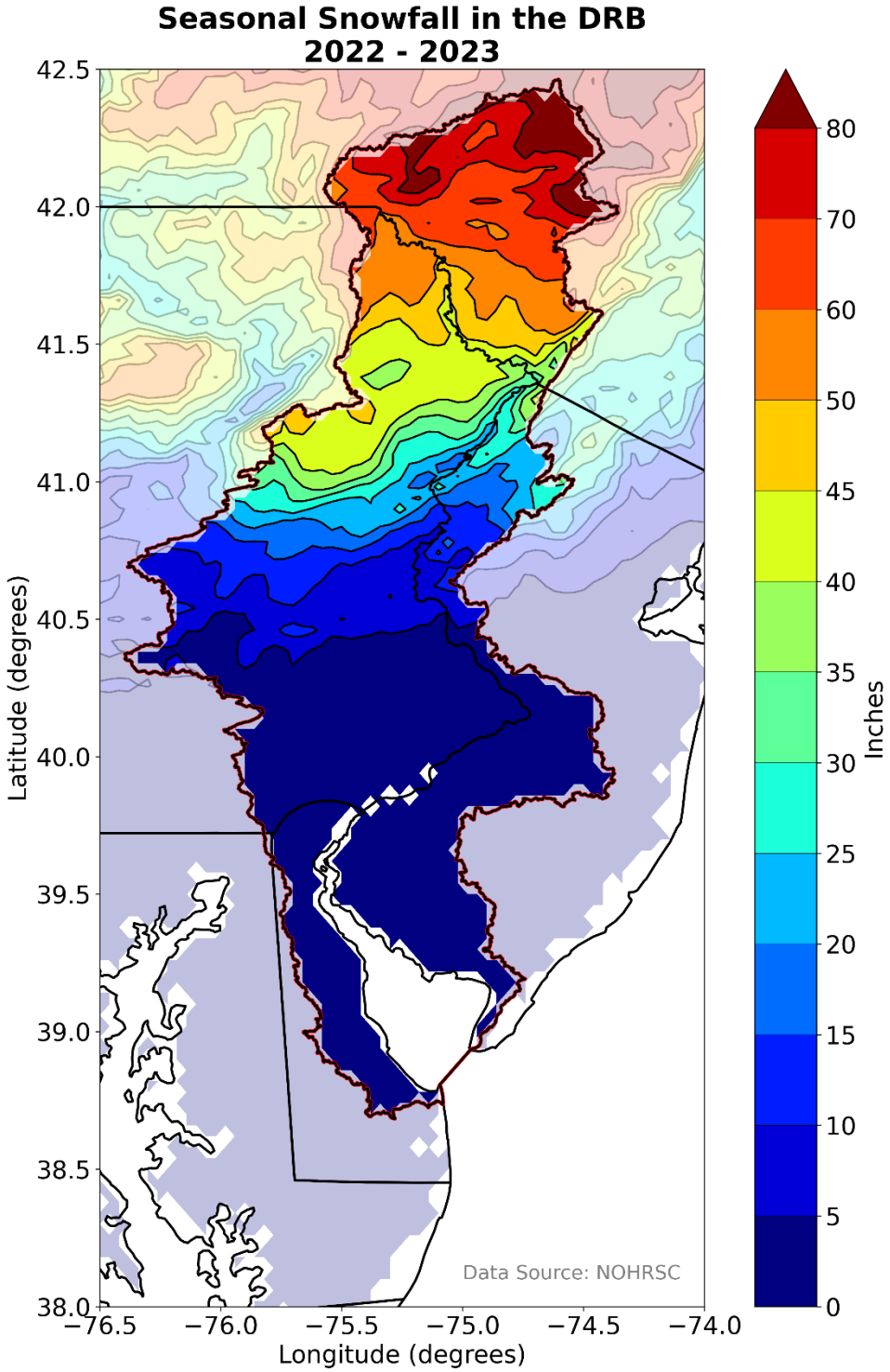


Figure 4:Total Snowfall for the Winter 2022-2023.

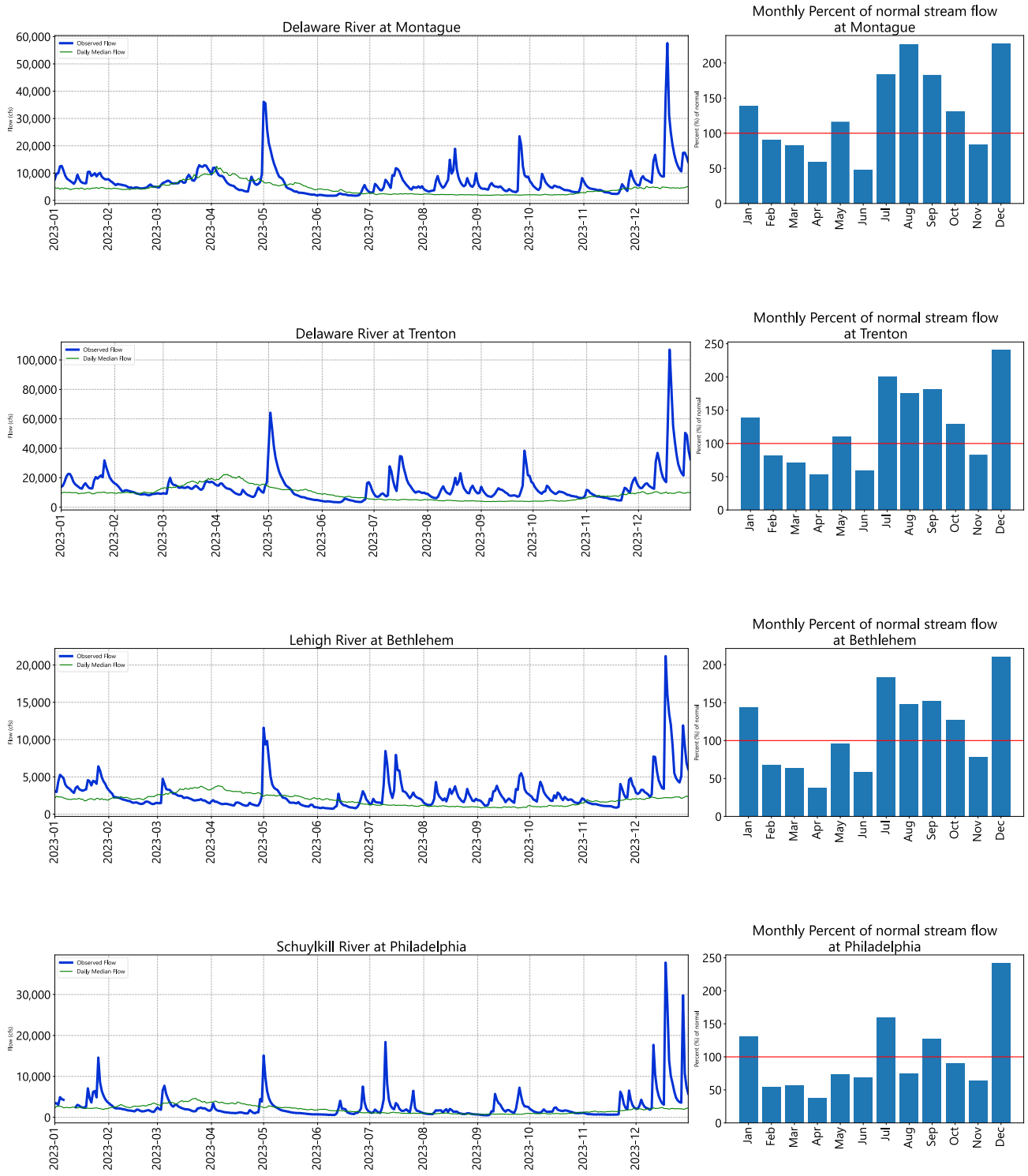


Figure 5: Streamflow and Percent of Normal Streamflow at Four Representative Locations.

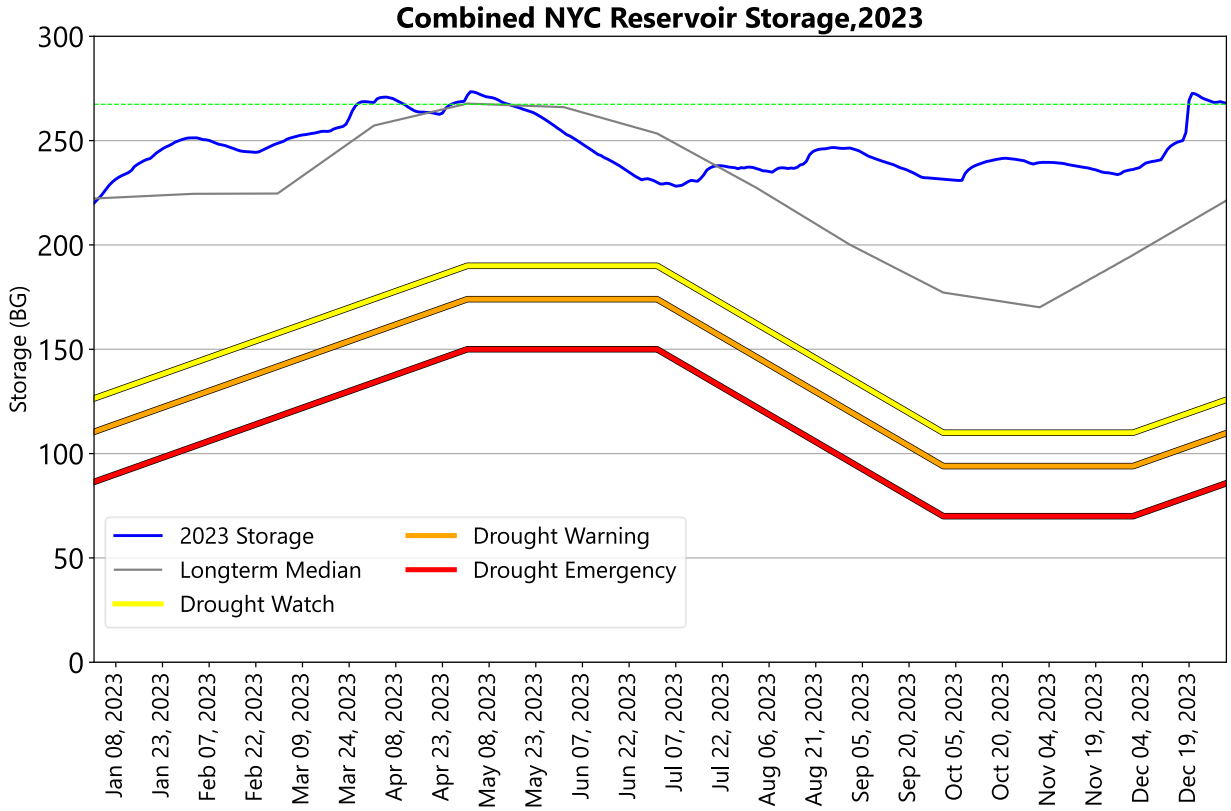


Figure 6: Combined New York City Reservoir Storage for Delaware River Basin Reservoirs (Cannonsville, Pepacton, and Neversink).

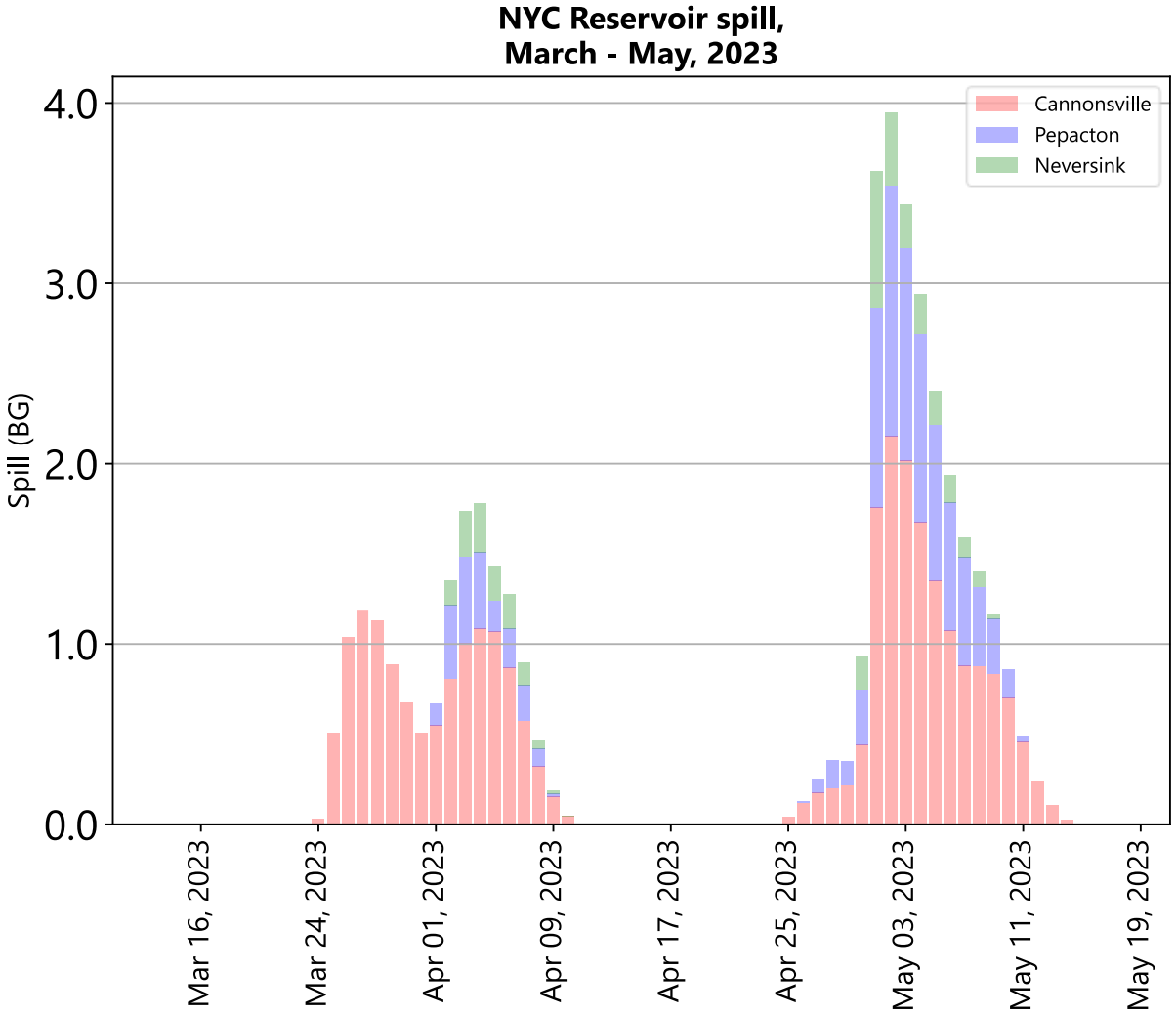


Figure 7: NYC Reservoir Spills (March - May 2023). Note: The total amount spilled over the period was approximately 25.4 BG.

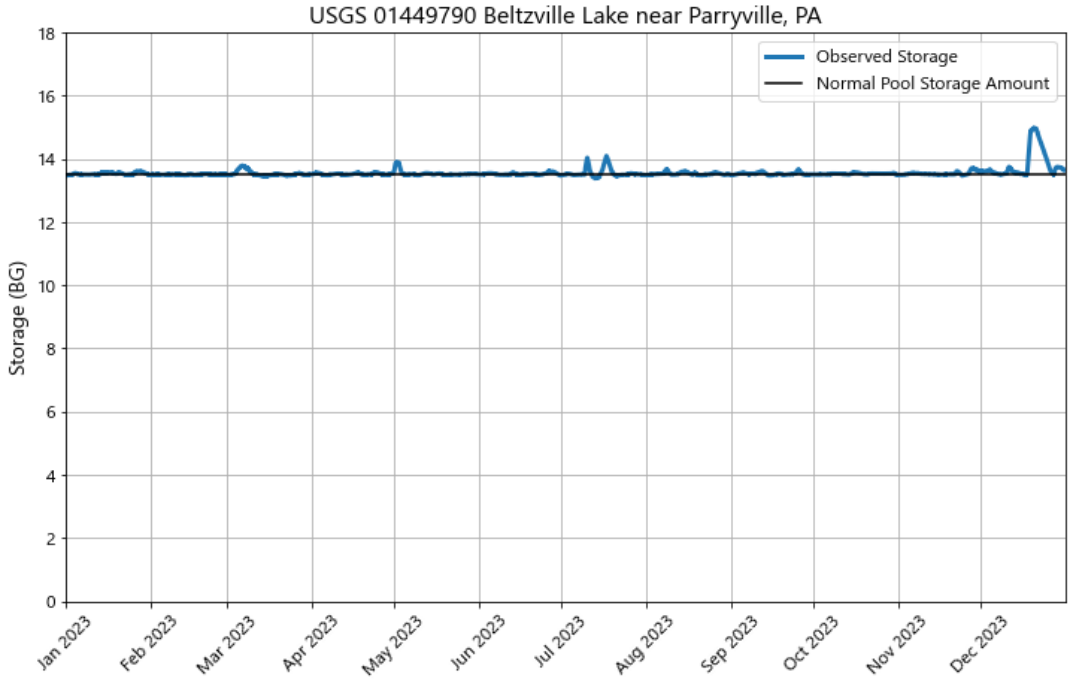


Figure 8: 2023 Beltzville Reservoir Storage

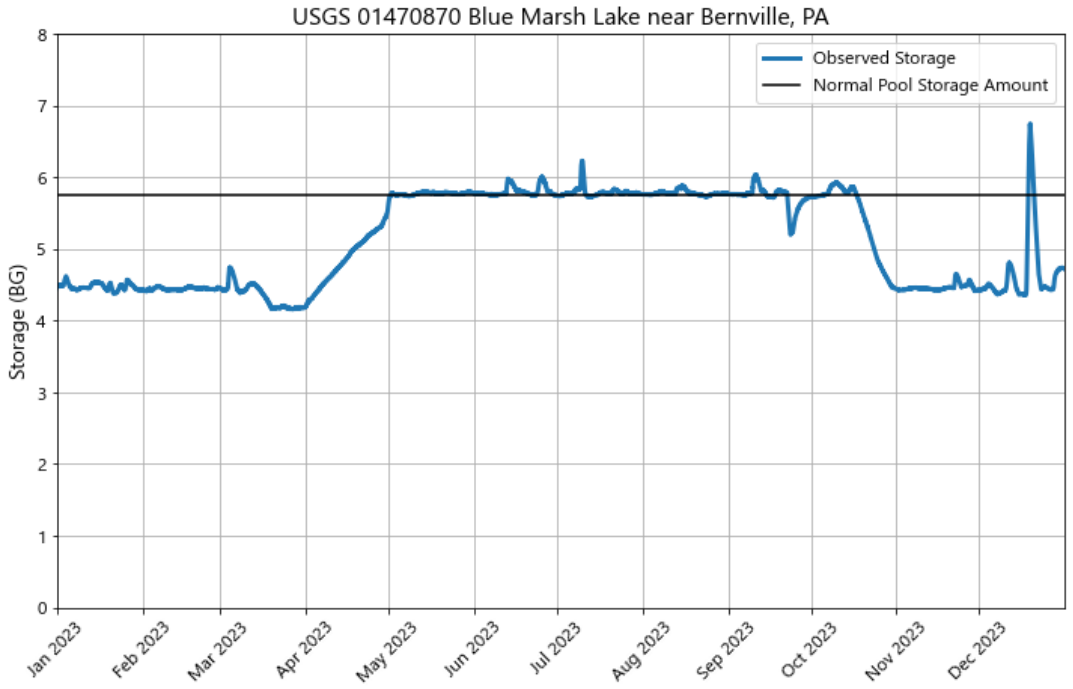


Figure 9: 2023 Blue Marsh Reservoir Storage

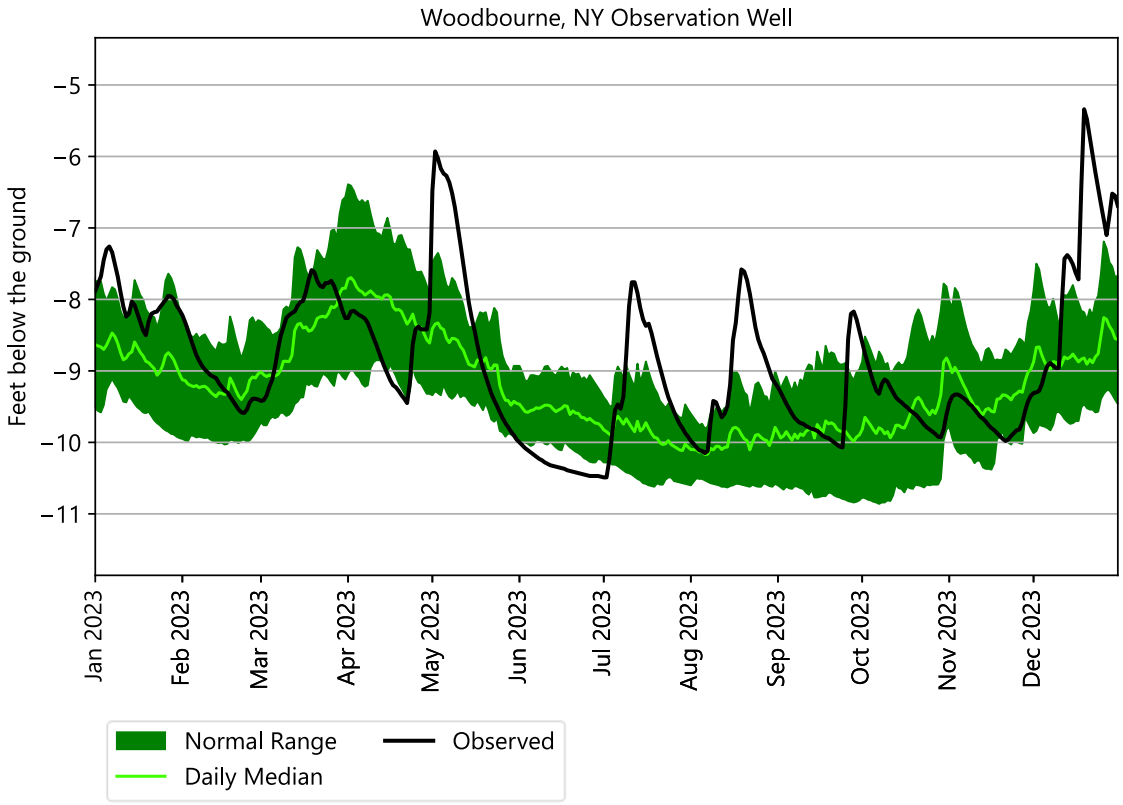


Figure 10: Groundwater Levels, Woodbourne, New York.

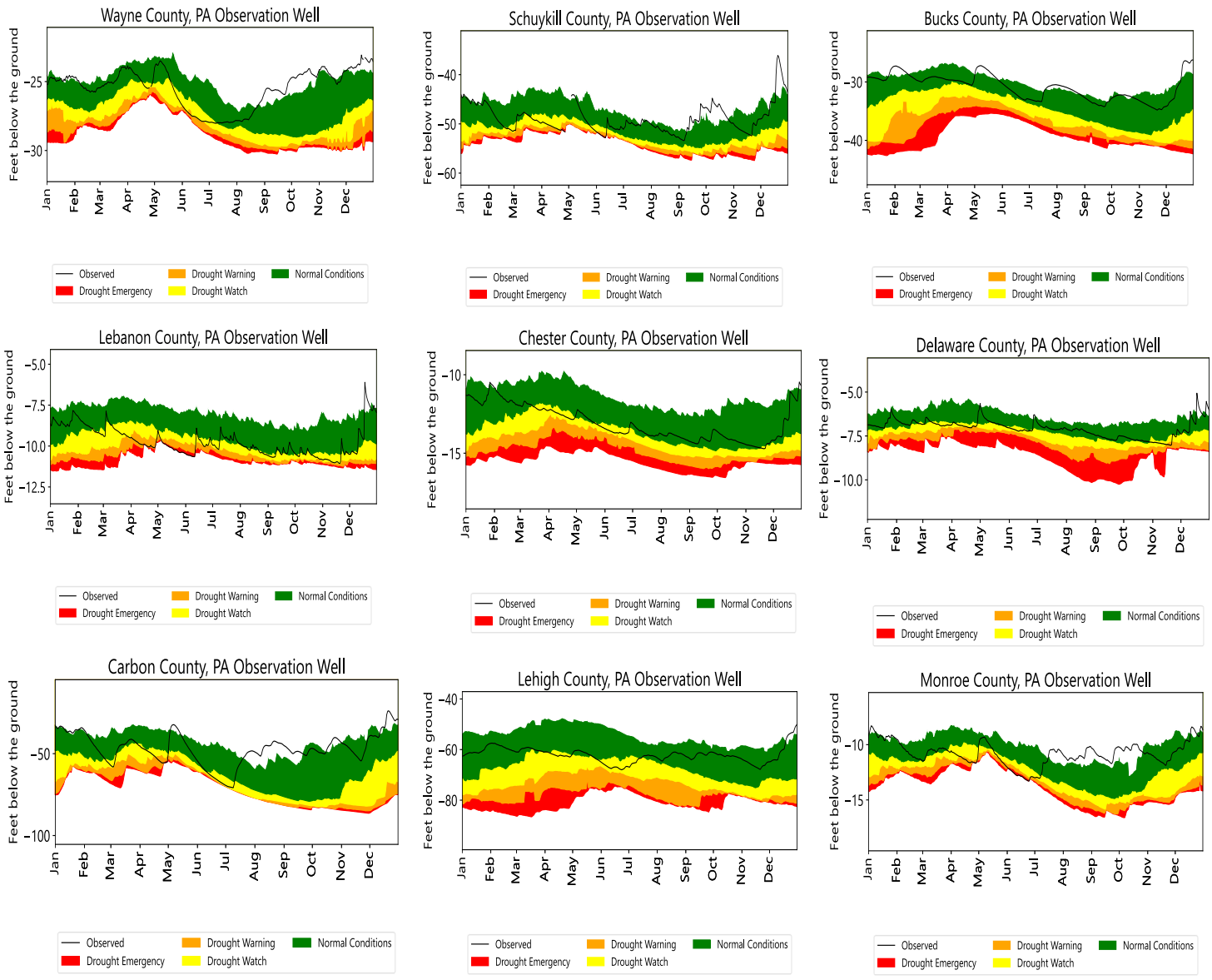


Figure 11: Groundwater Levels at Pennsylvania sites.

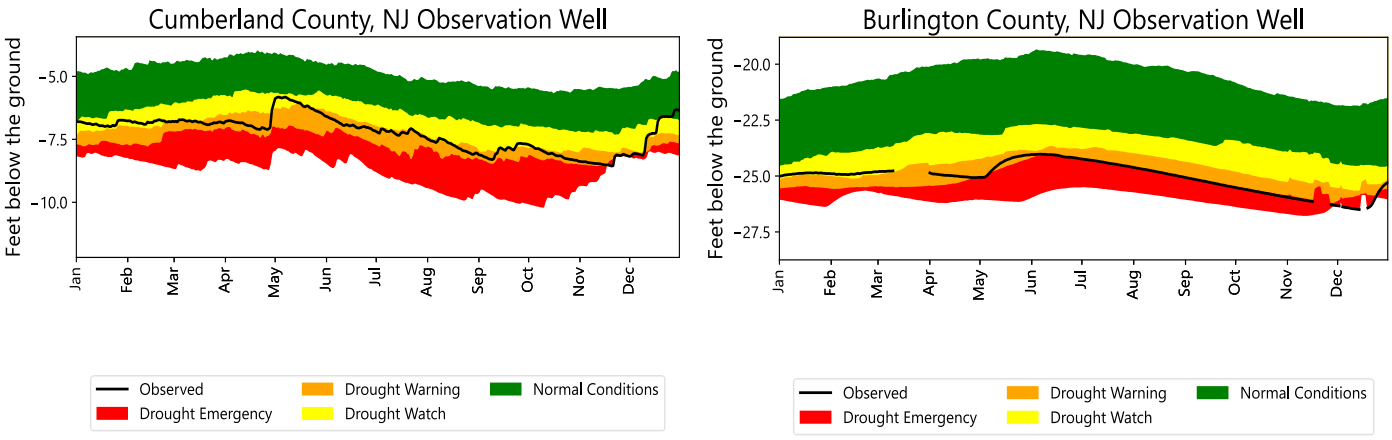


Figure 12: 2023 Groundwater levels at New Jersey sites.

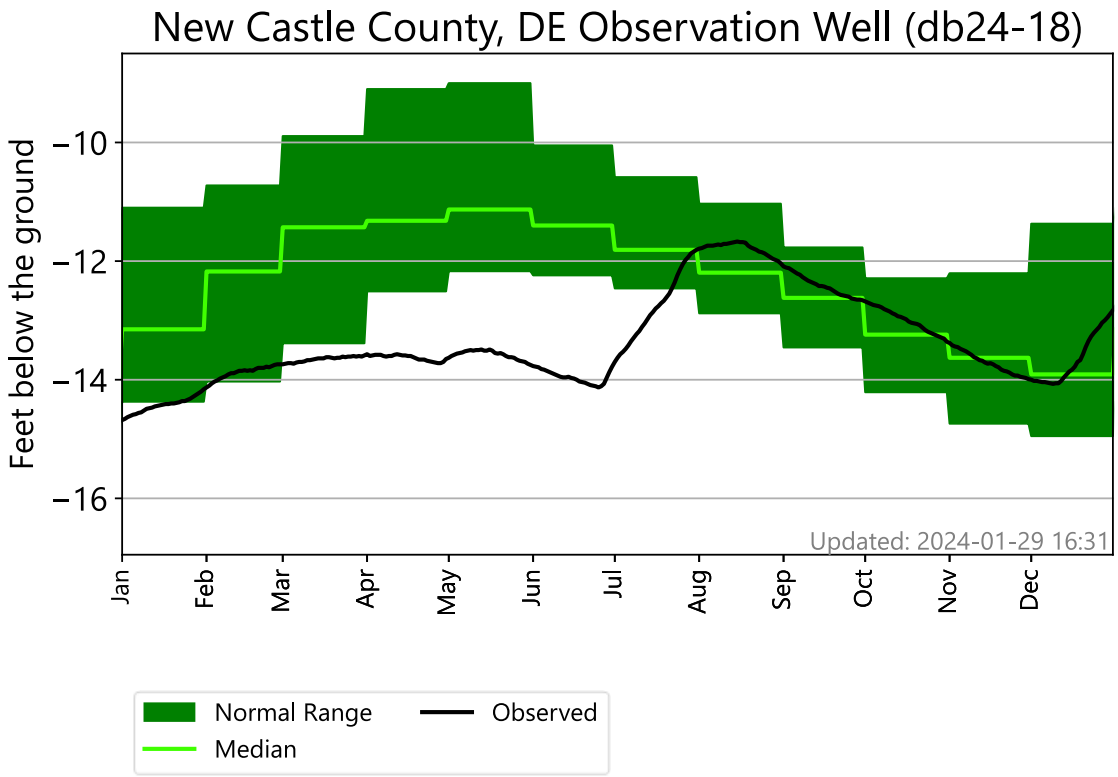


Figure 13: Groundwater levels at New Castle County, Delaware site.

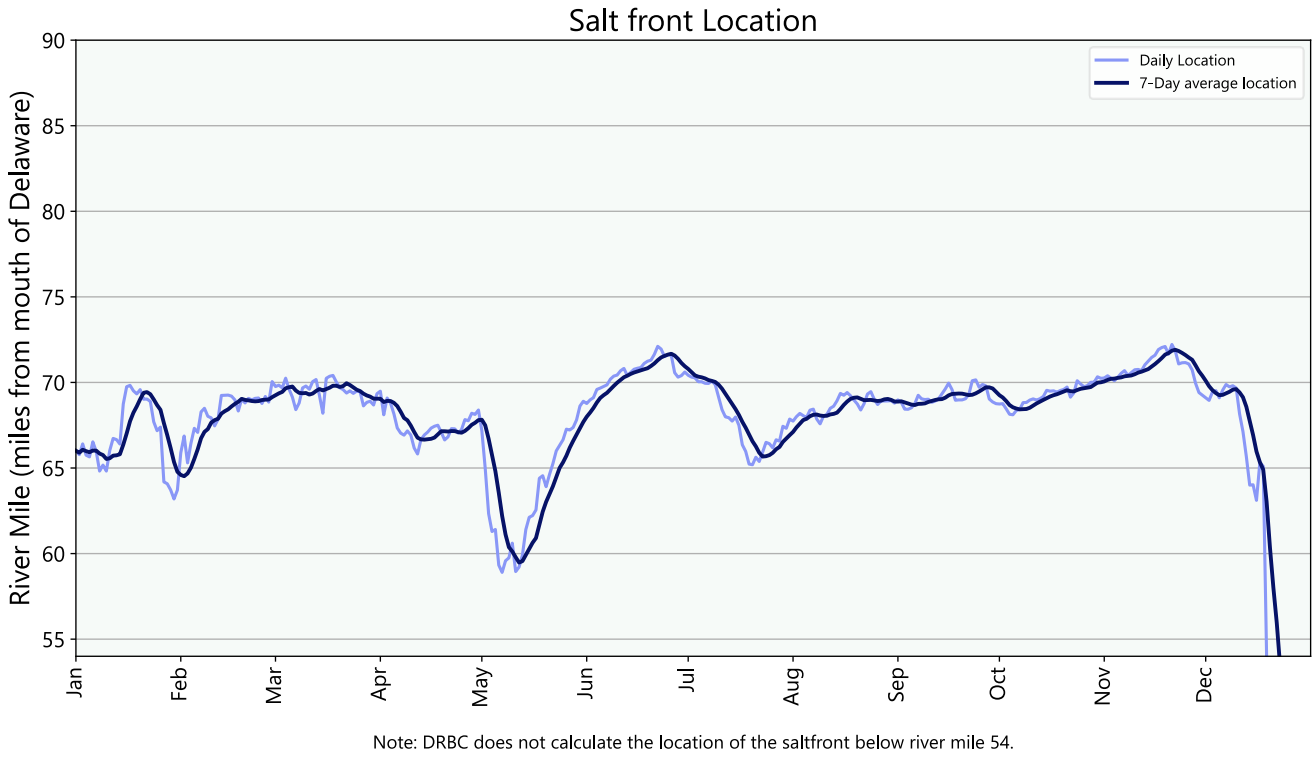


Figure 14: Salt front location in 2023.

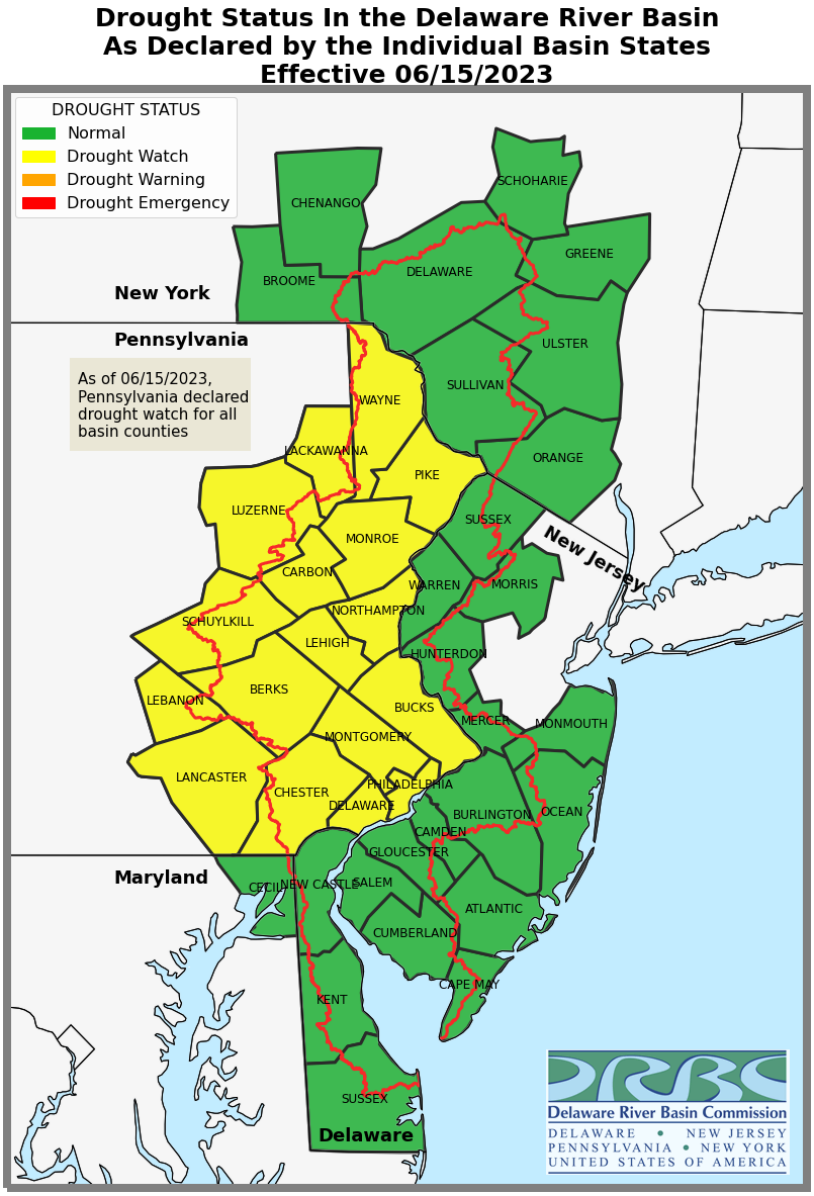
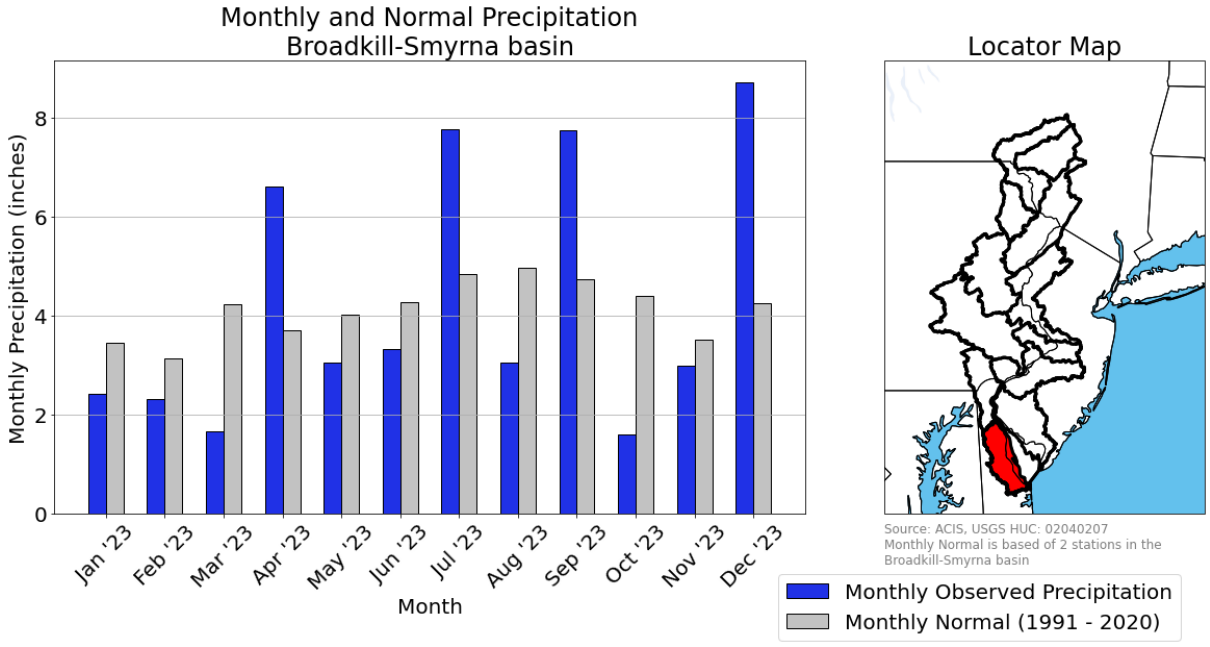


Figure 15: Drought status in the Delaware River Basin. This is a map of all counties partly or completely contained within the DRB, colored based on drought status as declared by individual basin states. On this map, the red line represents the boundary of the basin.

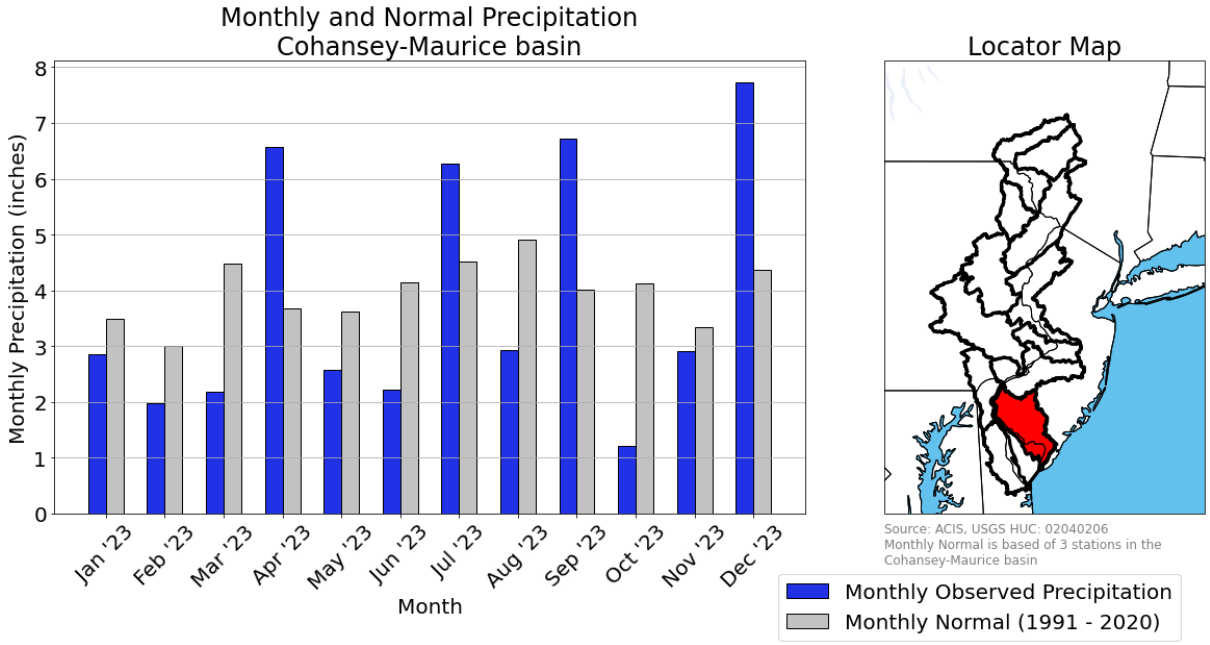
9. APPENDIXES

APPENDIX A: MONTHLY PRECIPITATION COMPARED TO NORMAL

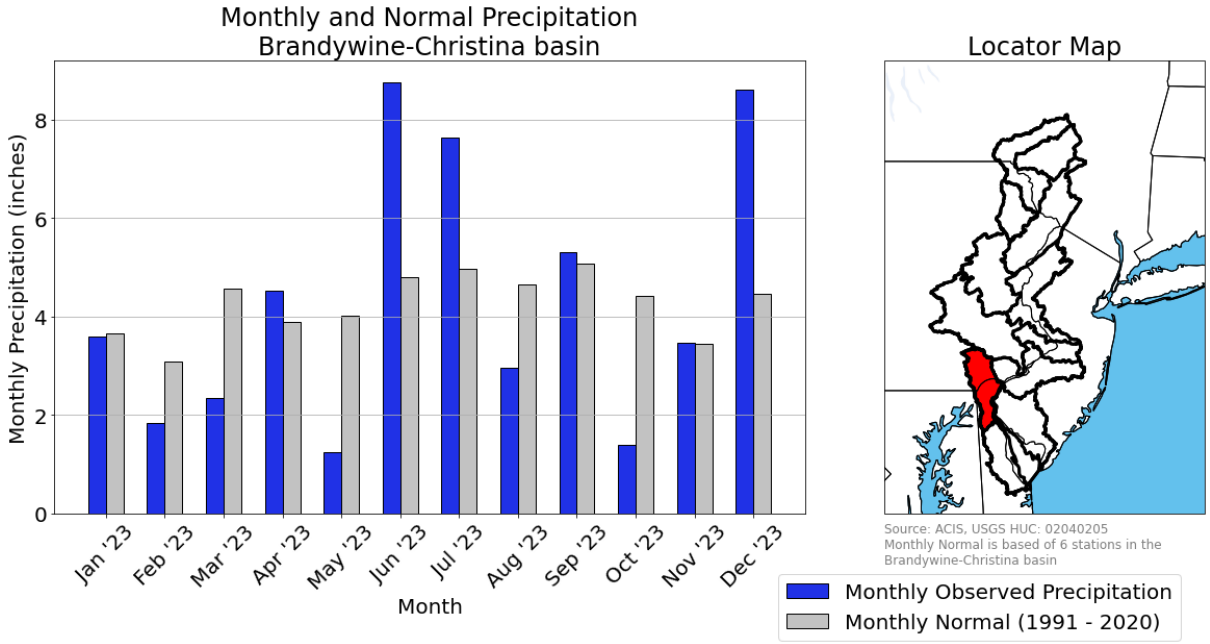
The following Figures present a comparison of observed monthly precipitation to normal monthly precipitation in twelve hydrologic regions across the DRB, as defined by the Hydrologic Unit Code system (HUC) at the eight-digit scale. The Applied Climate Information System (ACIS) is a service provided by the Northeast Regional Climate Center (NRCC), which compiles daily meteorological records from across the United States. The monthly total and normal are calculated using the daily average of precipitation stations within each HUC. In the Figures below, the observed precipitation for the year is depicted by dark blue bars, while the grey bars represent the normal precipitation using the 30-year period from 1991 to 2020, in accordance with NOAA's current definition of normal precipitation. A locator map accompanies each Figure.



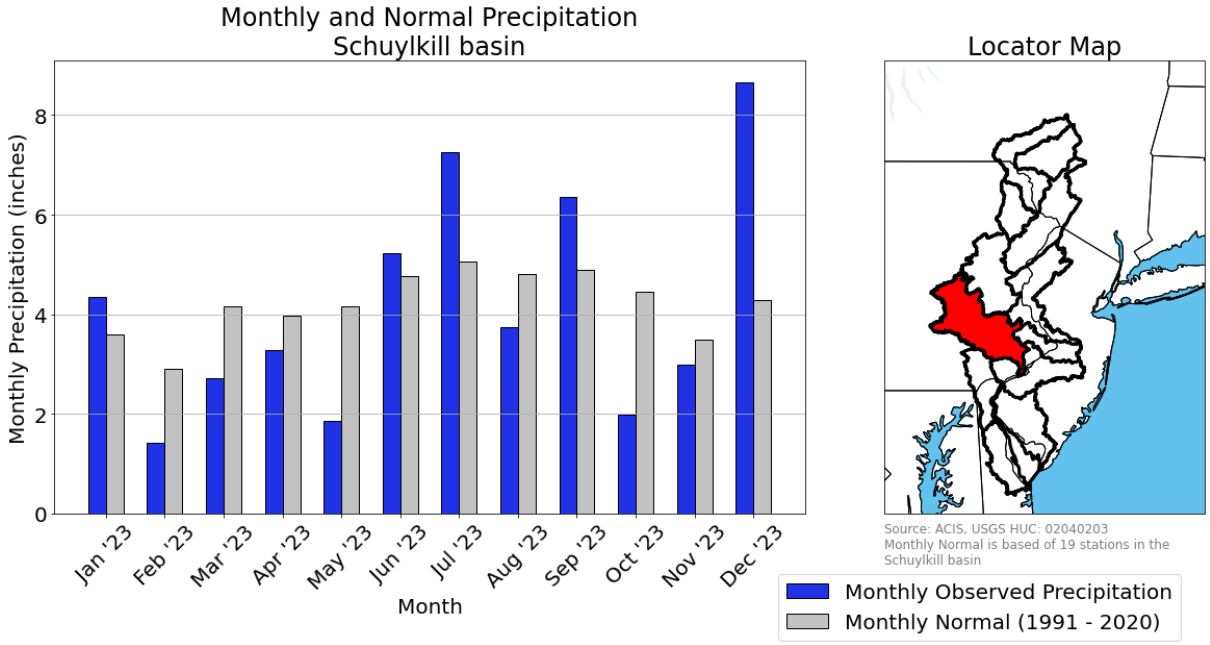
Appendix Figure A: Monthly and normal precipitation in the Broadkill-Smyrna basin.



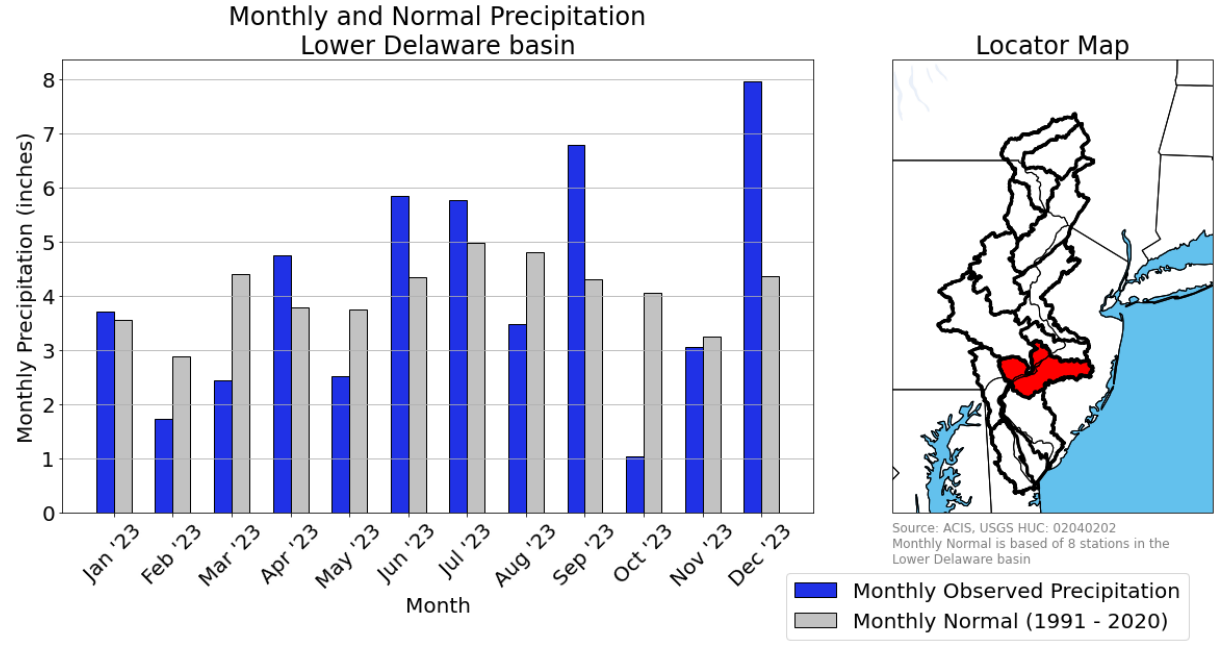
Appendix Figure B: Monthly and normal precipitation in the Cohansey-Maurice basin.



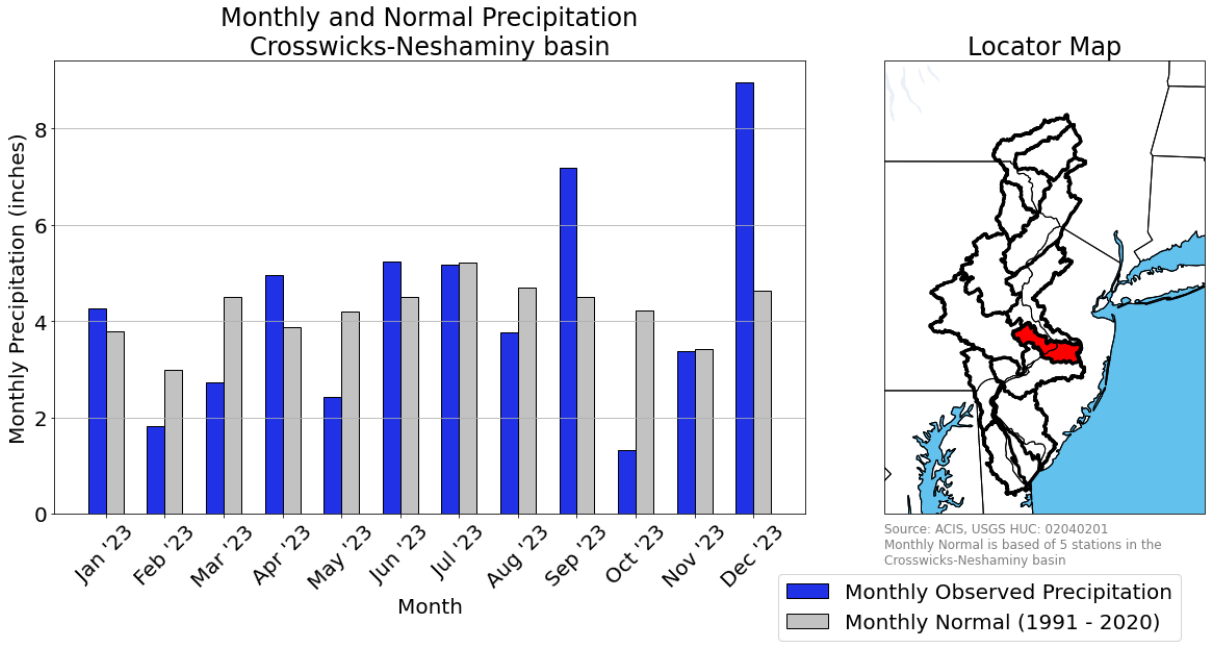
Appendix Figure C: Monthly and normal precipitation in the Brandywine-Christina basin.



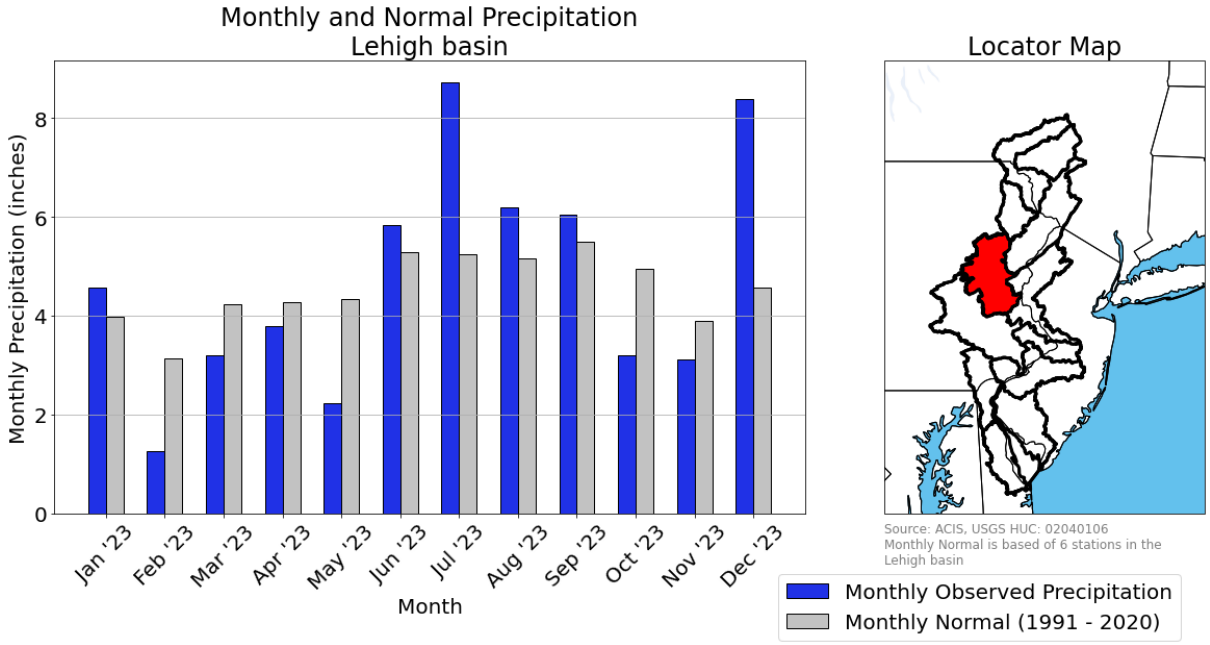
Appendix Figure D: Monthly and normal precipitation in the Schuylkill basin.



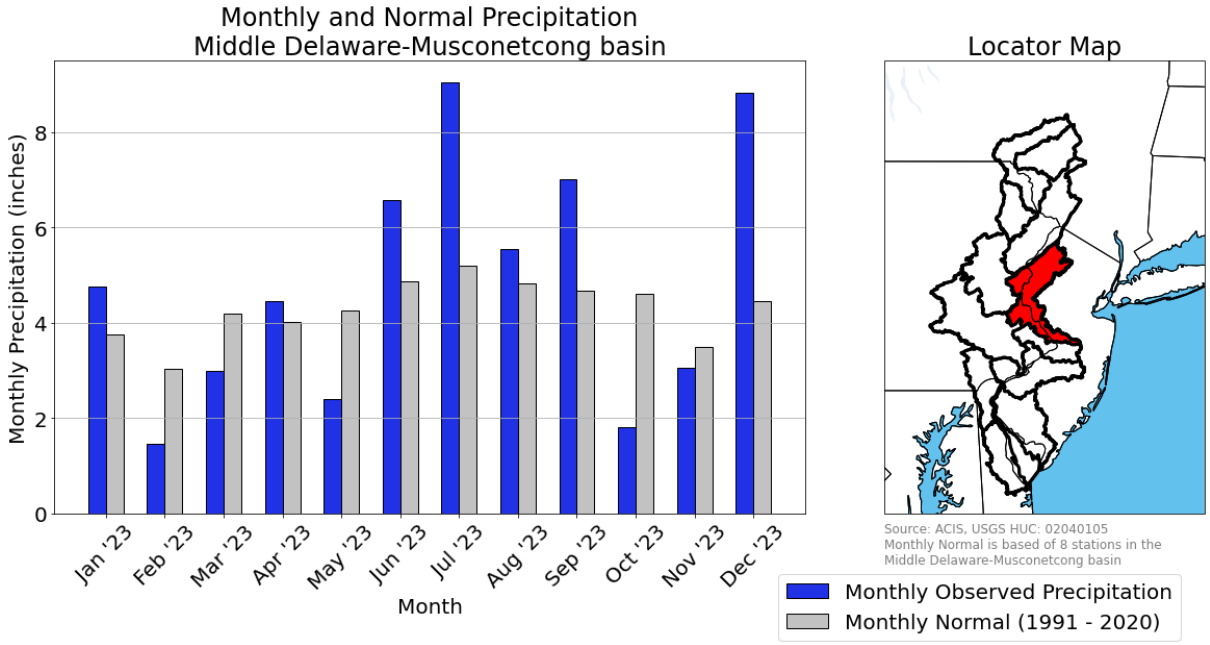
Appendix Figure E: Monthly and normal precipitation in the Lower Delaware basin.



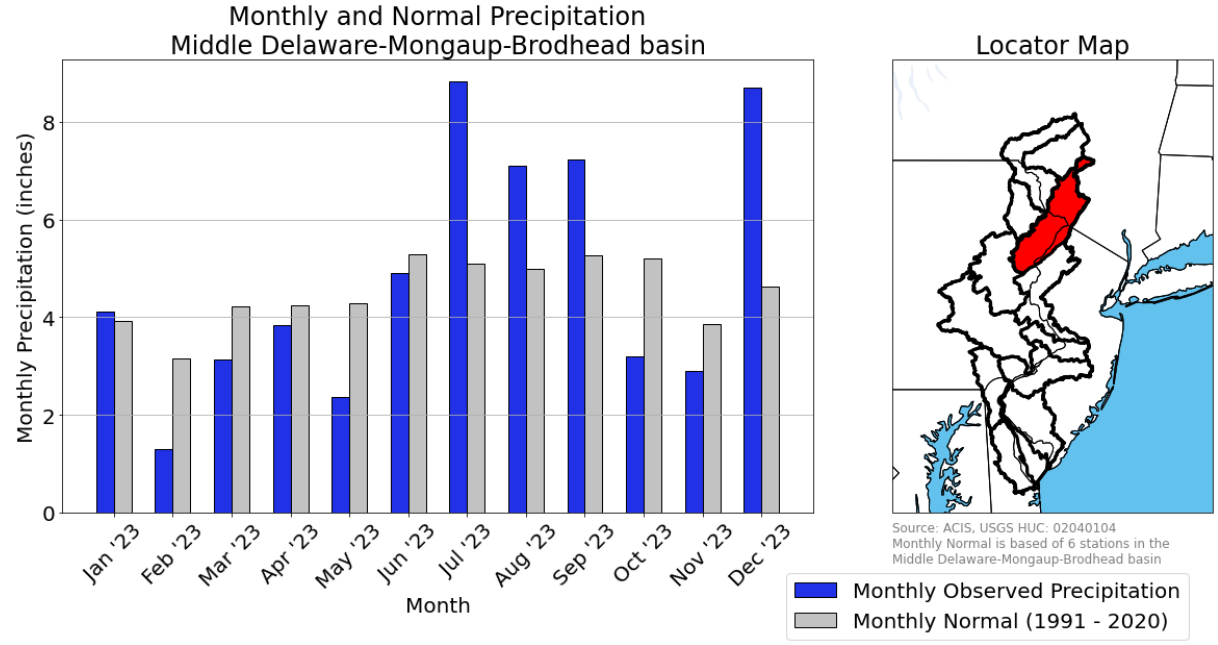
Appendix Figure F: Monthly and normal precipitation in the Crosswicks-Neshaminy basin.



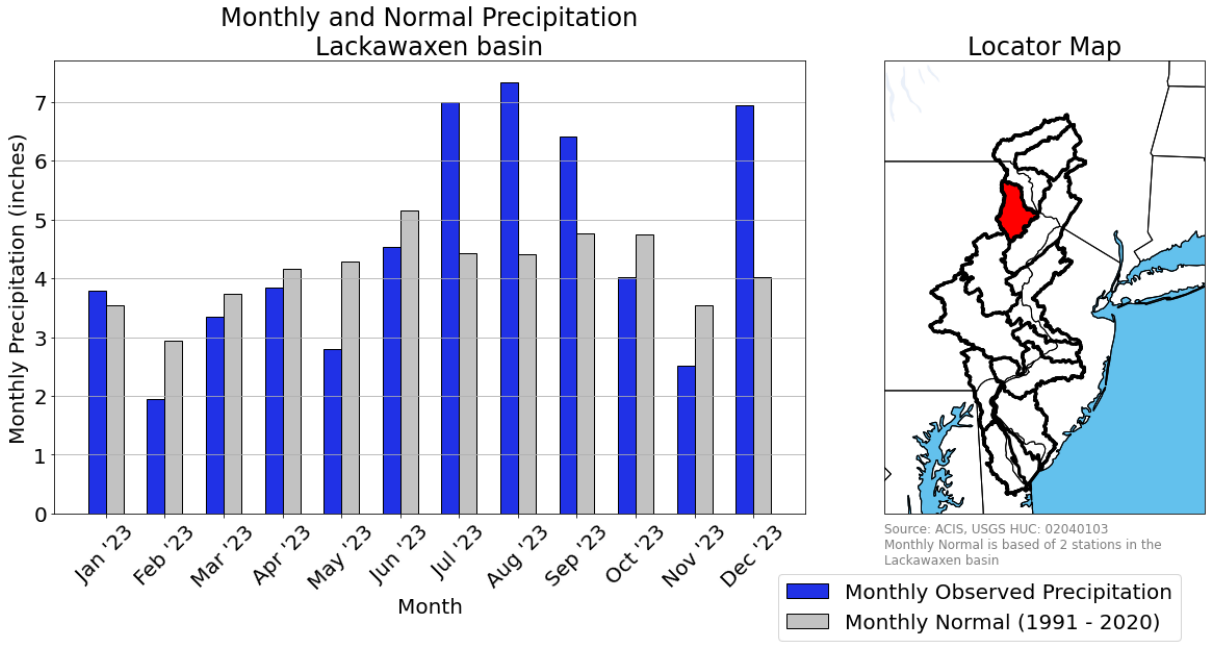
Appendix Figure G: Monthly and normal precipitation in the Lehigh basin.



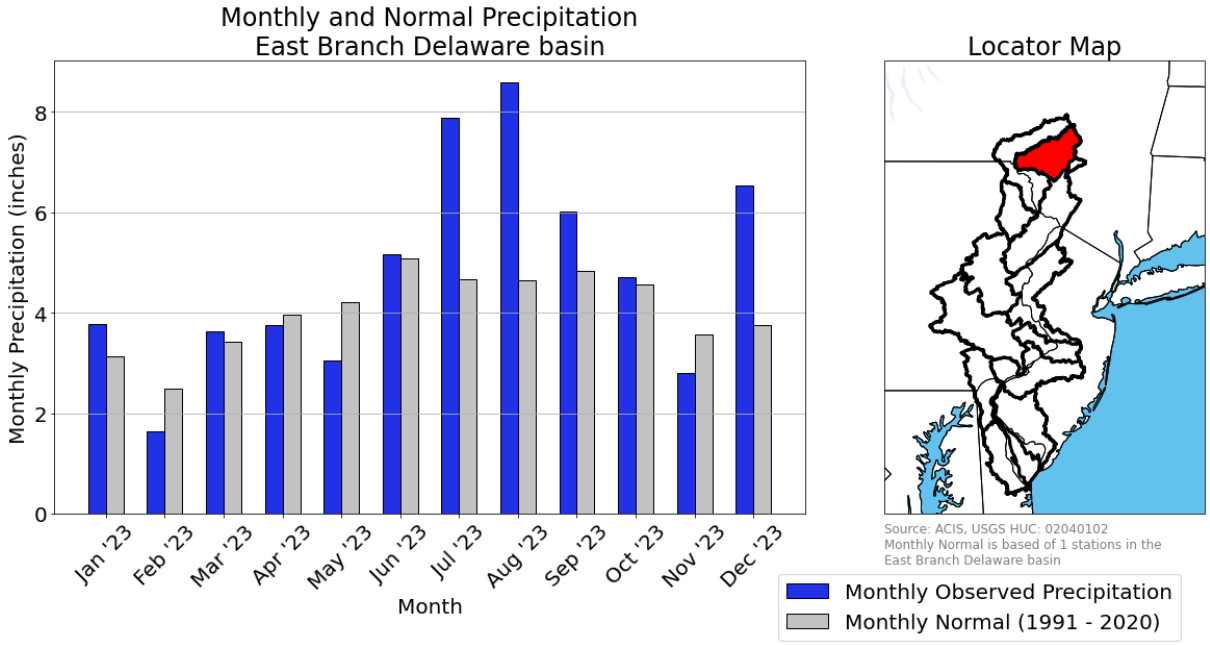
Appendix Figure H: Monthly and normal precipitation in the Middle Delaware-Musconetcong basin.



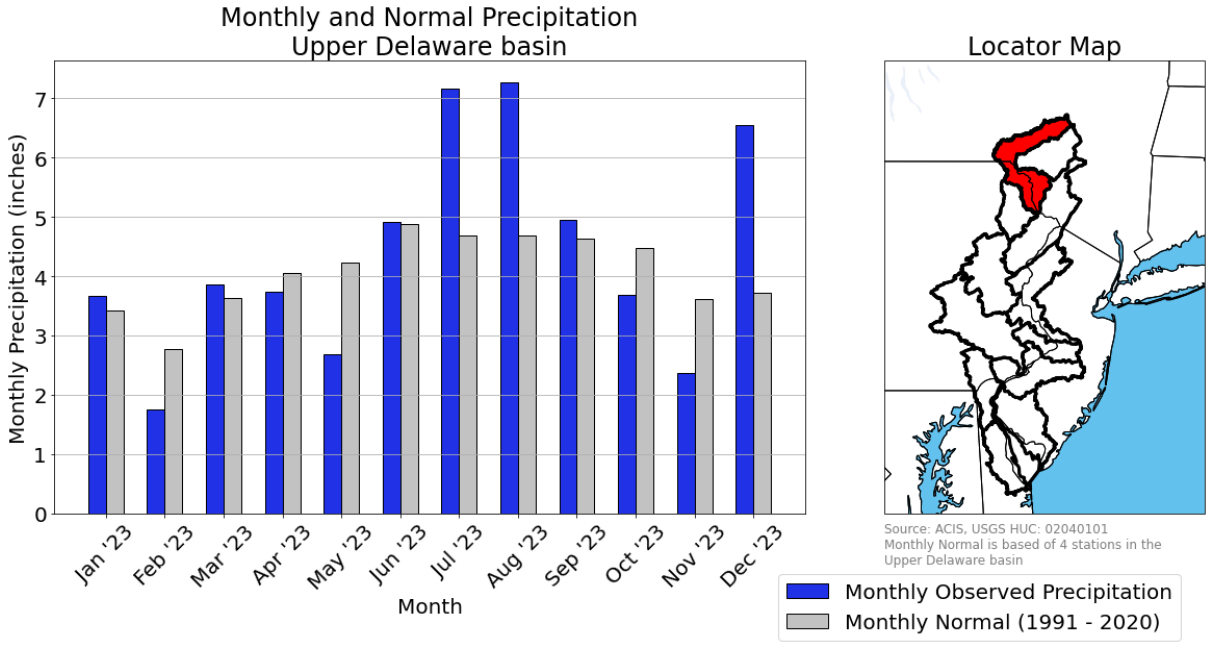
Appendix Figure I: Monthly and normal precipitation in the Middle-Delaware-Mongaup-Brodhead basin.



Appendix Figure J: Monthly and normal precipitation in the Lackawaxen basin.



Appendix Figure K: Monthly and normal precipitation in the East Branch Delaware basin.



Appendix Figure L: Monthly and normal precipitation in the Upper Delaware basin.

Table A: **Monthly Precipitation Totals for 2023, Mean Monthly, and Maximum values (Source: ACIS).** Note: The normal precipitation is based on a precipitation average between 1990-2021

Location		**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Callicoon, NY	2023 Obs.	3.78	1.76	3.88	4.53	2.19	4.73	7.43	8.02	6.01	3.04	2.33	6.27
	Mean	2.95	3.2	3.13	4.66	4.95	5.24	5.93	6.08	5.16	4.87	3.24	4.29
	Max	6.14 (2019)	5.08 (2018)	5.78 (2011)	8.57 (2019)	8.72 (2012)	8.62 (2011)	10.07 (2021)	12.47 (2011)	10.6 (2011)	7.8 (2010)	8.18 (2018)	6.27 (2023)
Mt.Pocono, PA	2023 Obs.	4.01	1.75	3.32	5.68	0.75	4.12	9.39	5.97	6.9	4.3	3.53	9.07
	Mean	3.25	3.03	3.63	4.29	4.37	5.05	4.92	5.23	5.89	5.59	3.71	4.62
	Max	7.16 (2005)	7.24 (2008)	9.75 (2011)	9.24 (2011)	7.27 (2019)	12.05 (2006)	10.85 (2018)	12.69 (2011)	12.93 (2011)	12.71 (2005)	8.53 (2018)	9.07 (2023)
Sussex, NJ	2023 Obs.	4.32	1.37	2.93	6.36	2.57	5.56	8.96	3.91	5.98	2.71	0.24	M
	Mean	3.22	2.86	3.4	3.87	3.91	4.17	4.54	4.41	4.06	3.64	3.48	3.43
	Max	10.17 (1979)	7.93 (2008)	8.85 (2010)	10.00 (1983)	10.58 (1984)	11.18 (1972)	12.77 (1945)	17.3 (1955)	14.51 (2011)	14.58 (2005)	10.2 (1972)	8.48 (1972)
Allentown, PA	2023 Obs.	4.07	1.05	2.78	6	0.24	3.98	6.27	4.78	4.03	1.64	2.92	8.62
	Mean	3.18	2.86	3.56	3.71	3.98	3.96	4.67	4.43	4.21	3.37	3.5	3.67

Location		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Max	8.42 (1979)	7.62 (2008)	7.21 (1953)	10.09 (1952)	10.62 (1984)	9.13 (2006)	10.42 (1969)	13.47 (2011)	12.99 (2011)	13.16 (2005)	9.73 (2018)	8.62 (2023)
Trenton, NJ	2023 Obs.	3.6	1.57	2.6	4.86	0.61	3.9	5.69	4.01	6.65	1.17	2.74	7.53
	Mean	3.21	2.92	3.63	3.82	3.99	4.32	4.58	4.22	4.37	3.9	3.05	3.99
	Max	6.59 (1999)	5.75 (2018)	8.34 (2018)	9.95 (2007)	7.57 (2019)	10.14 (2013)	9.87 (1945)	15.69 (2011)	11.22 (1999)	11.21 (2005)	8.85 (2018)	7.53 (2023)
Reading, PA	2023 Obs.	3.45	1.17	2.53	4.23	0.09	3.76	10.07	3.72	5.64	1.58	2.58	7.70
	Mean	2.84	2.75	3.23	3.38	3.64	4.31	4.97	4.55	5.20	3.76	2.67	3.62
	Max	6.10 (1949)	6.88 (2008)	6.53 (2000)	6.47 (2014)	9.72 (2019)	9.05 (2006)	11.37 (2004)	14.81 (2018)	12.35 (1999)	10.53 (2005)	8.15 (2018)	7.70 (2023)
Phila., PA	2023 Obs.	3.36	1.32	1.99	5.17	0.24	4.24	5.24	3.25	5.99	0.72	2.75	7.92
	Mean	3.12	2.76	3.71	3.49	3.57	3.8	4.28	4.14	3.7	2.98	3.21	3.57
	Max	8.86 (1978)	6.44 (1979)	7.33 (2010)	9.05 (2007)	7.40 (1948)	10.56 (2013)	13.24 (2013)	19.31 (2011)	13.07 (1999)	8.68 (2005)	9.06 (1972)	8.86 (2009)
Millville, NJ	2023 Obs.	2.33	1.96	2.16	8.7	0.99	1.53	6.08	3.49	6.62	0.96	2.65	8.51

Location		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Mean	3.12	2.99	3.93	3.61	3.56	3.46	3.87	4.36	3.3	3.27	3.34	3.74
	Max	7.93 (1999)	7.64 (1971)	10.13 (1994)	8.70 (2023)	8.60 (1948)	12.74 (2015)	12.9 (1969)	12.74 (2011)	7.66 (1966)	7.63 (2005)	8.60 (1972)	9.30 (1969)
Wilmington, DE	2023 Obs.	2.92	1.65	2.26	4.55	0.2	11.91	8.85	2.77	5.08	0.83	3.09	7.98
	Mean	3	2.81	3.68	3.23	3.38	3.84	4.16	3.63	3.71	3.04	3.06	3.45
	Max	8.41 (1978)	7.02 (1979)	9.17 (2000)	8.55 (2007)	7.38 (1983)	13.66 (2013)	12.63 (1989)	14.7 (2011)	12.68 (1999)	8.01 (1995)	8.69 (2018)	8.58 (2009)

APPENDIX B: FLOODING EVENTS

Table B- 1: NWS Forecast Locations with Levels at Action or Minor Flood Stage (April 30- May 6)

NWS Flood Forecast Location	Type	Peak	Stage
Neshaminy Creek at Langhorne	Stream	9.70 ft	Minor

Table B-2: NWS forecast locations with Levels at Action or Minor Flood Stage (Dec.11)

NWS Flood Forecast Location	Type	Peak	Stage
Neshaminy Creek at Langhorne	Stream	9.89 ft	Minor

Table B-3: NWS forecast locations with Levels at Action or Minor Flood Stage (Dec. 18-25)

NWS Flood Forecast Location	Type	Peak	Stage
Beaver Kill at Cooks Falls	Stream	11.51 ft	Minor
North Branch Rancocas at Pemberton	Stream	2.83 ft	Minor
Bush Kill at Shoemakers	Stream	6.26 ft	Minor
Assunpink Creek at Trenton	Stream	9.29 ft	Minor
West Branch Delaware River at Walton	Stream	12.13 ft	Minor
Schuylkill River at Berne	Stream	13.35 ft	Minor
Brandywine Creek at Chadds Ford	Stream	12.14 ft	Moderate
Perkiomen Creek at Graterford	Stream	13.97 ft	Moderate
Neshaminy Creek at Langhorne	Stream	13.59 ft	Moderate
Schuylkill River at Norristown	Stream	15.85 ft	Minor
Schuylkill River at Philadelphia	Stream	11.82 ft	Minor
Schuylkill River at Pottstown	Stream	13.92 ft	Minor
Brandywine Creek at Wilmington	Stream	17.08 ft	Minor
White Clay Creek near Newark	Stream	13.25 ft	Minor
Red Clay Creek at Wooddale	Stream	8.50 ft	Moderate
Christina River at Coochs Bridge	Stream	12.22 ft	Moderate

Table B-4: NWS Forecast Locations with Levels at Action or Minor Flood Stage (Dec. 28- Jan 1)

NWS Flood Forecast Location	Type	Peak	Stage
Brandywine Creek at Chadds Ford	Stream	10.25 ft	Minor
Perkiomen Creek at Graterford	Stream	13.87 ft	Moderate
Neshaminy Creek at Langhorne	Stream	9.50 ft	Minor
Schuylkill River at Norristown	Stream	14.94 ft	Minor
Schuylkill River at Philadelphia	Stream	11.27 ft	Minor
Christina River at Coochs Bridge	Stream	12.03 ft	Moderate

[i] https://forecast.weather.gov/glossary.php?word=water%20equivalent