**U.S. Geological Survey (USGS) Maryland-Delaware-District of Columbia**
**Monthly Water Conditions Summary**

## February 2016 Highlights: Sixty-seven percent of groundwater levels and 91 percent of streamflow levels were above normal at sites monitored by the U.S. Geological Survey across Maryland, Delaware, and the District of Columbia.

### Why is it important for the USGS to collect and analyze water-resources data?

USGS water data are valuable to the public, researchers, water managers, planners, and agricultural users, especially during floods and droughts. These data can be used to assess how water resources respond to changes in climate. Scientists at the USGS have measured streamflow and groundwater levels to assess water resources for over 125 years.

In addition to providing the most extensive set of historical streamflow and groundwater data available to the public, the USGS continues to collect water data and quality-assures the data using standardized techniques across the country. The uniformity of the dataset enables multi-state comparisons and other comparative statistical analyses that better inform policy makers of the possible water-resources conditions they might encounter in the future.

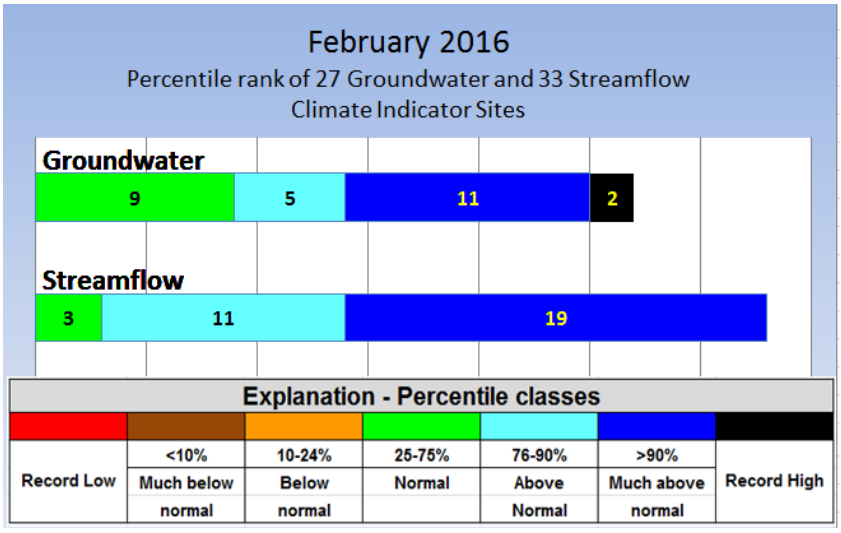
The sites used in this water summary were carefully selected to show the response of streamflow and groundwater levels to weather conditions. Ideally, these sites will show no effects from human influences. The streamflow and groundwater data are ranked in comparison to the historical record and summarized. Precipitation and reservoir data are also presented to give a more complete picture of the region's water resources.

## USGS February 2016 Water Conditions Summary

In February, groundwater levels and streamflow were normal to above normal at all sites used to monitor the response of water resources to changes in climatic conditions in Maryland, Delaware, and the District of Columbia. Sixty-seven percent of the groundwater levels and 91 percent of the monthly mean streamflows were above normal in February.

Groundwater levels were normal (between the 25th and 75th percentiles) in 9 of 27 USGS monitoring wells in Maryland and Delaware. Groundwater levels were above normal in the remaining 16 wells, and were at a record February high at 2 observation wells. In Frederick County, Maryland, the groundwater level was at an all-time record high as well as the February record high. The other observation well with a record February high groundwater level was in Montgomery County, Maryland.

February monthly mean streamflow levels were above normal at 30 of 33 streamgages in Maryland, Delaware, and the District of Columbia. Streamflows were close to a record monthly high at several of the sites, although effects from ice may make the measurements higher or lower than reported. Streamflows at the remaining three sites were normal.




A **percentile** is a value on a scale from 0 to 100 that indicates the percent of a distribution that is equal to or below it. A percentile between 25 and 75 is considered normal. For example, a groundwater level in the 90th percentile is equal to or greater than 90 percent of the values recorded for that month.

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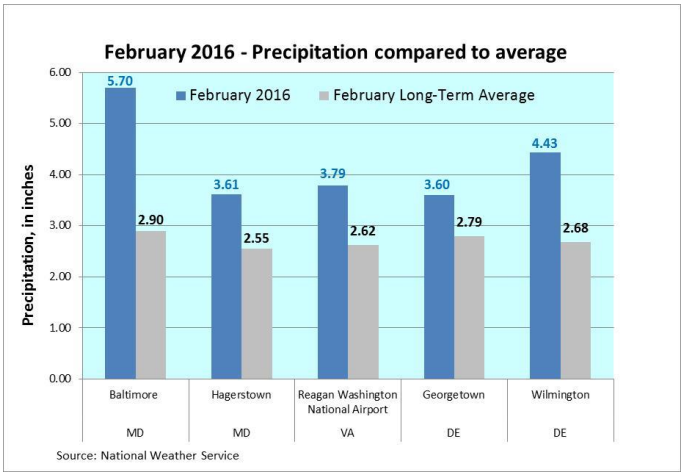
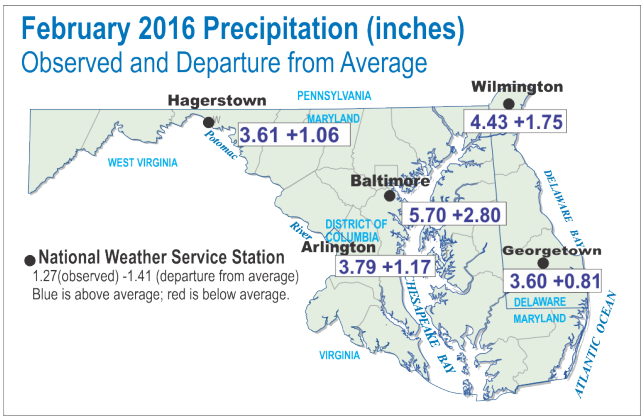
## February 2016 Precipitation and Weather

After the January record-setting snowfall in the Mid-Atlantic region, most of the snow melted in February which contributed to many high streamflow and groundwater levels. Precipitation was more than an inch above the long-term average at four of the five National Weather Service (NWS) Mid-Atlantic weather stations in February. At Georgetown, Delaware, precipitation was 0.81 inches above average.




The highest precipitation of the five Mid-Atlantic weather stations was in Baltimore, Maryland, with 5.70 inches, which was 2.80 inches above the long-term average. At this station, a total of 3.22 inches fell between February 23 and 25, which is approximately the average monthly precipitation for February. Rainfall on February 24 was 2.61 inches, which broke the daily maximum precipitation record of 1.70 inches set in 1979.




National Weather Service Stations

**Baltimore** =
Baltimore/Washington International Thurgood Marshall Airport (BWI)
**Georgetown** =
Georgetown, Sussex County Airport
**Hagerstown** =
Hagerstown Regional Airport
**Arlington** =
Ronald Reagan Washington National Airport
**Wilmington** =
New Castle Airport

The NWS Middle Atlantic River Forecast Center's (MARFC) 365-day precipitation data for Maryland, Delaware, and the District of Columbia showed that precipitation in all counties in Maryland and Delaware was normal to above normal. The highest departure from average was in Harford County, Maryland, which was 13.1 inches above average for the 365-day period. Precipitation was below normal in the three counties in western Maryland: Allegany, Garrett, and Washington.

February average temperatures ranged from 0.9 to 2.4 degrees Fahrenheit above normal at the five Mid-Atlantic NWS weather stations. Temperatures were 2.4 degrees Fahrenheit above normal at Georgetown, Delaware, which tied the weather station in Arlington, Virginia for the warmest monthly average temperature at 39.9 degrees Fahrenheit. The lowest temperature was in Hagerstown, Maryland at 34.8 degrees Fahrenheit, which was 1.2 degrees Fahrenheit below average.

Sources: National Weather Service and Middle Atlantic River Forecast Center (MARFC)
MD and DC: http://www.weather.gov/climate/index.php?wfo=lwx
DE: http://www.weather.gov/climate/index.php?wfo=phi:
MARFC:http://www.weather.gov/marfc/Precipitation_Departures

# Groundwater

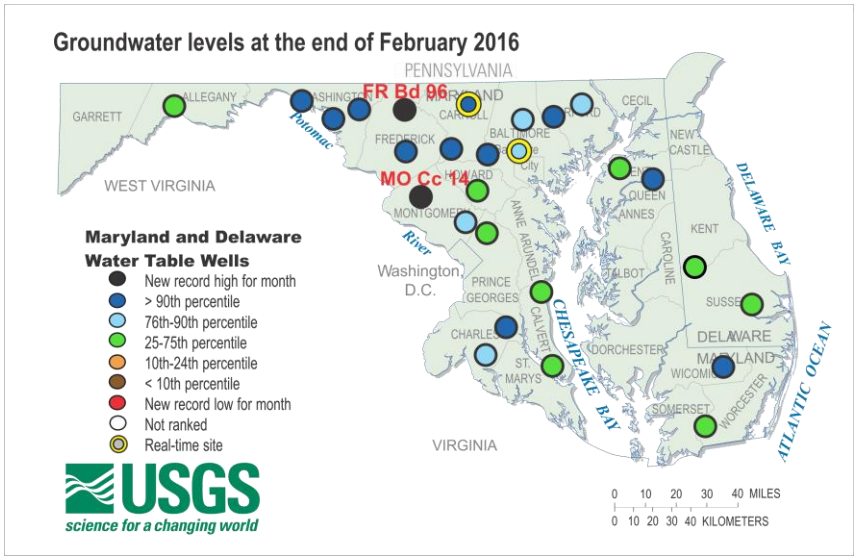
The USGS monitors groundwater levels in unconfined aquifers, providing observations that can be compared to both short-term and long-term changes in climatic conditions. The groundwater wells used for the monthly water summary were selected based on the following criteria:

- Located in an unconfined (water-table) aquifer;
- Open to a single, known hydrogeologic unit/aquifer;
- Groundwater hydrograph reflects changes in climatic conditions;
- No indicated nearby pumpage and likely to remain uninfluenced by pumpage, regulated streamflow, or changes related to human activities;
- Minimum period of record is 10 years of continuous/monthly records;
- Minimally affected by irrigation, canals, drains, pipelines, and other potential sources of artificial recharge;
- Well has a casing – dug wells are generally not used;
- Water levels show no apparent hydrologic connection to nearby streams;
- Well has never gone dry; and
- Long-term accessibility likely.

## February 2016 Groundwater Levels

At USGS wells used to monitor climatic conditions in Maryland and Delaware, all groundwater levels were normal to above normal in February with one all-time record high and two February record highs. Since January, the groundwater levels rose at every well except the observation well in Somerset County, Maryland.

Sixty-seven percent (18 of 27 wells) of the groundwater levels were above normal in February. That includes the two record highs, one in Frederick County, Maryland and the other in Montgomery County, Maryland. There were 11 wells with groundwater levels above the 90th percentile (dark blue on map), many of which were close to a monthly record high. There were five wells between the 76th and 90th percentiles (cyan on map) and 33 percent (9 of 27 wells) of the groundwater levels were normal (25th-75th percentiles; green on map). These data are provisional and subject to revision.




To access the clickable groundwater map, go to:
http://md.water.usgs.gov/groundwater/web_wells/current/water_table/counties/

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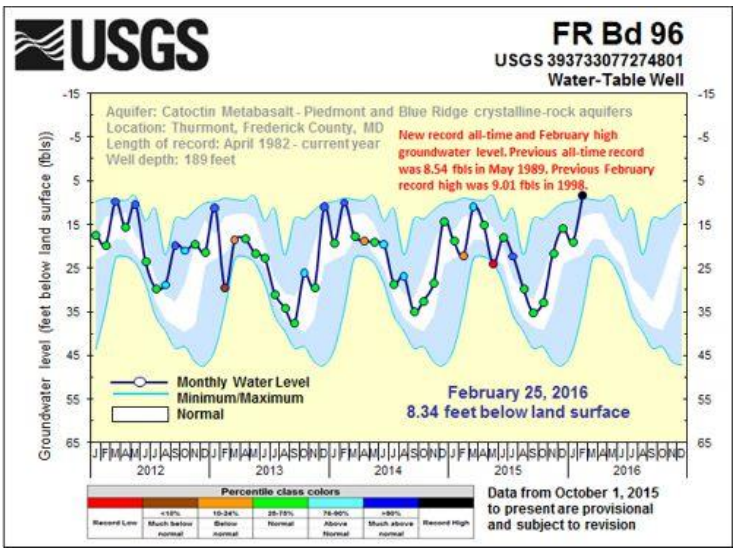
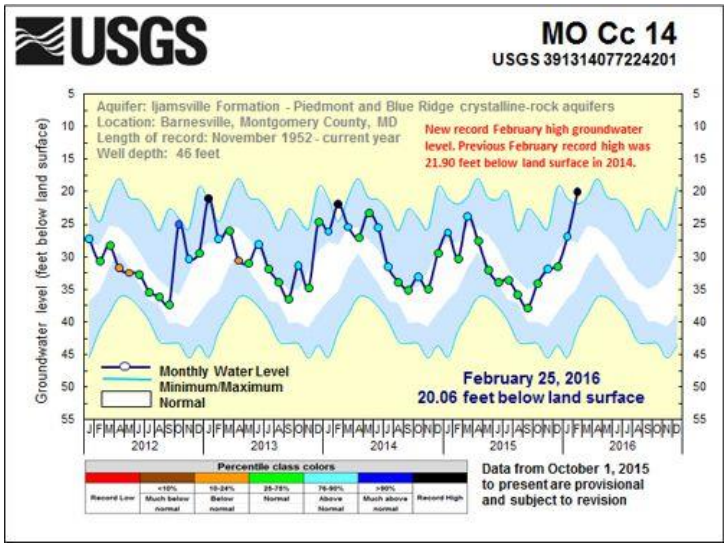
There were two February record high groundwater levels and one all-time record high groundwater level in February 2016. The high groundwater levels are likely due to snowmelt from the 2 to 3 feet of snow that fell in at the end of January and normal to above normal precipitation in February. The average highest groundwater level at both wells (FR Bd 96 and MO Cc 14) is usually in April, so it is possible the groundwater levels will be even higher during the next 2 months.

The groundwater level in USGS observation well FR Bd 96 in Frederick County, Maryland was 8.34 feet below land surface, which was a record all-time and February high this month. The previous all-time record was 8.54 feet below land surface in May 1989. The previous February record was 9.01 feet below land surface in February 1998. Record-keeping at this well began in 1982.

The groundwater level in USGS observation well MO Cc 14 in Montgomery County, Maryland was 20.06 feet below land surface, which was a February record high level. The previous record was 21.90 feet below land surface in 2014.




Five-year groundwater hydrographs can be viewed at:
http://md.water.usgs.gov/groundwater/web_wells/current/water_table/counties

The 5-year hydrograph shows groundwater levels as a dark blue line, the minimum and maximum monthly values, and the normal range (between the 25th and 75th percentiles) as a white band based on the period of record. The maximum water level is at the top of the upper blue section and the minimum water level is at the bottom of the lower blue section in the graph. Each monthly measurement is colored according to the percentile rank in which it falls for the month.

## Streamflow

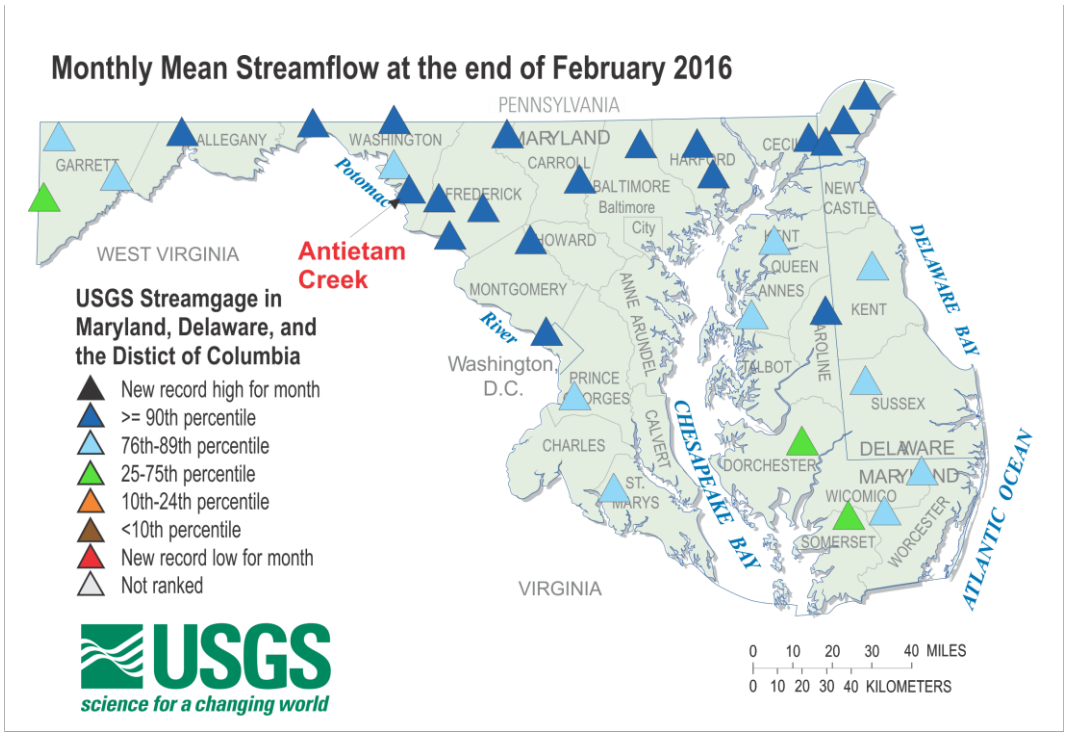
Streamflow data are used for many purposes. A few of the most common uses are to assess water supply and the risk of droughts and floods. Streamflow data are also used to calculate loads of chemical constituents and assess how biological communities are affected by hydrologic conditions. The USGS operates the most extensive network of streamgages in the region.

The streamflow locations chosen for the monthly water summary were selected based on the following criteria:

- Minimum period of record is 10 years of continuous data;
- Watershed areas greater than 5 square miles;
- Streamflow is not regulated, or has relatively natural flow;
- Streamflow data reflect climatic conditions; and
- The surrounding area and watershed are not urban.

### February 2016 Streamflow

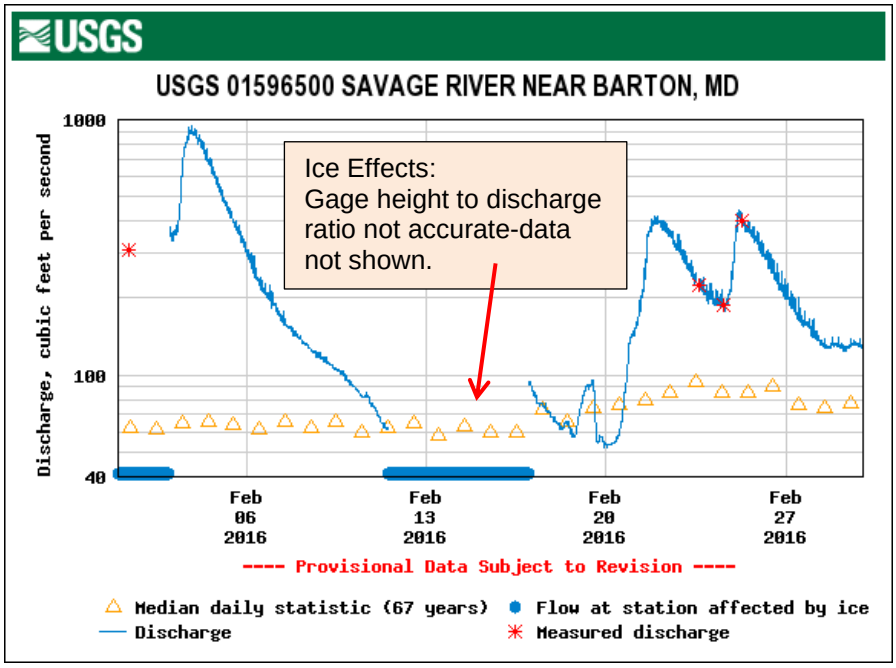
Snowmelt and normal to above normal precipitation in February caused monthly mean streamflows to rise since January at all 33 streamgages used to monitor climatic response in Maryland, Delaware, and the District of Columbia. All sites had monthly mean streamflow that was normal to above normal. February monthly mean streamflows were above normal (cyan and blue on map) at 91 percent (30 of 33) of the USGS streamgages. Monthly mean streamflow was normal (25$^{th}$-75$^{th}$ percentiles, green on map) at three streamgages in Maryland or 9 percent of sites in Maryland, Delaware, and the District of Columbia.




To access the clickable streamflow map, go to:
http://md.water.usgs.gov/surfacewater/streamflow/

In the Mid-Atlantic region, ice effects on streams can typically occur between December and March. Below freezing air temperatures can lead to the formation of ice and it will often result in very erratic water level readings. Ice in the stream may result in a biased gage height record, invalidating the known stage–discharge relationship.

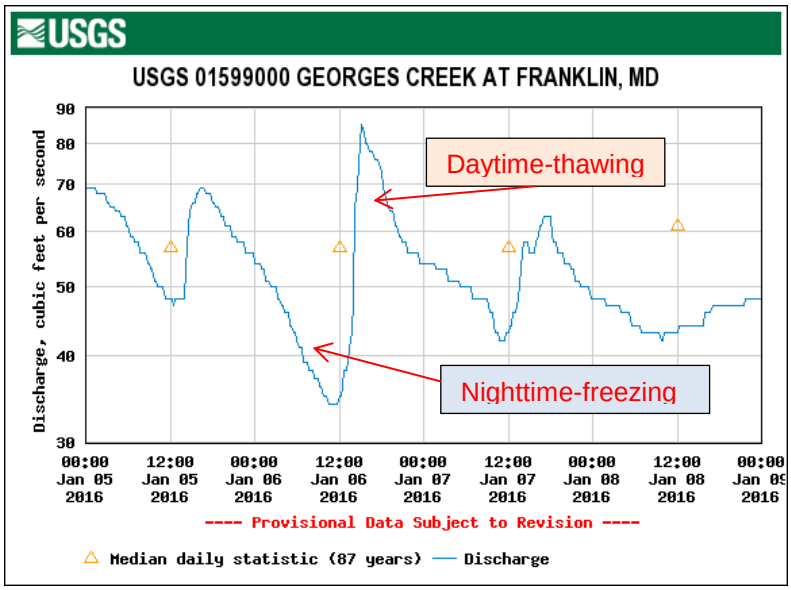
When erroneous gage height values appear, they are flagged or removed from the web display. However if the gage heights are considered to be accurate but the ice in the channel is causing a bias to the stage–discharge relationship then a heavy blue line will mask discharge values, as shown in this example at the Savage River. Hydrographers will later analyze the data available and estimate daily discharge values affected by ice. Weather records, discharge data obtained through direct measurements (made during the ice-affected period) and/or hydrographic comparison with non-ice affected streamgages in the surrounding area all play an important role in making these estimations.




All data are provisional and subject to revision until approved.

Below-freezing temperatures may also affect the amount of water in a stream channel. In wintertime, a natural freeze/thaw cycle can occur, as shown in the hydrograph below from Georges Creek. When the water in smaller tributary streams upstream of a gaging location freezes, typically after dark, then less water is able to pass by the gage; causing the sudden dropoff in flow as seen here. When the sun comes out the next day and if the air temperature rises, upstream channels will thaw and release the water, resulting in increased streamflow at the gage.

Frozen ground leads to less infiltration and groundwater movement (baseflow) to streams, which could result in lower streamflow, but as temperatures get warmer, the water is released. Fluctuations related to the freeze/thaw cycle may represent actual flow conditions which would not need corrections to the data.



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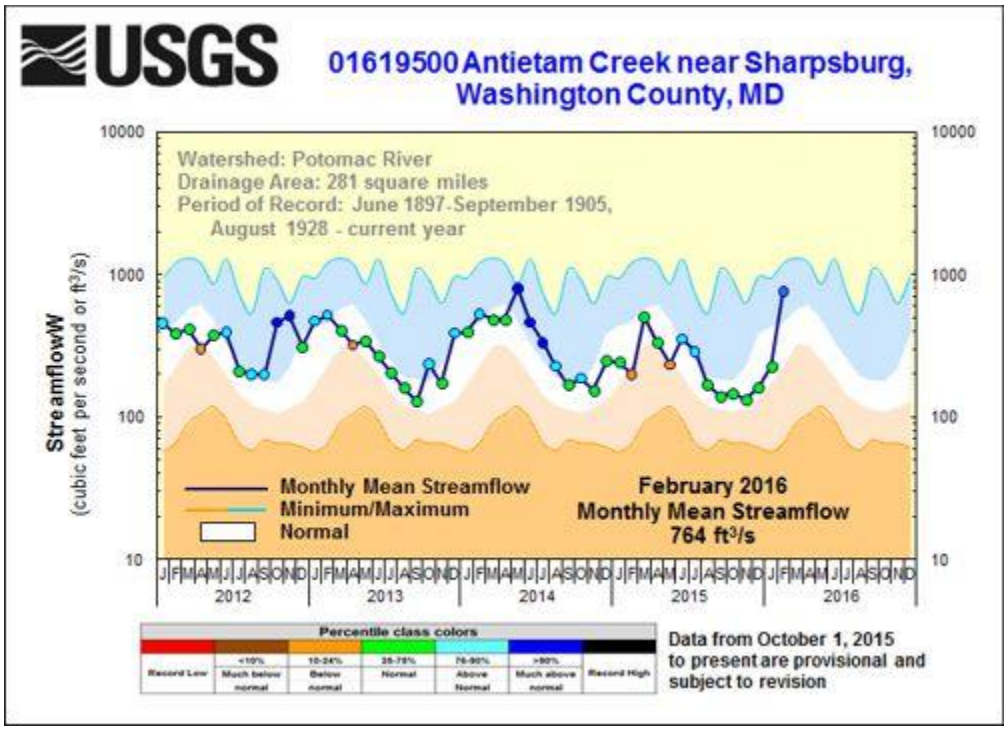
Monthly mean streamflow on Antietam Creek near Sharpsburg in Washington County, Maryland rose sharply in February from normal to 764 cubic feet per second ($ft^3/s$), which is above the 90th percentile. The highest average monthly mean streamflow at Antietam Creek was in April (452 $ft^3/s$), so it is possible that streamflow in March and April will be even higher at Antietam Creek than it is now.



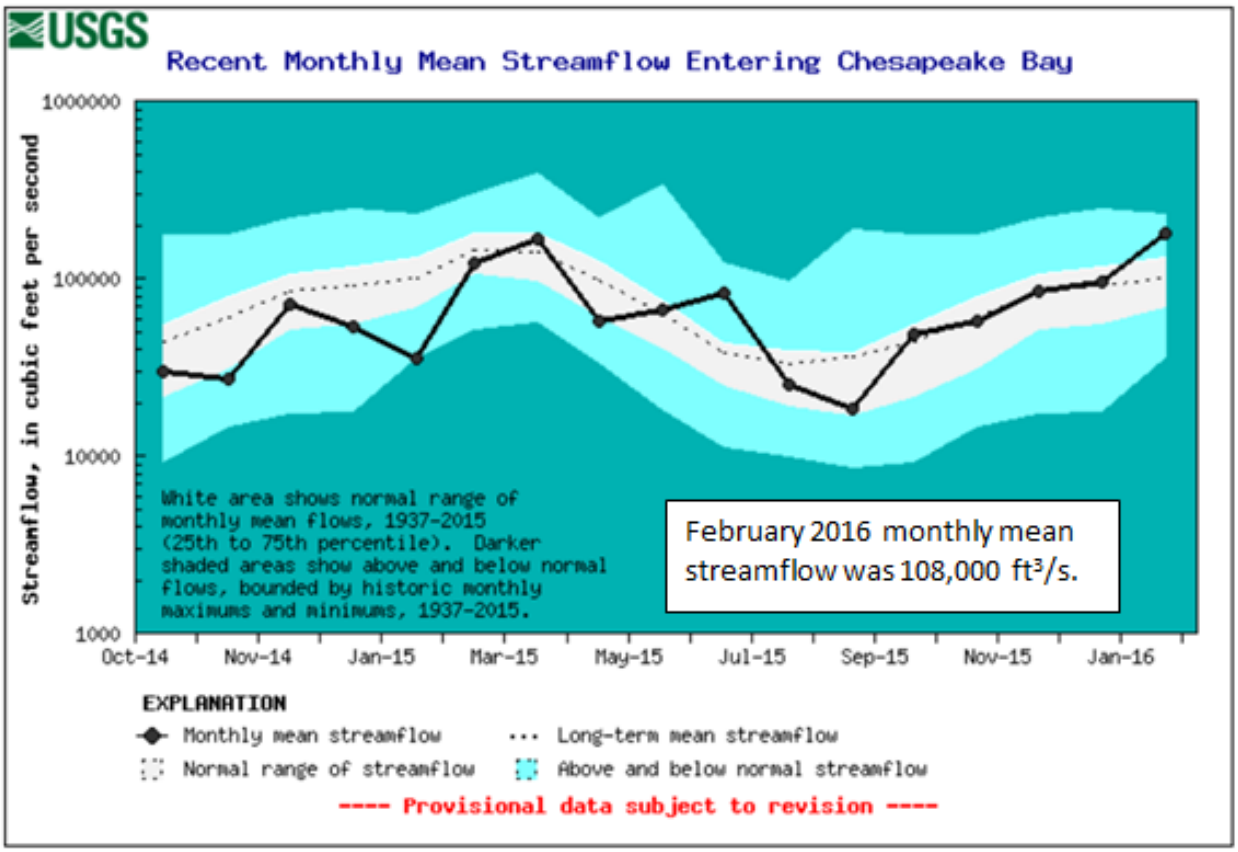

Five-year hydrographs can be viewed at:
http://md.water.usgs.gov/surfacewater/streamflow/

The dark line in the 5-year hydrograph represents the monthly mean streamflow for this period and the white band shows the normal range (25th-75th percentiles) based on the period of record. The maximum monthly mean streamflow is at the top of the blue shaded section, and the lowest monthly mean streamflow is at the top of the dark orange area. Each monthly mean measurement is colored according to the percentile rank in which it falls for the month.

## Estimated Streamflow to the Chesapeake Bay

The USGS estimates monthly mean freshwater streamflow to the Chesapeake Bay using streamflow measurements from the Susquehanna, Potomac, and James Rivers. In February 2016, the monthly mean freshwater flow to the Chesapeake Bay was 180,000 $ft^3/s$ (provisional, and subject to revision), which is above normal. The long-term February average (mean) is 101,000 $ft^3/s$, and the normal range is between 68,700 $ft^3/s$ and 131,000 $ft^3/s$, the 25th and 75th percentiles of all February values. Streamflow to the Bay had been in the normal range for the previous 6 months. These provisional statistics are based on a 79-year period of record.

Runoff in the Chesapeake Bay watershed carries pollutants, such as nutrients and sediment, to rivers and streams that drain to the Bay. The amount of water flowing into the Chesapeake Bay from its tributaries has a direct impact on how much pollution is in the estuary and it also affects the salinity levels that are important for fish, crabs, and oysters. Generally, as river flow increases, it brings more nutrient and sediment pollution to the Bay.




More information on the freshwater flow to the Bay can be found here:
**http://md.water.usgs.gov/waterdata/chesinflow/**

## Reservoir Levels

Available reservoir storage at the end of February 2016 in the Baltimore reservoirs (Loch Raven, Liberty, and Prettyboy) was 100 percent of available storage capacity, or a total of 75.85 billion gallons of water. The Baltimore City Environmental Services Division manages the Baltimore reservoirs.

Total normal storage in the Triadelphia and Duckett Reservoirs, which serve parts of Howard, Montgomery, and Prince George's Counties in suburban Maryland around the District of Columbia, rose 27.14 percent to 104.85 percent of normal storage capacity at the end of February 2016 with 11.14 billion gallons of water.

Not all of the water in the Patuxent Reservoirs is usable; for operational purposes, percent of normal storage capacity is used, but this value can exceed 100 percent of the usable storage. In the graph below, 100 percent is the maximum. The Washington Suburban Sanitary Commission (WSSC) manages the Patuxent reservoirs.

| February 2016 | Percent available/normal storage | Volume (billion gallons) |
|---|---|---|
| **Baltimore Reservoirs**<br>**Baltimore City – Environmental Services Division** | | |
| Liberty | 100.00% | 36.80 |
| Loch Raven | 100.00% | 21.20 |
| Prettyboy | 100.00% | 17.85 |
| **Total** | **100.00%** | **75.85** |
| | | |
| **Patuxent Reservoirs**<br>**Washington Suburban Sanitary Commission (WSSC)** | | |
| Triadelphia | 107.12% | 6.00 |
| Duckett | 102.57% | 5.14 |
| **Total** | **104.85%** | **11.14** |