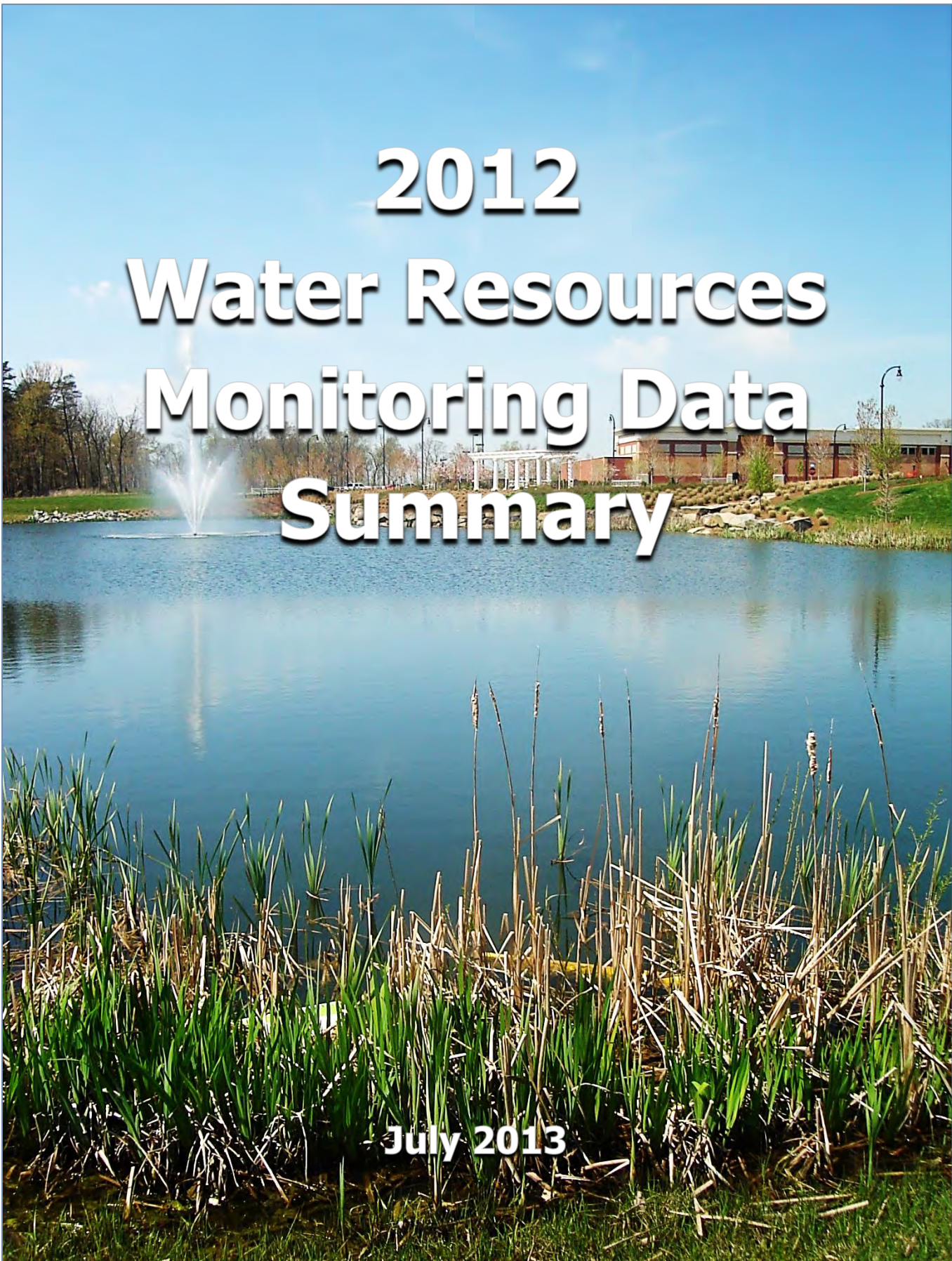


*Loudoun County, Virginia*

A photograph of a pond with a fountain, reeds in the foreground, and a building in the background. The text is overlaid on the image.

# **2012 Water Resources Monitoring Data Summary**

**July 2013**



# **2012**

## **Water Resources Monitoring Data Summary**



**Loudoun County, Virginia  
Department of Building and Development  
Engineering Division  
Water Resources Team**

**July 2013**

## ABBREVIATIONS AND ACRONYMS

<i>cfs:</i>	<i>cubic feet per second</i>
<i>DEQ:</i>	<i>Virginia Department of Environmental Quality</i>
<i>EPA:</i>	<i>U.S. Environmental Protection Agency</i>
<i>MCL:</i>	<i>maximum contaminant level</i>
<i>mg/L:</i>	<i>milligrams per Liter</i>
<i>NWS-COOP:</i>	<i>National Weather Service Cooperative monitoring station</i>
<i>OWTS:</i>	<i>On-site Wastewater Treatment System</i>
<i>TDS:</i>	<i>Total Dissolved Solids</i>
<i>uS/cm:</i>	<i>microSiemens per centimeter</i>
<i>USGS:</i>	<i>U.S. Geological Survey</i>
<i>WRMP:</i>	<i>Water Resources Monitoring Program (Loudoun County)</i>
<i>NWS:</i>	<i>National Weather Service (Division of National Oceanographic and Atmospheric Administration)</i>

## DATA LIMITATIONS

While efforts have been made to insure the accuracy of the data presented in this report, Loudoun County does not assume any liability arising from the use of these data. Reliance on these data is at the risk of the user. The U.S. Geological Survey (USGS) and the National Climatic Data Center (who distribute National Weather Service data) have data quality assurance procedures in which data are considered “provisional” until they are checked and corrected as needed. Data used in this report that are provisional are:

- USGS rainfall site Limestone/Leesburg, 1/1/2004 - 12/31/2012
- USGS rainfall site Catoctin/Lovettsville, 1/1/2005 - 12/31/2012
- USGS stream gaging station South Fork Catoctin Creek, 10/24/2012 - 12/31/2012
- USGS stream gaging station Goose Creek (Leesburg ), 10/24/2012 - 12/31/2012
- USGS stream gaging station Catoctin Creek (Taylorstown), 10/25/2012 - 12/31/2012

## HYPERLINKS

The underlined text in this document indicates hyperlinks to additional data and online resources that may be accessed when this document is opened in a program designed to view portable document format (pdf) files. The report can be found at [www.loudoun.gov/watermonitoring](http://www.loudoun.gov/watermonitoring) and follow the link to Data Analysis & Reporting.

## ACKNOWLEDGMENTS

This document was prepared by County staff members Scott Sandberg, David Ward, Dennis Cumbie, and Glen Rubis of the Water Resources Team in the Engineering Division of the Department of Building and Development.

**Loudoun County, VA**  
**2012 Water Resources Monitoring Data Summary**

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### INTRODUCTION AND SETTING

This document summarizes data collected during various water resources monitoring activities in and adjacent to Loudoun County, Virginia, by government, private and volunteer organizations during calendar year 2012. Specifically, data characterizing precipitation, stream flow, groundwater levels, and surface water and groundwater quality are presented. Loudoun County Department of Building and Development either collects these data or compiles them from other sources as part of the County's Water Resources Monitoring Program (WRMP). The data are presented and discussed in two sections: water quantity – measurements of precipitation, stream flows, and groundwater levels; and water quality – the chemical and biological characteristics of stream water and groundwater.

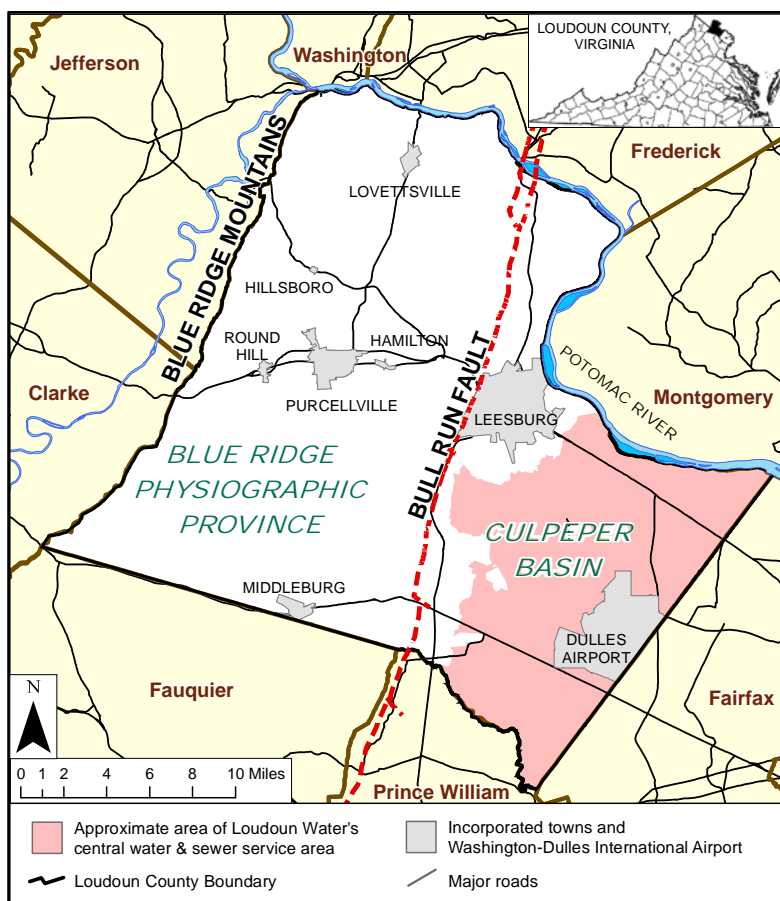
The WRMP was initiated in 2001 to help assess the conditions of water resources in Loudoun County, which has been one of the fastest growing counties in the nation during the past decade. The estimated population of Loudoun in 2012 is nearly 320,000 and is forecast to reach 460,000 by 2030; an increase of 44 percent.

### General Characteristics of Loudoun County

Loudoun County is located in Northern Virginia approximately 30 miles west of Washington, D.C. The county covers an area of 521 square miles and is bordered on the north by the Potomac River and the west by the Blue Ridge Mountains (Figure 1).

Urban and suburban development is concentrated mostly in the eastern part of the county, generally from the Town of Leesburg to Washington Dulles International Airport and the border with Fairfax County. The western portion of the county is more rural, with crop farms, pastures, vineyards, several small towns, and numerous large-lot residential subdivisions.

Loudoun Water, formerly known as the Loudoun County Sanitation Authority, owns and operates a centralized water and sewer system that serves the developed area of eastern Loudoun as shown in Figure 1. The Town of Leesburg provides treated Potomac River water to residents inside the Town limits, and to several residential areas adjacent to its eastern boundary. Outside of the Leesburg and Loudoun Water central service areas, county residents obtain water primarily from wells. In the rural towns and several of the subdivisions, water may come from communal water systems and sewage is treated in small wastewater treatment plants. The remaining single-family homes and businesses have on-site individual wastewater treatment systems.



**Figure 1. Major features of Loudoun County, VA.**

## Physiography and Geology

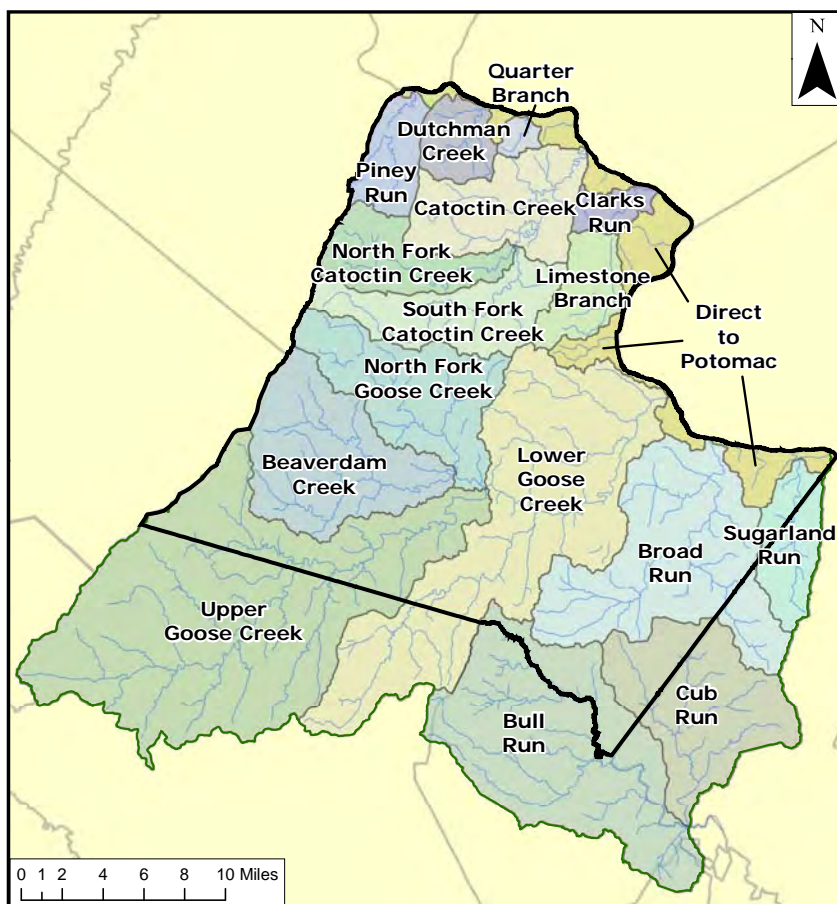
Loudoun County intersects two physiographic provinces which are separated by the Bull Run Fault (Figure 1). The fault separates the Culpeper Basin (a Triassic-age rift basin) of the Piedmont Province on the east from the Blue Ridge Province to the west. The Culpeper Basin is comprised of sedimentary rocks and sedimentary-derived metamorphic rocks, both of which may include intrusions of dense, igneous diabase rock. The north-eastern area of the county, generally from the Town of Leesburg northward, is underlain by limestone conglomerate rock (the Leesburg Member of the Balls Bluff Siltstone) and has the surface features and hydrogeologic characteristics of a karst environment. Western Loudoun is underlain by metamorphic rocks derived from both sedimentary and igneous parent material. Bedrock in the county is covered by regolith (unconsolidated sediments and soils) that is commonly between 20 and 50 feet thick, but ranges from 0 to more than 90 feet thick. Soils are generally less permeable in eastern Loudoun compared to western Loudoun.

## Watersheds

Watersheds are defined by topography and drain all of the surface water in an area to a single location such as a stream or lake. They are often used to delineate areas for monitoring, analyzing, and managing water resources. Watersheds can be defined at many different scales but the watershed scale that is most convenient for county-wide investigations in Loudoun is based on the 17 watershed areas shown in Figure 2. The majority of the county is covered by three major drainage areas that empty into the Potomac River by way of the following stream systems: Goose Creek, Catoctin Creek, and Broad Run.

The eastern and southern borders of the county share watersheds with the neighboring Virginia counties of Fairfax, Prince William, and Fauquier. The upper reaches of Broad Run and Sugarland Run watersheds lie to the east in Fairfax County and Goose Creek originates to the southwest in Fauquier County, but all three streams/watersheds drain into Loudoun County and ultimately the Potomac River.

The southeastern region of Loudoun includes the headwaters of Bull Run and Cub Run. These streams drain out of Loudoun County to the south and are tributaries to the Occoquan River which eventually discharges into the Potomac River.



**Figure 2. Watersheds and streams in and adjacent to Loudoun County, VA.**

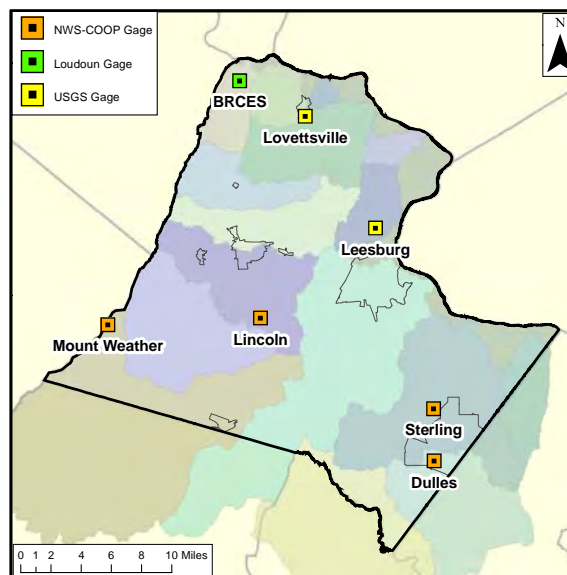
## WATER QUANTITY

This section presents information on the quantity of water resources with data on precipitation, stream flows, and groundwater levels in Loudoun County during calendar year 2012.

### Precipitation

Total annual precipitation in 2012, 35.7 inches, was 5.5 inches below the normal (mean) annual precipitation of 41.2 inches for the full period of annual records of 1964 to 2012 at the Dulles Airport monitoring station. Precipitation data used in the WRMP are obtained from seven monitoring sites in the county (Figure 3). Four precipitation stations are part of the National Weather Service's (NWS) cooperative monitoring network and two rain gages are operated by the U.S. Geological Survey (USGS). The NWS sites have relatively long periods of record with one having nearly continuous data since 1930 (Table 1). The two USGS rain gages have mostly continuous data records beginning in 2004 and 2005.

Data from the long-term records indicate that annual precipitation has ranged from 20.4 inches (at the Lincoln station in 1930) to 67.7 inches (at the Sterling station in 2003). For purposes of identifying "normal" (mean) conditions and for comparison to current conditions, the standard practice is to group climatic data into periods of 30 consecutive years with the most recent year of the group ending in "0". For the 30-year period of 1981 through 2010, the normal annual precipitation at the Dulles station was 41.5 inches. Of the total precipitation at the Dulles station during 2012, frozen precipitation totaled 5.3 inches, which was much less than the normal annual total of 22.6 inches of frozen precipitation and well below the 53.3 inches in calendar year 2010. Note that frozen precipitation contributes to the total (liquid) reported precipitation, however, at a reduced ratio based on the characteristics of the frozen precipitation. For example, heavy snow may be a 3 to 1 ratio (3 in of snow = 1 in of water) while dry, powdery snow may be 50 to 1 or more.



**Figure 3. Precipitation monitoring sites.**

**Table 1. Precipitation monitoring stations and data.**

Precipitation Monitoring Station Name	Start of Record <sup>1</sup>	Station Operated by <sup>2,3</sup>	Annual Statistics (Inches) for Period of Record <sup>4</sup>			2012 Total (Inches) <sup>3</sup>	Days missing in 2012
			Minimum	Median	Maximum		
Blue Ridge Center <sup>5</sup>	2009	Loudoun	NA	NA	NA	NA	NA
Dulles	1964	NWS-COOP	27.0	39.1	65.7	35.7	0
Limestone Branch	2004	USGS	28.0	39.0	76.1	31.9	1
Lincoln	1930	NWS-COOP	20.4	41.4	63.5	39.5	NA <sup>6</sup>
Lovettsville	2005	USGS	27.6	38.4	61.3	31.6	64
Mt. Weather	1949	NWS-COOP	24.8	40.0	64.1	35.6	16
Sterling RCS	1978	NWS	30.3	42.2	67.7	32.1	40

<sup>1</sup> First full year that generally continuous data collection began.

<sup>2</sup> National Weather Service Cooperative weather station; U.S. Geological Survey; Loudoun County Government

<sup>3</sup> NWS-COOP stations record liquid & frozen precipitation; USGS & Loudoun stations record rainfall only.

<sup>4</sup> Annual precipitation statistics based on site's period of available record through 2012 (see footnote 1).

<sup>5</sup> Only one complete year of data (2011) exists for this monitoring station (50.5").

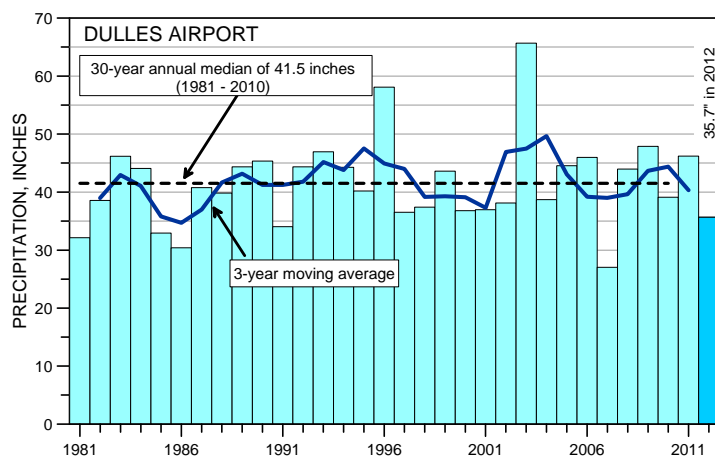
<sup>6</sup> Daily precipitation statistics are not maintained.



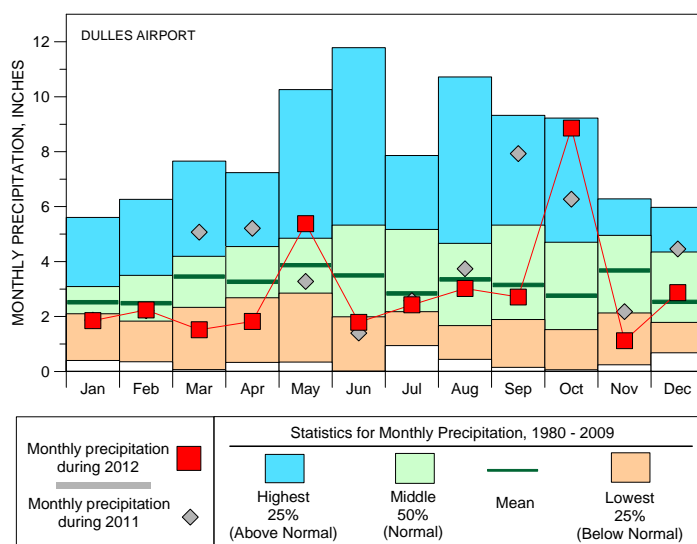
Figure 4 presents annual precipitation data from the Dulles station from 1981 through 2012. Figure 5 shows 2012 monthly precipitation at the Dulles station in relation to monthly data for the 30-year period from 1981 through 2010. The data indicate that during 2012, May, October and December were above normal in rainfall, while the remaining months were below normal. Rainfall in October approached the highest recorded for that month during the previous 30 year period.

A graph of daily precipitation at the Dulles station is shown in Figure 6. Only two days during 2012 received rainfall totals greater than two inches. One of those days, October 29<sup>th</sup>, the Dulles station received 4.26 inches of rain as Hurricane Sandy moved across the region. Over a three-day period, the hurricane delivered 5.65 inches of rain to the Dulles station.. Although Sandy devastated parts of the Northeast U.S. Coast, Loudoun County was spared major damage, with some road flooding, downed trees, and limited power outages. Over the entire year, there were 249 days with no recorded precipitation at the Dulles station.

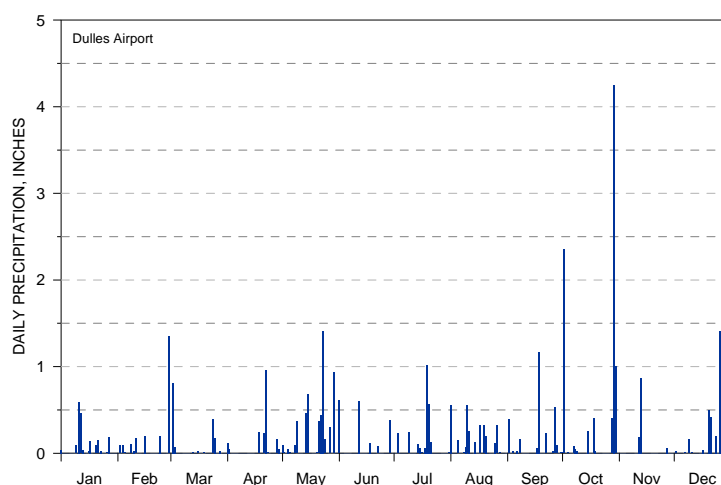
*Hurricane Sandy hit the Northeast coast of the U.S. on October 27, 2012, dropping almost six inches of rain on Loudoun County from October 28<sup>th</sup> through October 30<sup>th</sup>. This event led to 2012 having one of the wettest Octobers in the past 30 years.*



**Figure 4. Annual precipitation at Dulles Airport from 1981 through 2012.**



**Figure 5. Monthly precipitation at Dulles Airport.**



**Figure 6. Daily precipitation at Dulles Airport in 2012.**

## Streamflow

Perennial streams flow all or most of the year. In the past, the USGS has estimated that Loudoun County has approximately 507 miles of perennial streams while more recent investigations using additional data and standardized methodologies have indicated that the county may have over 1,500 miles of perennial streams. Knowing how much water flows in the larger perennial streams and how it varies over both short and long time periods is useful in the assessment of floodplains, flood control, stormwater structures, and environmental conditions. There are 10 stream gages that measure and record water stage (level) in Loudoun County streams (Figure 7). Measured water levels at each gaging station are reported via telemetry to the USGS, correlated to historical site-specific stream discharges (flows), and the data posted in near real-time with updates normally every 15 minutes. The data are available at the [USGS web site for Loudoun County](#). Three additional stream gages are located along the county's perimeter: at [Harpers Ferry](#) and [Point of Rocks](#) on the Potomac River (both with real-time data on an internet web page) and on Bull Run near Route 705.

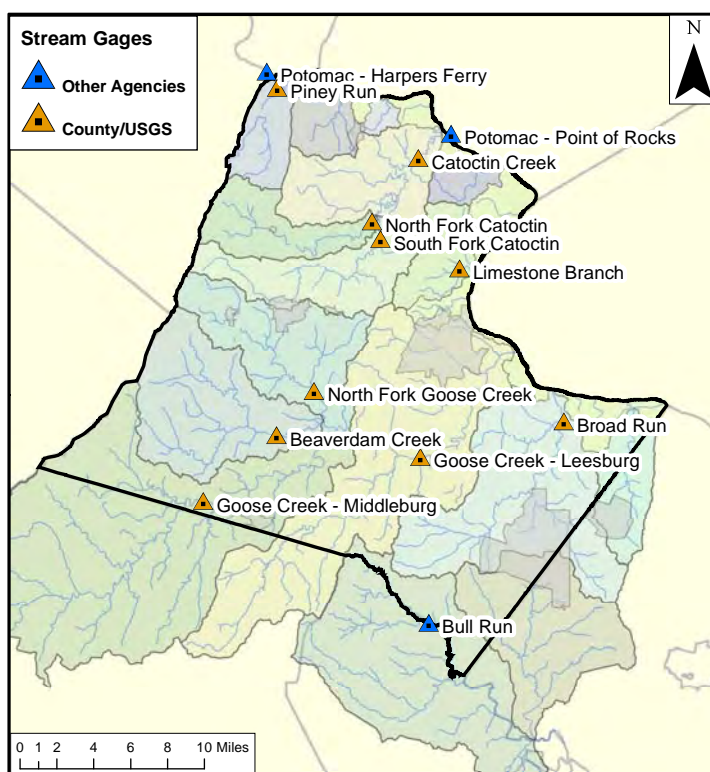


Figure 7. Locations of stream gaging stations.

The USGS regularly inspects the gaging stations to check the monitoring equipment and measure stream channel cross sections, water levels, and stream flow velocities in order to maintain calibration and data accuracy. However, data are considered provisional until passing the USGS's full quality control process.

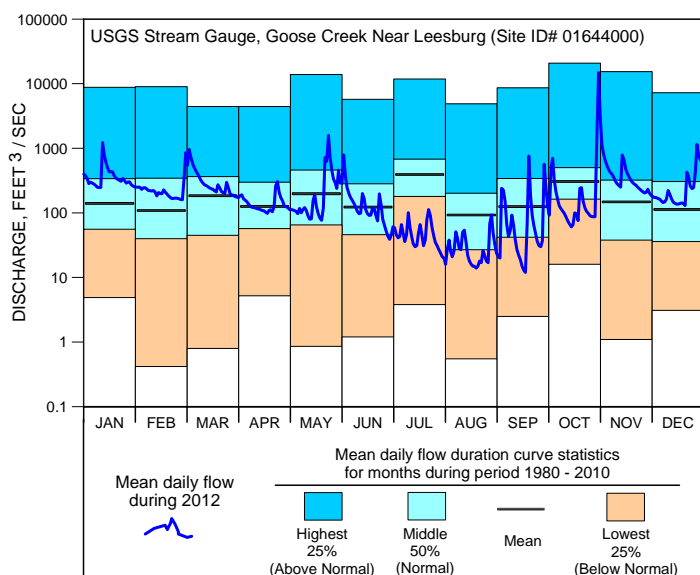


Figure 8. Stream discharge hydrograph for Goose Creek during 2012 compared to data from 1981-2010.

Figure 8 illustrates mean daily flow rates in Goose Creek near Leesburg during 2012 and compares it to monthly flow statistics at the same site for the period 1981 through 2010. These data indicate that streamflows were above normal from January through April, then mostly below normal from June through late October, and again above normal through November and December. Spikes in streamflow are generally correlated with rainfall at Dulles Airport (Figure 6). Although these two monitoring sites are approximately 5 miles apart, the upper reaches of the watershed drainage area for the streamflow gage are over 30 miles from the Dulles site, which can result in significant variations in accumulated precipitation and monitoring results.

## 2012 Water Resources Monitoring Data Summary

during localized storm events. The highest peak flow recorded in 2012 at this station occurred on October 30<sup>th</sup>, the end of rainfall associated with Hurricane Sandy. This storm event brought the flow at this gage from below normal to a very high flow rate in the period of just three days. Goose Creek is the County's largest stream and flows through the county from its headwaters in Fauquier County to the Potomac River.

Table 2 lists the 10 gaging stations in the county along with selected data statistics. The peak flow rates for 2012 occurred on October 30 at all of the stream gages.

**Table 2. Stream gaging stations and basic statistics.**

Stream Gage Site Name	Start of Record	Drainage Area <sup>1</sup> (sq. miles)	2012 Avg <sup>2</sup> (cfs)	Previous Historic Avg <sup>3</sup> (cfs)	2012 Min <sup>4</sup> (cfs)	Previous Historic Min <sup>5</sup> (cfs)	2012 Peak <sup>6</sup> (cfs)	Previous Historic Peak <sup>7</sup> (cfs)	2012 Non-flowing <sup>8</sup> (days)	Average Annual Historic Non-flowing <sup>9</sup> (days)
Beaverdam Creek	Jul 2001	47.2	43.4	50.5	0.1	0.0	3710	5000	11	25
Broad Run	Oct 2001	76.1	97.2	133.4	17.4	1.6	6240	10300	0	0
Catoctin Creek - Taylorstown	Oct 1970	89.5	80.7	103.5	3.3	0.1	5380	6770	1	2
Goose Creek - Leesburg	Jul 1909	332.0	261.0	363.0	15.7	1.2	14900	20800	0	0
Goose Creek - Middleburg	Oct 1965	122.0	118.5	137.6	5.3	0.0	7470	14000	0	7
Limestone Branch	Aug 2001	7.9	4.6	9.0	0.6	0.4	124	976	0	0
North Fork Catoctin Creek	Jul 2001	23.1	19.5	24.5	0.6	0.0	921	1190	0	12
North Fork Goose Creek	Jul 2001	38.1	32.0	50.2	2.4	0.3	1500	3040	0	0
Piney Run	Oct 2001	13.5	11.1	14.3	0.8	0.0	238	488	0	3
South Fork Catoctin Creek	Jul 2001	31.6	30.0	36.6	0.7	0.0	1620	1920	0	4

<sup>1</sup> Drainage area above the stream gage (square miles)

<sup>2</sup> Average daily flow rate during 2012

<sup>3</sup> Average daily flow rate for the period 2002–2011

<sup>4</sup> Lowest 7-day average flow rate during 2012. Note: Broad Run flow augmented by wastewater discharge up to 11 MGD starting in 2008.

<sup>5</sup> The lowest 7-day average flow rate for the period 2002–2011

<sup>6</sup> Peak daily flow rate during 2012

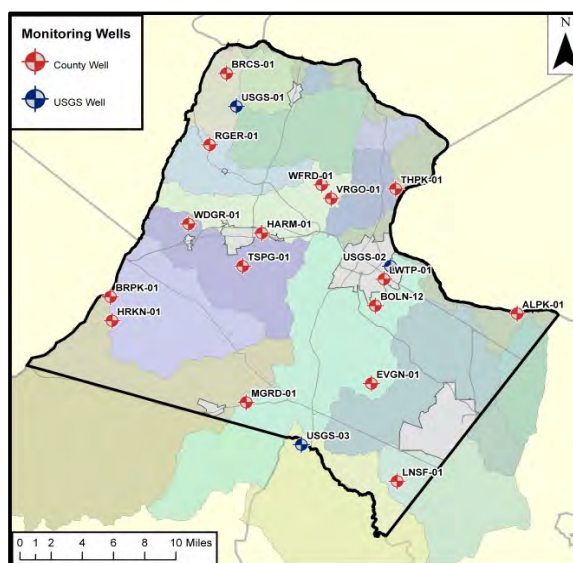
<sup>7</sup> Peak daily flow rate for the period 2002–2011

<sup>8</sup> Maximum number of consecutive days with very low flow (below 0.2 cfs) during 2012

<sup>9</sup> Maximum number of consecutive days per year with less than 0.2 cfs flow during the period 2002–2011

## Groundwater Levels and Wells

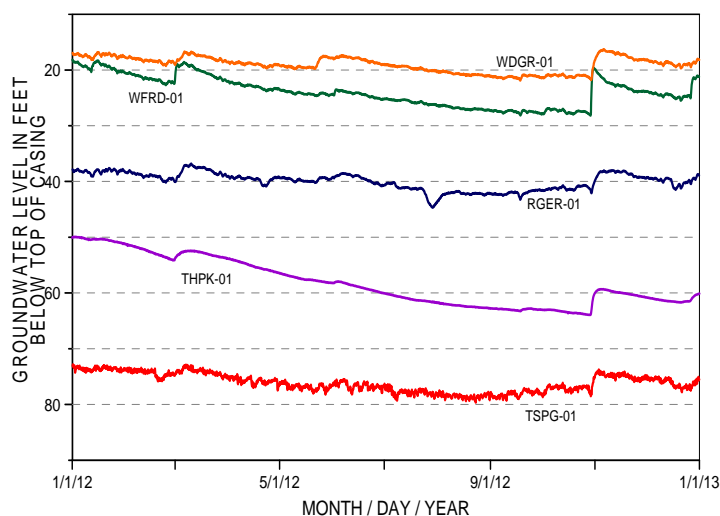
There are approximately 14,200 active water supply wells throughout Loudoun County. Groundwater is the primary source of drinking water for the majority of residents in western Loudoun. Groundwater levels during 2012 were recorded at 18 dedicated monitoring wells at the sites shown in Figure 9 and the data were included in the County's Water Resources Monitoring Program. Fifteen of these wells were monitored by County staff from the Department of Building and Development and three were monitored by the USGS. Groundwater level data have been collected from the three USGS wells since the late 1960s or early 1970s. Most of the County-monitored wells were established as monitoring sites within the past few years. Table 3 lists the monitoring wells, basic information about each well, and groundwater level data for both 2012 and the well's historic record.



**Figure 9. Locations of groundwater monitoring wells.**

## 2012 Water Resources Monitoring Data Summary

Figure 10 shows hydrographs for selected monitoring wells that are representative of groundwater levels in the county for calendar year 2012. Short-term natural increases in groundwater levels occur because of recharge from precipitation. In the absence of additional recharge from precipitation and outside influences such as nearby pumping, groundwater levels normally exhibit a steady, slow decline over time after rain events. Groundwater levels are typically highest in late spring/early summer and lowest in late fall/early winter. Assuming normal precipitation patterns, this is due to greater recharge to the groundwater system during cooler winter/spring weather when evapotranspiration is low, thereby allowing more water to infiltrate downward to the water table.



**Figure 10. Groundwater levels from selected County WRMP monitoring wells.**

**Table 3. Monitoring wells and groundwater level data for 2012.**

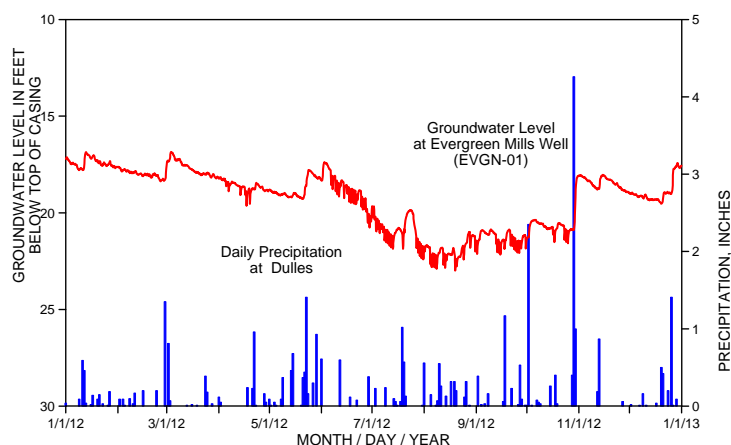
Well Site ID (see map for location)	Monitoring Organization	Well Depth (feet)	Rock Type	Period of Record	Groundwater Level (feet) <sup>1, 2</sup>			
					Historic High	2012 High	Historic Low	2012 Low
USGS-01	USGS	516	Meta-conglomerate/metasilstone	8/1969 - Present	1013.9	1009.4	1001.4	1001.4
USGS-02	USGS	535	Fluvial, deltaic sandstone	10/1977 - Present	376.8	378.5	361.2	367.5
USGS-03	USGS	165	Siltstone/sandstone	11/1968 - Present	418.1	415	407.5	409.8
BOLN-12	Loudoun	515	Fluvial, deltaic sandstone	12/2006 - Present	346.2	345.9	339.7	340.9
BRCS-01	Loudoun	320	Igneous intrusive	12/2007 - Present	532.8	528.5	521.1	522.0
HARM-01	Loudoun	945	Plutonic igneous intrusive	2/2005 - Present	500.4	500.4	475.8	495.8
MGRD-01	Loudoun	400	Plutonic igneous intrusive	12/2007 - Present	491.8	491.7	477.4	484.3
RGER-01	Loudoun	700	Igneous intrusive	2/2005 - Present	664.9	660.0	652.2	652.2
TSPG-01	Loudoun	360	Plutonic igneous intrusive	2/2005 - Present	435.3	430.7	419.1	423.8
WDGR-01	Loudoun	940	Mafic igneous intrusive	3/2005 - Present	646.8	643.8	629.6	631.6
WFRD-01	Loudoun	400	Plutonic igneous intrusive	11/2002 - Present	421.8	413.3	399.7	403.3
BRPK-01	Loudoun	680	Igneous intrusive	7/2009 - Present	1645.5	1645.5	1632.6	1636.0
THPK-01	Loudoun	360	Limestone conglomerate	7/2009 - Present	195.3	187.9	173.6	173.9
ALPK-01	Loudoun	240	Alluvium/metasilstone	7/2009 - Present	214.4	208.2	193.6	193.6
HRKN-01	Loudoun	600	Plutonic igneous intrusive	3/2009 - Present	688.5	688.5	661.7	665.2
VRGO-01	Loudoun	300	Igneous intrusive	3/2009 - Present	563.1	NA <sup>3</sup>	538.4	NA <sup>3</sup>
EVGN-01	Loudoun	320	Diabase	3/2009 - Present	308.7	307.4	300.2	301.2
LWTP-01	Loudoun	250	Metasilstone	3/2009 - Present	276.9	NA <sup>3</sup>	273.4	NA <sup>3</sup>

<sup>1</sup> Elevation above mean sea level.

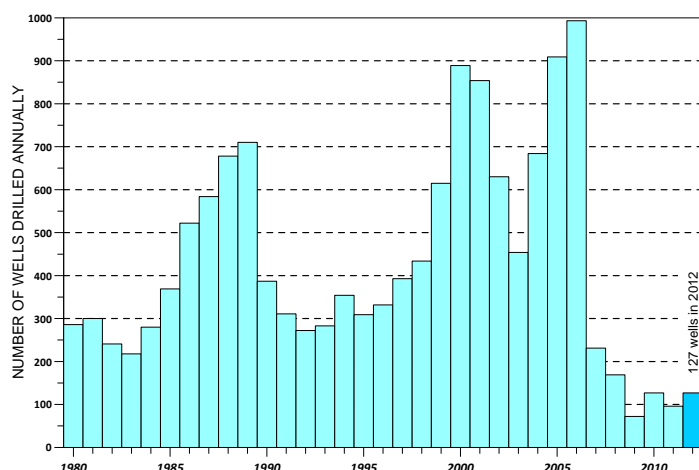
<sup>2</sup> Historic data highs and lows are during the period of record through 2012.

<sup>3</sup> Unreliable data due to equipment malfunction.





**Figure 11. Groundwater hydrograph and daily rainfall in 2012.**



**Figure 12. Number of wells constructed in Loudoun County between 1980 and 2012.**

Figure 11 shows a hydrograph from a monitoring well off Ryan Road near Brambleton and a plot of daily rainfall at the NWS rain gauge at Dulles Airport. Both data sets are during 2012 and show the response of groundwater levels to precipitation events.

During 2012, 127 new water supply wells were constructed. Figure 12 presents the number of wells drilled each year since 1980. The installation of new wells is primarily driven by the pace of residential construction and, occasionally, zoning changes affecting residential development potential. As occurred during the previous three to four years, the number of new wells drilled in 2012 remained relatively low. The median total depth of wells installed in 2012 was 410 feet with the depths ranging from 180 to 1,100 feet. The median estimated yield (based on air-lift pumping) was 13.5 gallons per minute with yields ranging from 0.5 to 300 gallons per minute.

*The median depth of wells drilled in Loudoun County has increased from 150 feet in the 1960's to the current median of 410 feet. The increase has been possible because of advances in drilling technology, allowing wells to be drilled cheaper, quicker and deeper to provide increased water storage.*

## WATER QUALITY

The quality of surface water in Loudoun County was quantified in 2012 using several metrics including chemical, microbiological, and benthic macroinvertebrates. Groundwater quality was assessed through chemical and bacteria analyses conducted on well water samples. Monitoring results from each of these data types are discussed below.

### Surface Water Chemistry

Chemical sampling and analysis of surface water in 2012 was primarily conducted by the Virginia Department of Environmental Quality (DEQ) as part of their state-wide surface water quality sampling program.

In 2012, DEQ collected 203 samples from 42 sites and conducted 2,334 analyses from the watersheds of Loudoun County (some watershed boundaries extend beyond the County's boundaries). Nutrient

enrichment has been identified as a major cause of the reported stream impairments nationwide and can lead to low dissolved oxygen, fish kills, shifts in flora and fauna and blooms of nuisance algae. Figure 13 illustrates the results of sampling by DEQ for nitrogen and phosphorus in the surface waters from the watersheds of Loudoun County during 2012.

In 2000, the U.S. Environmental Protection Agency (EPA) developed ambient water quality criteria recommendations and information for 14 nutrient ecoregions in the continental United States. Individual states could adopt the criteria developed by EPA or elect to develop their own criteria and methodologies. Virginia has been working on a methodology to evaluate nutrient stress in wadeable streams since that time. As shown in Figure 13, the percent of stream samples which exceed the threshold levels for nitrogen and phosphorous between 2000 and 2012 are shown. In 2012, approximately 77 percent and 46 percent of the samples collected by DEQ contained nitrogen and phosphorus concentrations above the 0.69 mg/L and 0.037 mg/L EPA guidance criteria, respectively.

### Surface Water Microbiology

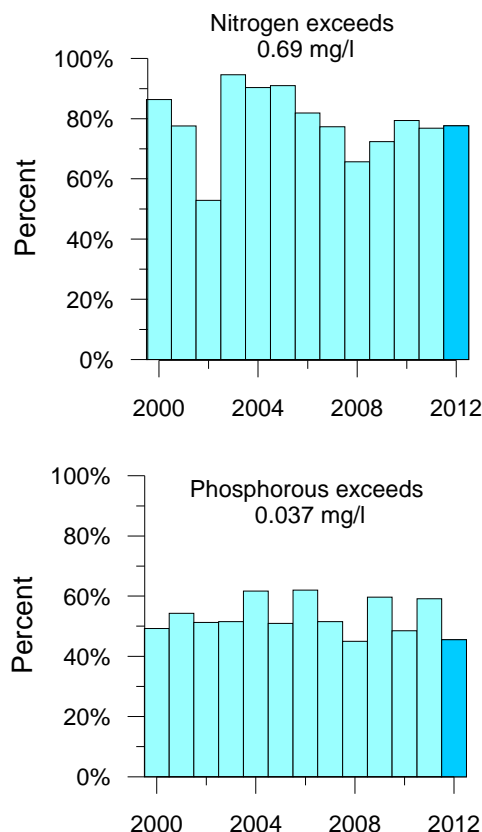
The primary microbiological area of concern for surface water relates to pathogens that may adversely affect human health. An accepted practice to test for pathogens from human and warm-blooded animal waste is to test water for *Escherichia coli* (*E. coli*) bacteria as an indicator of waste contamination. EPA uses *E. coli* concentrations as an indicator of whether the water is considered safe for humans after casual contact. This criterion is identified by EPA as “recreational use” and includes activities such as swimming, fishing and boating.

In 2012, DEQ collected and analyzed approximately 180 samples from the watersheds of Loudoun County and found that approximately 74 percent were above the recreational limit of 235 *E. coli* colonies per 100 milliliters. Stream segments that are tested and exceed the recreational use criteria more than 10 percent of the time may be identified as “impaired” by DEQ. Using a similar approach, Table 4 summarizes the number of sites in which more than 10.5 percent of the samples exceeded the recreational limit over the last 5 years. Several programs are in place to reduce bacterial contamination in the impaired surface waters of Loudoun County including initiatives to repair or upgrade on-site wastewater treatment systems (e.g., septic systems and drain fields), reduce pet waste, and fence livestock out of streams.

**Table 4. Summary of surface water microbiological testing by DEQ.**

Year	Number of Samples	Number of Monitoring Sites	Number of Sites Exceeding <sup>1</sup>	Percent Sites Exceeding <sup>1</sup>
2008	152	27	18	67%
2009	180	29	24	83%
2010	159	28	23	82%
2011	158	33	28	85%
2012	180	31	23	74%

<sup>1</sup> Exceeds recreational use criteria for *Escherichia coli*.



**Figure 13. Nutrient concentrations as percent of samples exceeding EPA guidance thresholds from 2000 to 2012.**

## Benthic Macroinvertebrates

Benthic macroinvertebrates are stream bottom-dwelling invertebrate organisms (mostly insect larvae) that can be seen without magnification. Their tolerance of poor water quality varies depending on the species and, as a result, these organisms are used as indicators of water quality.

Sampling a stream for benthic macroinvertebrates usually involves collecting all the organisms within a small area of the stream bottom, identifying the types of organisms collected to the order, family or genus taxa level, and counting the number of each type. These results are then converted to a “macroinvertebrate score” which is used to qualitatively grade the water quality. In 2012, two techniques were used to evaluate the benthic macro-invertebrate populations: the Virginia Stream Condition Index (VA SCI) at both the family and genus level used by DEQ and the Virginia Save Our Streams (VA SOS) index used by several citizen volunteer organizations in and adjacent to the county. During the period 2007 through 2012, DEQ sampled a total of 151 times at 39 locations in Loudoun and calculated VA SCI scores which ranged from severe stress to excellent. Figure 14 illustrates the average stream conditions from benthic samples collected by DEQ between 2007 and 2012.

Several volunteer organizations in Loudoun Watershed Watch collect benthic macroinvertebrate data. From 2008 through 2012, Loudoun Wildlife Conservancy, Goose Creek Association, and other volunteer groups collected 319 samples from approximately 54 locations using the VA SOS methodology. Results ranged from acceptable to unacceptable as shown in Figure 15.

*Benthic macroinvertebrate species vary in their tolerance of poor water quality. Monitoring benthic populations is an efficient way for professionals and volunteers to assess one aspect of stream water quality.*

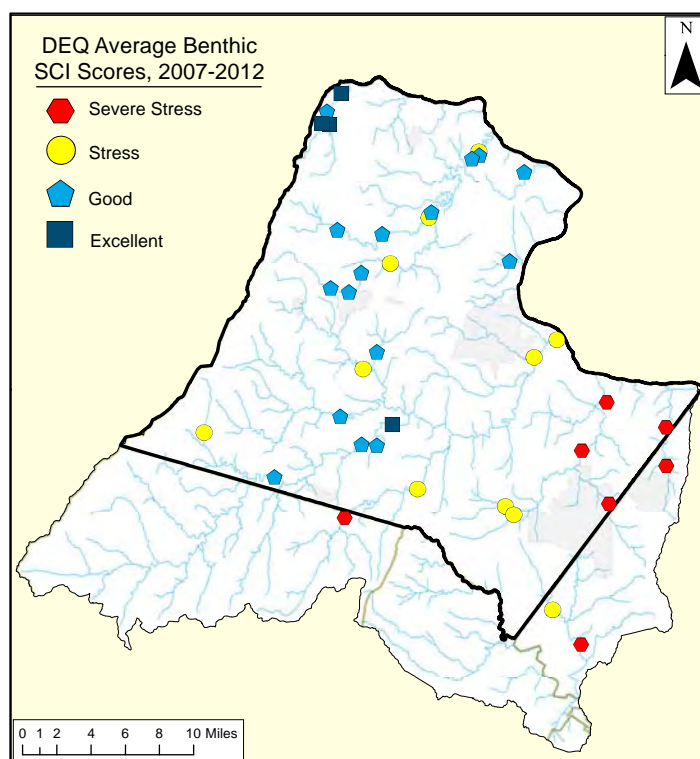


Figure 14. Summary of DEQ benthic monitoring results.

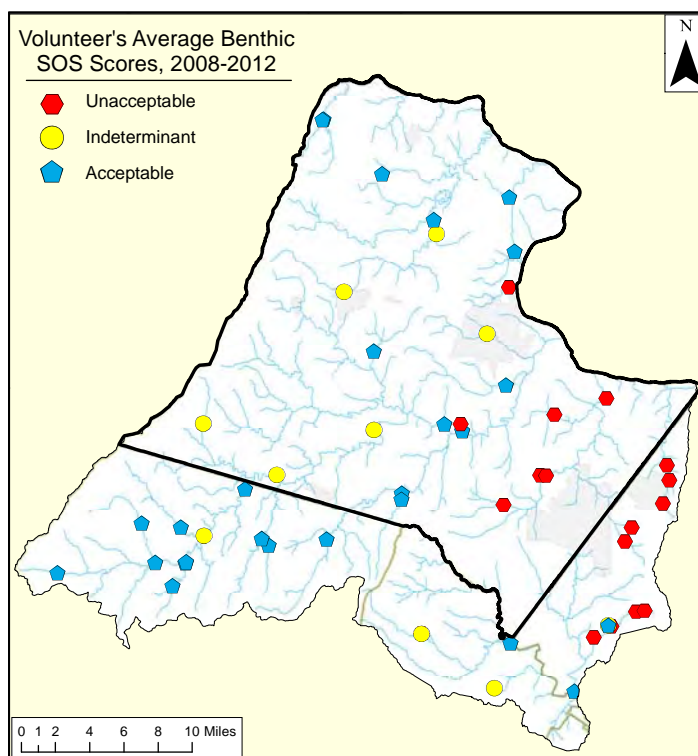
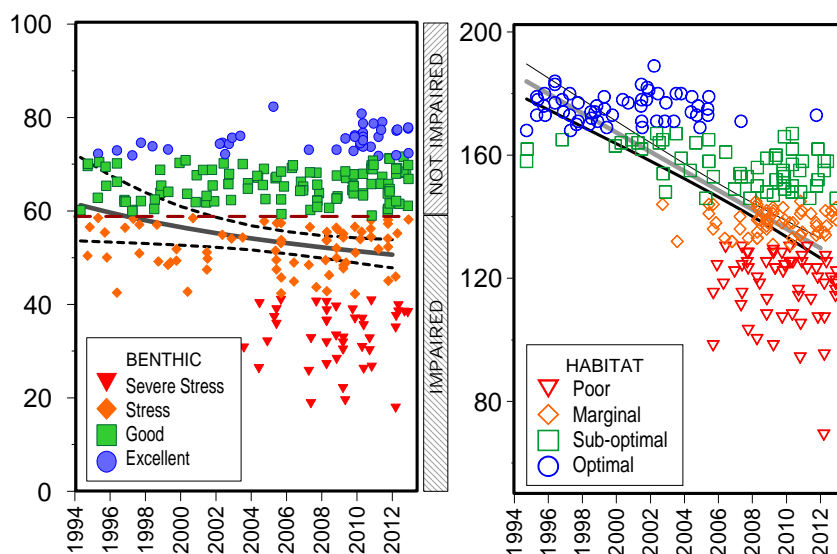


Figure 15. Summary of volunteer benthic monitoring results.

### Stream Health Trend

Since the early 1990's Virginia DEQ has evaluated stream health by monitoring benthic macroinvertebrates and assessing riparian habitat conditions. Using EPA-approved protocols, the benthic and habitat conditions are scored by DEQ biologists. The trend line generated by the benthic data is not statistically significant, while the habitat trend line is statistically significant at a 95% confidence interval (Figure 16). The benthic data are used by DEQ to identify stream impairments as described in the next section.



**Figure 16. Long-term trend in benthic and habitat scores.**

### Stream Impairments

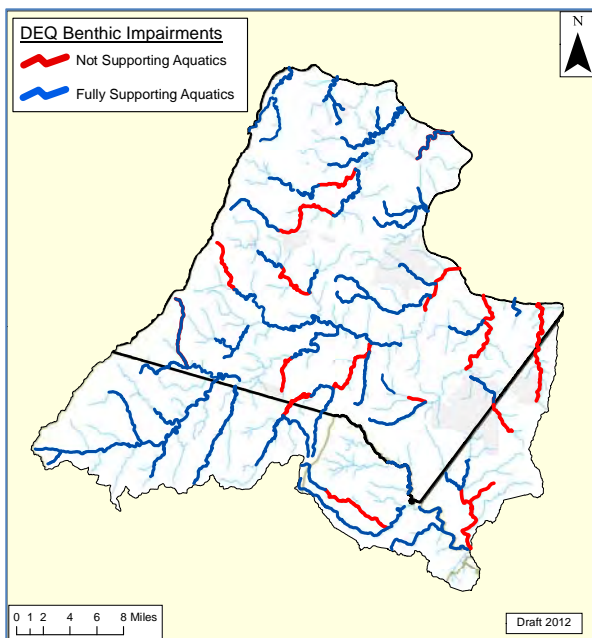
Each year, DEQ tests a statistically significant fraction of Virginia's streams, rivers, lakes, and tidal waters as part of their water quality assessment program. Over 130 different pollutants are monitored to determine whether the waters can be safely used for swimming, fishing and drinking. Waters that do not meet the adopted standards are reported to EPA in the Clean Water Act 303(d) Impaired Waters Report. DEQ has developed lists of impaired waters every even calendar year since 1992. In Loudoun County, DEQ water quality impairments have included:

- aquatic life (benthic macroinvertebrates)
- recreational/swimming (bacteria)
- fishing/consumption (tissue analysis)

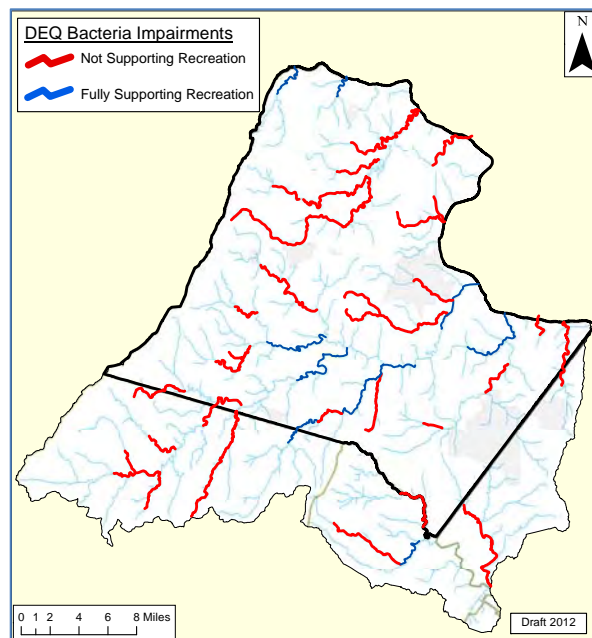
In the latest report released in 2012, there were a total of 124 stream miles in Loudoun County identified as impaired for one or more criteria. Listing a stream as “impaired” begins a multi-year process of identifying pollution sources, determining appropriate pollution loadings, and designing and implementing corrective measures. Figure 17 through Figure 20 illustrate the impairments for aquatic life use, recreational/swimming use, fish consumption and public water supply, respectively. These figures are DRAFT as EPA has not yet approved the 2012 305(b)/303(d) Water Quality Assessment Integrated Report.

*Surface water quality impairments are reported to the Environmental Protection Agency every two years by the Virginia Department of Environmental Quality (DEQ). The Final 2012 305(b)/303(d) Water Quality Assessment Integrated Report (Integrated Report) was released on March 26, 2012. The 2012 Integrated Report summarizes the water quality conditions from Jan. 1, 2005, to Dec. 31, 2010.*

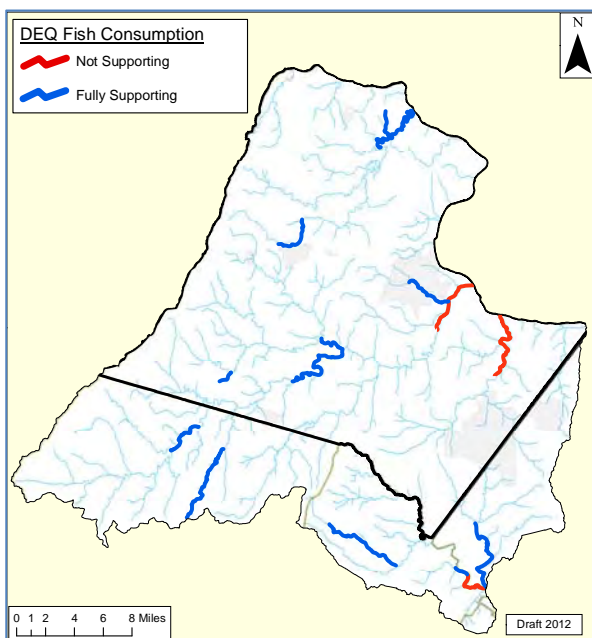




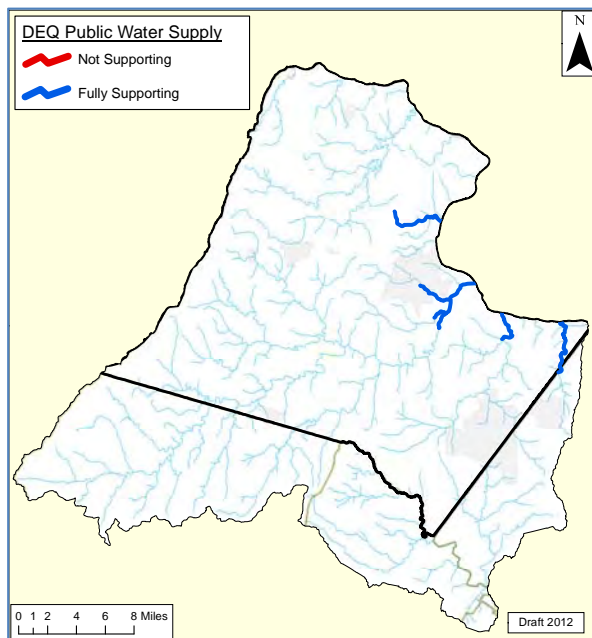
**Figure 17. Aquatic life use (benthic macroinvertebrates) impaired stream segments.**



**Figure 18. Recreational/swimming use (bacteria) impaired stream segments.**



**Figure 19. Fish consumption use (PCB and mercury in fish tissue) impaired stream segments.**



**Figure 20. Public water supply use (chemicals) impaired stream segments.**

## Groundwater Quality

Groundwater is the source of drinking water for most of Loudoun County outside of Loudoun Water's central service area (see Figure 1) and the Town of Leesburg. Information on groundwater quality is obtained from several sources. Before new potable water wells can be used, they must be tested and pass drinking water quality standards for a wide range of chemical parameters listed by the County Health Department. In 2012, groundwater samples collected and analyzed from new wells were generally consistent with historical data (Table 5). There are some areas of the county that have elevated levels of iron and manganese which are aesthetic contaminants and do not adversely affect human health at the concentrations found in the county. In general, groundwater quality in the county is good.

**Table 5. Statistics for selected groundwater chemistry parameters.**

Analyte	MCL(mg/L)	Samples		# above MCL	% above MCL
Nitrate	10	All	3341	15	0.4
		2012	119	0	0.0
Sulfate	250	All	3341	14	0.4
		2012	119	1	0.8
Lead	0.015	All	3344	33	1.0
		2012	119	1	0.8
Fluoride	4	All	3341	7	0.2
		2012	119	0	0.0
Arsenic	0.01	All	3348	16	0.5
		2012	119	1	0.8
Manganese	0.05*	All	3348	2163	64.6
		2012	119	71	59.7
Iron	0.3*	All	3366	2286	67.9
		2012	119	78	65.5
TDS	500*	All	3344	23	0.7
		2012	119	2	1.7

\* Secondary MCL for taste, color, and odor.

There are a few isolated locations in the County where significant groundwater contamination is known to exist. The most notable location is the Hidden Lane Landfill in northeast Loudoun, which was placed on the EPA's National Priorities List (Superfund). The EPA has developed fact sheets to update citizens on clean-up and investigation activities at the site. The latest Hidden Lane fact sheet and more information can be found by visiting the [EPA web site](#).

The most prevalent sources of potential groundwater pollution are the on-site wastewater treatment systems (OWTS) serving homes and small businesses in the rural areas of the county. There are approximately 15,000 active OWTSs in the county and during 2012, 99 new OWTSs were installed. An OWTS that is properly installed and serviced should not pose a threat to groundwater quality. However, improper OWTS installation or maintenance can cause wastewater to be untreated or undertreated and lead to groundwater or surface water contamination. Because OWTSs are typically used in areas with private water wells, it is important to properly maintain the OWTS and regularly have the well water sampled and tested to assure that it is safe to drink. The Loudoun County Department of Environmental Health can provide information on maintenance and testing of private water wells and OWTSs (703-777-0234 and [www.loudoun.gov/onsite](http://www.loudoun.gov/onsite)).

*Of the 119 groundwater samples collected in 2012, only three analytes had concentrations higher than the EPA Maximum Contaminant Level (MCL); one for sulfate, one for lead and one for arsenic. Although groundwater quality is generally good, this shows why owners of private drinking water wells should have their well water tested regularly to assure that the water is safe to consume.*

### FUTURE WATER RESOURCES OUTLOOK

The EPA grant that supported the WRMP ended in 2009; however, continuation of most monitoring activities is positioned to continue with limited local funding. Although no major new monitoring projects are planned, the monitoring objectives for 2013 and beyond will include:

- Precipitation/rainfall – continue to monitor and/or obtain data from the stations operated by NWS, USGS, or Loudoun County.
- Stream flow – continue the cooperative funding agreement with the USGS to monitor stream stage and discharge (flow) within 10 of the county's major watersheds.
- Groundwater levels – maintain continuous groundwater level recording instrumentation in the 18 dedicated monitoring wells operated by Loudoun County or the USGS. One additional monitoring well will be instrumented in 2013, bringing the County's monitoring network count up to 19 wells.
- Water quality sampling – groundwater and/or surface water quality sampling may be conducted depending on available funding.

The Department of Building & Development has proposed to continue watershed management planning activities through initiation of a pilot project in the Broad Run watershed. The Upper Broad Run Watershed Management Plan Pilot Project Request for Proposals was made public in November of 2012, with the one year project expected to begin by June of 2013. Water resources monitoring data will be used to help develop the plan and, if the plan is implemented, track progress in the efficacy of watershed improvement projects.

On December 30, 2010, the U. S. Environmental Protection Agency issued a Total Maximum Daily Load (TMDL) for the 64,000 square-mile Chesapeake Bay watershed, which includes all of Loudoun County. The Bay TMDL is focused on reducing the amounts of phosphorus, nitrogen, and sediment entering the Chesapeake Bay from the contributing watershed. The target amounts that will meet the Bay TMDL goal are sometimes called the "pollution diet". Virginia submitted the state Phase II Watershed Implementation Plan (WIP) to the EPA in March of 2012. The Phase II WIP is designed to show how the Commonwealth and local Bay jurisdictions, including Loudoun, will meet Virginia's portion of the pollution diet. During 2012, at the request of the Board of Supervisors, County staff began a public process to determine the most cost effective and reasonable strategies to meet Virginia's Phase II WIP goals for Loudoun County. Data from the WRMP will be available to help support those goals. This effort is scheduled to be completed near the end of 2013.

County staff will continue to explore grant opportunities to supplement Loudoun County funding for monitoring and watershed management programs.

**More information about Loudoun County's water resources monitoring program can be obtained at:**

**[www.loudoun.gov/watermonitoring](http://www.loudoun.gov/watermonitoring)**

## 2012 – Moment to Remember

# Hurricane Sandy



On October 27-30, 2012, Hurricane Sandy strikes the East Coast, causing heavy rain and wind in Northern Virginia (NOAA Satellite Image).

Although Sandy was only rated a category 1 Hurricane when it came ashore in New Jersey on October 29<sup>th</sup>, it was the largest Hurricane ever recorded in the Atlantic, with tropical storm winds felt over 1,100 miles across. High winds, heavy rain, and extensive storm surge caused over \$65 billion in damages in 27 states. In addition to tropical storm damages, Sandy merged with a cold front to the west, bringing blizzard conditions from the Appalachians to Ohio.

Although heavy rain and some flooding was reported, Loudoun County escaped the extensive damage that was seen in New Jersey, New York, and areas farther north.