## Loudoun County, Virginia

2020

Water Resources

Monitoring Data

Summary

## December 2021

Early Morning Fog

# 2020 Water Resources Monitoring Data Summary



Loudoun County, Virginia Department of Building and Development Natural Resources Division Floodplain Management Team

December 2021

#### ABBREVIATIONS AND ACRONYMS

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

#### DATA LIMITATIONS

While efforts have been made to ensure 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 are all "Approved".

#### 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 <u>www.loudoun.gov/watermonitoring</u> and follow the link to Data Analysis & Reporting.

#### ACKNOWLEDGMENTS

This document was prepared by David Ward, Floodplain Management Team in the Natural Resources Division of the Department of Building and Development. Cover Photo Credit: David Ward.

#### DELAYED DATA ACQUISITION

This document was delayed by COVID-19 where County staff was not able to perform field work on groundwater level data collection until Fall 2021.

### Loudoun County, VA 2020 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 2020. Specifically, data characterizing precipitation, streamflow, groundwater levels, and surface water and groundwater quality are presented. The Loudoun County Department of Building and Development collects these data or compiles them from other sources. Efforts originated with the Loudoun County Water Resources Monitoring Program in 2001 as originally funded through a grant from the US Environmental Protection Agency (EPA). Although the grant ended in 2009 the County continues to collect and compile groundwater level and streamflow data. The data are presented and discussed in two sections: water quantity – measurements of precipitation, streamflows, and groundwater levels; and water quality – the chemical and biological characteristics of stream water and groundwater.

Loudoun County has been one of the fastest growing counties in the nation during the past decade. The estimated population of Loudoun County in 2020 is nearing 423,046 and is forecast to reach 548,213 by 2045; an increase of 30 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.

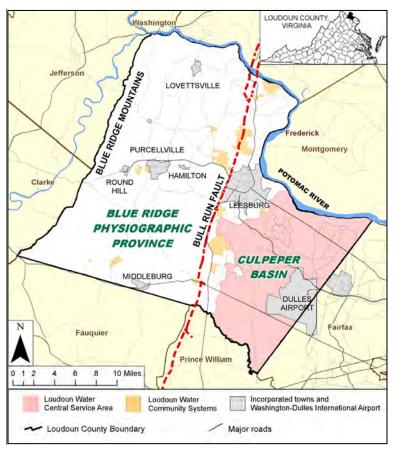


Figure 1. Major features of Loudoun County, VA.

#### **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.

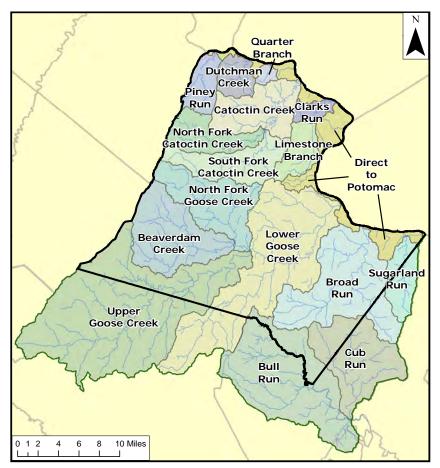


Figure 2. Watersheds and streams in and adjacent to Loudoun County, VA.

#### WATER QUANTITY

This section presents information on the quantity of water resources with data on precipitation, streamflows, and groundwater levels in Loudoun County during calendar year 2019.

#### **Precipitation**

Total annual precipitation in 2020, was 40.8 inches, which is 1.0 inches (3%) greater the normal. The (median) annual precipitation for the full period of record between 1964 and 2020 at the Dulles Airport monitoring station was 39.8 inches. Precipitation data 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 and provide data at 5-minute intervals.

Data from the long-term records indicate that annual precipitation has ranged from a minimum of 20.4 inches (at the Lincoln station in 1930 and no longer in service) to maximum of 76.1 inches (at the Limestone Branch station in 2003). For purposes of identifying "normal"

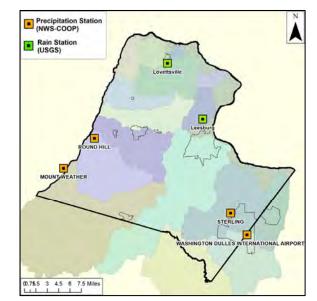


Figure 3. Precipitation monitoring sites.

(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 annual median precipitation at the Dulles Airport was 40.5 inches and for the period of record 39.8 inches.

Precipitation	Start of	Station		itatistics (Ind	2020	Days	
Monitoring Station Name	Record <sup>1</sup>	Operated by <sup>2, 3</sup>	Minimum	Median	Maximum	Total (Inches) <sup>3</sup>	missing in 2020
Dulles Airport	1963	NWS-COOP	27.0	39.9	66.7	44.6	0
Limestone Branch	2004	USGS	28.0	39.1	76.1	48.8	0
Round Hill	2018	NWS-COOP	30.3	48.0	65.6	44.6	0
Lovettsville	2005	USGS	27.6	38.0	61.3	38.7	0
Mt. Weather	1949	NWS-COOP	24.8	41.5	71.1	47.1	0
Sterling RCS	1978	NWS-COOP	30.3	43.1	67.7	49.7	0

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

<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 2020 (see footnote 1).

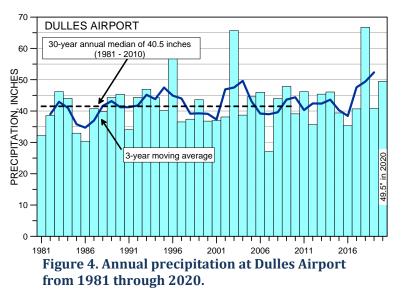
Figure 4 presents annual precipitation data from the Dulles Airport from 1981 through 2020. Annual precipitation has alternated above and below the 30-year median for the last several years so that there has not been a prolonged, multi-year deficit or surplus of precipitation.

In 2020 the NWS increased from four to eight sites reporting completed records. For consistency with previous reports only four stations are included in this report.

Figure 5 shows 2020 monthly precipitation at the Dulles Airport in relation to monthly data for the 30-year period from 1981 through 2010. The data indicate that precipitation during April, August and December 2020 were above normal, whereas March, May and September were below normal.

During 2020 the maximum number of consecutive days without precipitation as measured by USGS in Lovettsville was 14 days. The maximum in 2013 was 53 days.

A graph of daily precipitation at the Dulles station is shown in Figure 6. There were 5 days when the precipitation exceeded 0.5 inches. Over the entire year, there were 232 days with no recorded precipitation at the Dulles station.



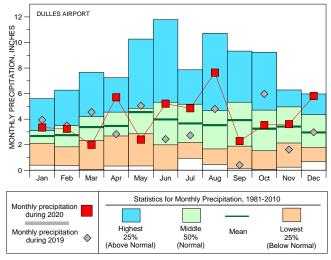


Figure 5. Monthly precipitation at Dulles Airport.

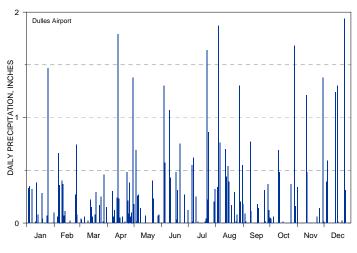
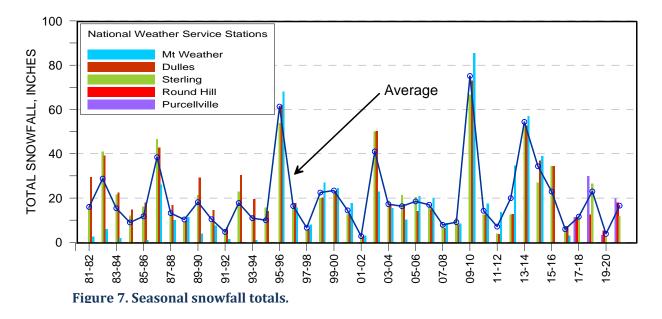


Figure 6. Daily precipitation at Dulles Airport in 2020.

#### **Snowfall**

Of the total precipitation at the Sterling station during 2020-2021 season, frozen precipitation averaged 16.5 inches, which was below the normal annual total of 19.5 inches of frozen precipitation and well below the 75.1 inches in winter season 2009-2010. The total snow depths are aggregated from daily values recorded at five weather stations operated by the National Weather Services as shown in Figure 7. In early years data were available from Mt. Weather, Dulles and Sterling. In recent years data are available for Sterling, Purcellville and Round Hill. The average total of the stations for each season is also shown.



#### 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 8). Measured water levels at each gaging station are reported via telemetry to the USGS, correlated to historical sitespecific 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.

Stream Gages Potomac - Harpers Ferry Other Agencies Piney Run County/USGS Potomac - Point of Rocks Catoctin Creek North Fork Catoctin South Fork Catoctin North Fork Goose Cree A Broad Run Beaverdam Creek Goose Creek - Leesburg oose Creek - Middleburg Bull R 10 Miles

Figure 8. 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 streamflow velocities in order to maintain calibration and data accuracy. However, data are considered provisional until passing the USGS's full quality control process.

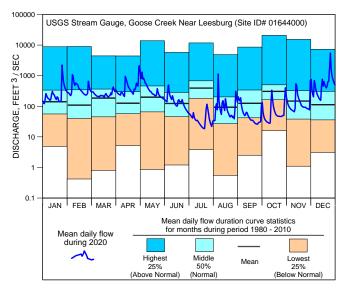


Figure 9. Stream discharge hydrograph for Goose Creek during 2020 compared to data from 1981-2010.

rates for 2020 occurred on December 24.

Figure 9 illustrates mean daily flow rates in Goose Creek near Leesburg during 2020 and compares it to monthly flow statistics at the same site for the period 1981 through 2010. These data indicate that streamflow was above normal for most of the year. Spikes in streamflow are generally correlated with rainfall at Dulles Airport (Figure 6). These two monitoring sites are approximately 5 miles apart, but the upper reaches of the watershed are over 30 miles from the Dulles precipitation station. If a storm event is localized in the upper area of the watershed, it can result in a relatively high stream discharge even though reported precipitation at the Dulles site is relatively low. The highest peak stream discharge recorded in 2020 at this station occurred on December 25, 2020. Goose Creek is the County's largest stream, with its headwaters in Fauquier County, flowing across Loudoun County, and discharging to the Potomac River.

Table 2 lists the 10 gaging stations in the county along with selected data statistics. The peak flow

Stream Gage Site Name	Start of Record	Drainage Area <sup>1</sup> (sq. miles)	2020 Avg <sup>2</sup> (cfs)	Previous Historic Avg <sup>3</sup> (cfs)	2020 Min <sup>4</sup> (cfs)	Previous Historic Min <sup>5</sup> (cfs)	2020 Peak <sup>6</sup> (cfs)	Previous Historic Peak <sup>7</sup> (cfs)	2020 Non- flowing <sup>8</sup> (days)	Average Annual Historic Non-flowing <sup>9</sup> (days)
Beaverdam Creek	Jul 2001	47.2	35.5	36.1	0.0	0.0	805	1,920	0	3
Broad Run	Oct 2001	76.1	127.5	24.3	1.1	0.0	377	1,190	0	7
Catoctin Creek - Taylorstown	Oct 1970	89.5	132.1	102.9	9.1	0.1	2,020	6,770	0	1.4
Goose Creek - Leesburg	Jul 1909	332.0	426.8	14.2	1.7	0.0	194	488	0	2
Goose Creek - Middleburg	Oct 1965	122.0	152.5	8.8	1.9	0.4	520	976	0	0.0
Limestone Branch	Aug 2001	7.9	12.0	46.0	0.0	0.2	701	3,040	3	0
North Fork Catoctin Creek	Jul 2001	23.1	33.6	50.4	0.3	0.0	717	5,000	0	18.8
North Fork Goose Creek	Jul 2001	38.1	56.3	134.7	4.8	0.0	1,520	14,000	0	4
Piney Run	Oct 2001	13.5	20.8	349.6	18.4	1.1	5,510	20,800	0	0.0
South Fork Catoctin Creek	Jul 2001	31.6	42.2	126.3	19.0	1.3	2,040	10,300	0	0.0

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

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

<sup>2</sup> Average daily flow rate during 2020

<sup>3</sup> Average daily flow rate for the period 2002–2019

<sup>4</sup> Lowest 7-day average flow rate during 2020. 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 2002–2019

<sup>6</sup> Peak daily flow rate during 2020

<sup>7</sup>Peak daily flow rate for the period 2002–2019

<sup>8</sup> Maximum number of consecutive days with very low flow (below 0.2 cfs) during 2020

<sup>9</sup> Maximum number of consecutive days per year with less than 0.2 cfs flow during the period 2002–2019

#### **Groundwater Levels and Wells**

There are more than 19,000 active individual 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 2020 were recorded at 13 of 16 dedicated monitoring wells at the sites shown in Figure 10. Sixteen of these wells are operated by staff from the Department of Building and Development and three are operated by the USGS. Groundwater level data have been collected from the three USGS wells since the late 1960s or early 1970s. Most of the Countymonitored wells were established as monitoring sites within the past decade, with one well dating back to 2002. Table 3 lists the monitoring wells, basic information about each well, and groundwater level data for both 2020 and the well's historic record.

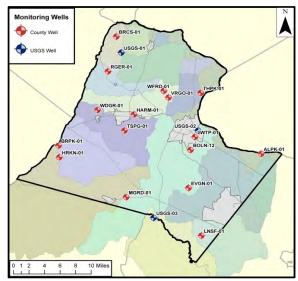


Figure 10. Locations of groundwater monitoring wells.

Well Site ID		Well			Ground		water Level (feet) <sup>1, 2</sup>		
(see map for location)	Monitoring Organization	Depth (feet)	Rock Type	Period of Record	Historic High	2020 High	Historic Low	2020 Low	
USGS-01	USGS	516	Meta-conglomerate/ metasiltstone	8/1969 - Present	1014.0	1009.2	1000.3	1002.	
USGS-02	USGS	535	Fluvial, deltaic sandstone	10/1977 - Present	362.2	360.5	342.6	349.7	
USGS-03	USGS	165	Siltstone/sandstone	11/1968 - Present	416.3	414.9	409.8	411.0	
BOLN-12	Loudoun	515	Fluvial, deltaic sandstone	12/2006 - 12/30/2016	340.3	NA	333.2	NA	
BRCS-01	Loudoun	320	Igneous intrusive	12/2007 - Present	548.8	545.2	537.5	540.2	
HARM-01	Loudoun	945	Plutonic igneous intrusive	2/2005 - 4/12/2017	501.1	NA	463.6	NA	
MGRD-01	Loudoun	400	Plutonic igneous intrusive	12/2007 - Present	483.1	478.8	469.7	469.	
RGER-01	Loudoun	700	Igneous intrusive	2/2005 - Present	646.9	642.7	620.2	637.3	
TSPG-01	Loudoun	360	Plutonic igneous intrusive	2/2005 - Present	434.7	432.1	422.6	422.0	
WDGR-01	Loudoun	940	Mafic igneous intrusive	3/2005 - Present	618.4	604.4	602.2	604.4	
WFRD-01	Loudoun	400	Plutonic igneous intrusive	11/2002 - 9/27/2016	421.9	NA	400.1	NA	
BRPK-01	Loudoun	680	Igneous intrusive	7/2009 - Present	1668.5	1660.1	1648.9	1648.	
THPK-01	Loudoun	360	Limestone conglomerate	7/2009 - Present	222.3	0.0	188.3	0.0	
ALPK-01	Loudoun	240	Alluvium/metasiltstone	7/2009 - Present	187.1	181.9	152.3	174.0	
HRKN-01	Loudoun	600	Plutonic igneous intrusive	3/2009 - 9/3/2020	645.4	639.9	632.0	634.0	
VRGO-01	Loudoun	300	Igneous intrusive	3/2009 - Present	529.9	522.7	502.6	502.	
EVGN-01	Loudoun	320	Diabase	3/2009 - Present	321.8	321.5	312.9	316.	
LNSF-01	Loudoun	322	Hornfels	8/2013 - Present	284.7	0.0	0.0	0.0	
LWTP-01	Loudoun	250	Metasiltstone	3/2009 - Present	240.6	43996.0	203.0	235.	

#### Table 3. Monitoring wells and groundwater level data for 2020.

<sup>1</sup> Elevation above mean sea level. <sup>2</sup> Historic data highs and lows are during the period of record through 2020.

In 2016, ground surface elevation were revised to 1-meter DEM derived from 2012 LiDAR.

Figure 11 shows hydrographs for selected monitoring wells that are representative of groundwater levels in the county for calendar year 2020. Shortterm 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.

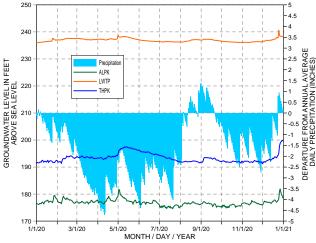
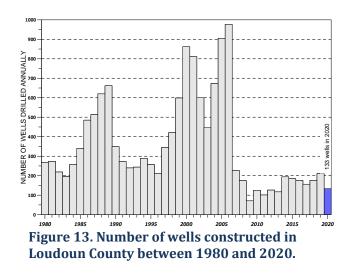


Figure 12. Groundwater hydrograph and daily rainfall in 2020.



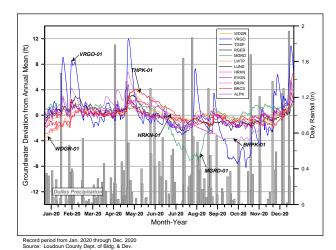


Figure 11. Groundwater levels from selected County monitoring wells.

Figure 12 shows hydrographs from three monitoring wells and the daily departure from annual average rainfall. Both data sets are during 2019 and show the response of groundwater levels to precipitation events. Note that during late summer, when conditions are generally dryer and evapotranspiration is highest, response to even significant rain events will produce only subtle increases in groundwater level.

During 2020, 133 new water supply wells were constructed. Figure 13 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 ten years, the number of new wells drilled in 2020 remained relatively low. The median total depth of wells installed in 2020 was 463 feet with the depths ranging from 100 to 1,000 feet. The median estimated yield (based on air-lift pumping) was 25.9 gallons per minute with yields ranging from 0.25 to 375 gallons per minute.

The median depth of wells drilled in Loudoun County has increased from 200 feet during 1970s to over 400 feet since 2000. The increase has been possible because of advances in drilling technology, allowing wells to be drilled less expensively, quicker and deeper to provide increased water storage.

#### WATER QUALITY

The quality of surface water in Loudoun County was quantified in 2020 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 2020 was primarily conducted by the Virginia Department of Environ-mental Quality (DEQ) as part of their state-wide <u>surface water</u> <u>quality sampling program</u>.

In 2020, DEQ collected samples from 10 and 11 sites and conducted 65 and 45 analyses of phosphorous and nitrogen, respectively. 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 14 illustrates the results of sampling by DEQ for nitrogen and phosphorus in the surface waters from the watersheds of Loudoun County during 2020.

In 2000, the U.S. Environmental Protection Agency (EPA) developed ambient water quality criteria recommendations and information for 14 nutrient eco-regions in the continental United States. Individual states could adopt the criteria developed by EPA or elect to develop their own criteria and methodologies.

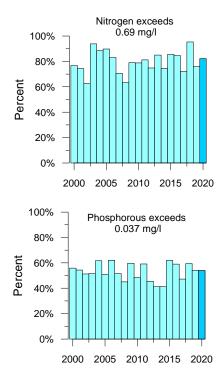


Figure 14. Nutrient concentrations as percent of samples exceeding EPA guidance thresholds from 2000 to 2020.

Virginia has been working on a methodology to evaluate nutrient stress in wadeable streams since that time. As shown in Figure 14, the percent of stream samples which exceed the threshold levels for nitrogen and phosphorous between 2000 and 2020 are shown. In 2020, approximately 82 percent and 54 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 2020, DEQ collected and analyzed 57 samples from the watersheds of Loudoun County and found that 100 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 10.5 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 ten 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.

Year	Number of Samples	Number of Monitoring Sites <sup>1</sup>	Number of Sites Exceeding <sup>2</sup>	Percent Sites Exceeding <sup>3</sup>
2009	101	16	13	81%
2010	122	20	8	90%
2011	124	24	19	85%
2012	117	24	19	79%
2013	136	20	19	95%
2014	62	10	8	80%
2015	118	16	15	94%
2016	123	14	12	86%
2017	72	13	6	46%
2018	107	14	13	93%
2019	58	9	9	100%
2020	57	9	8	89%

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

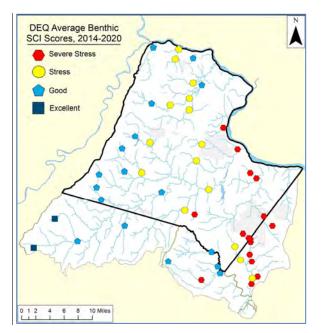
<sup>1</sup> Limited to stations with 6 or more samples annually.

<sup>2</sup> Exceeds recreational use criteria for *Escherichia coli* in more than 10.5% of the samples .
3 Percent of the sites when more than 10.5% of samples exceeded recreational use criteria.

#### **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 macro-invertebrates 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 2020, 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 2014 through 2020, DEQ sampled a total of 155 times at 50 locations in Loudoun and calculated VA SCI scores which ranged from Severe Stress to Excellent. Figure 15 illustrates the average stream conditions from benthic samples collected by DEQ between 2014 and 2020 where the annual average number of stations was less than 12.

Figure 15. Summary of DEQ benthic monitoring results.

Several volunteer organizations in Loudoun Watershed Watch collect benthic macroinvertebrate data. From 2014 through 2020, Loudoun Wildlife Conservancy, Goose Creek Association, and other volunteer groups collected 140 samples from approximately 43 locations using the VA SOS methodology. Results ranged from Acceptable to Unacceptable as shown in Figure 16.

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.

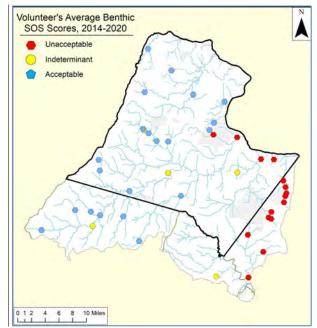


Figure 16. Summary of volunteer benthic monitoring results.

#### **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, there were over 200 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. The most recent EPA 305(b)/303(d) Water Quality Assessment Integrated Report is for Final 2020 which was released December 9, 2020.

Surface water quality impairments are reported to the Environmental Protection Agency every two years by the Virginia Department of Environmental Quality (DEQ). The FINAL 2020 305(b)/303(d) <u>Water Quality Assessment Integrated Report</u> (Integrated Report) summarizes the water quality conditions from Jan. 1, 2013, to Dec. 31, 2018.

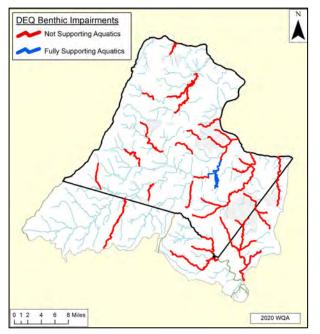


Figure 17. Aquatic life use (benthic macroinvertebrates) impaired stream segments.

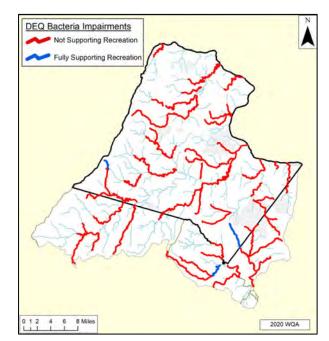


Figure 18. Recreational/swimming use (bacteria) impaired stream segments.

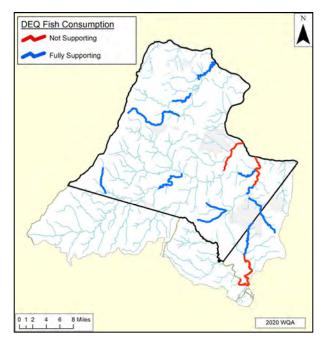


Figure 19. Fish consumption use (PCB and mercury in fish tissue) impaired stream segments.

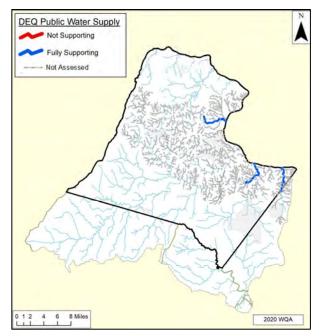


Figure 20. Public water supply use (chemicals) impaired stream segments.

#### **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 2020, groundwater samples collected and analyzed from new wells were generally consistent with historical data (Table 5). There are large areas of the county that have elevated levels of iron and manganese; aesthetic contaminants that 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	5063	17	0.3%
		2020	167	0	0.0%
Sulfate	250	All	5123	20	0.4%
		2020	167	0	0.0%
Lead	0.015	All	5027	39	0.8%
		2020	167	1	0.6%
Fluoride	4	All	5037	6	0.1%
		2020	167	0	0.0%
Arsenic	0.01	All	5022	18	0.4%
		2020	167	0	0.0%
Manganese	0.05*	All	5118	2350	45.9%
		2020	167	120	71.9%
Iron	0.3*	All	5129	2482	48.4%
		2020	167	133	79.6%
TDS	500*	All	4606	37	0.8%
		2020	167	0	0.0%

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

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 18,363 active OWTSs in the county and during 2020, 213 new OWTSs were installed of which 74 were alternative. 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).

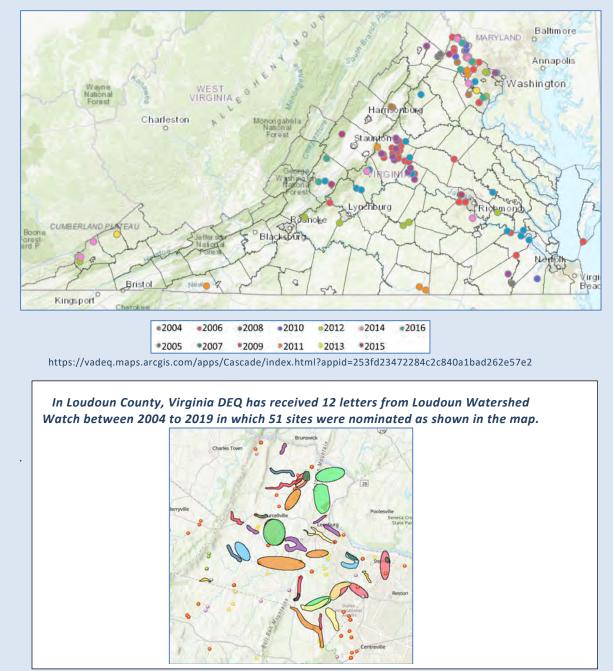
There are a few isolated locations in the County where significant groundwater contamination is known to exist. The most notable location is the Hidden Lane Landfill in northeast Loudoun, which was placed on the EPA's National Priorities List (Superfund). The EPA has developed fact sheets to update citizens 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.

*Of the 167 groundwater* samples reported in 2020, there were a few samples with analyte concentrations (sulfate and arsenic) that were higher than the EPA Maximum Contaminant Level (MCL). Secondary MCL for manganese, iron and total dissolved solids were exceeded. Groundwater quality in Loudoun is generally good, but these data show why private drinking water well owners should have their well water tested regularly to assure that the water is safe to consume.

#### WATER RESOURCES 2020 HIGHLIGHT:

Citizen Nominated Water Quality Monitoring – Submission of water quality monitoring nominations to Virginia Dept of Environmental Quality

Each year, Virginia DEQ seeks input from Virginia citizens to identify Virginia waters that could benefit from monitoring by the agency. Nominations may be submitted from Jan. 1 to April 30. DEQ reviews each nomination based on staff and resource availability, if recent monitoring has occurred in the waterbody, and if the request falls under the agency's water quality monitoring program. If the agency is able to honor the nomination, follow-up sampling will occur in the following calendar year.





In 2020, the state of Virginia commemorated 50 years of dedication and commitment to the conservation of Virginia's water resources with the 50th anniversary of the Virginia Scenic Rivers Program. The designated waterways are tracked and managed by the Virginia Department of Conservation and Recreation (DCR) and are recognized for their pristine beauty and contribution to the well-being of local communities through provenance of clean drinking water, meaningful recreation, healthy and beautiful freshwater wildlife habitats, and unique community landscapes. Protection of these streams through programs like the Scenic Rivers Program and partnerships with local residents and grassroots organizations help ensure these benefits for the people of Virginia and generations to come. Within Loudoun County are two Virginia-designated scenic - Catoctin Creek from Waterford to the confluence of the Potomac, and Goose Creek from the confluence of the north and south prongs near Linden to the confluence of the Potomac.

**Catoctin Creek** was designated in 1977. The Catoctin Creek's battle for designation began with a grassroots movement to protect the creek from proposed intensive development. In 1974, a joint project between the Fairfax County Water Authority and the U.S. Army Corps of Engineers proposed the construction of a dam and reservoir along Catoctin Creek. The Catoctin Creek Scenic River Advisory Committee is a state-recognized and designated citizens' committee that advocates for its protection and works to support landowners putting their land in conservation easement.

Goose Creek was designated in 1976. The Goose Creek Association, an independent non-profit, was founded in 1970 to fight the discharge of sewage effluent into Goose Creek. Its volunteer board guides multiple programs to steward the creek. They encourage landowners to improve the streamside habitat on their properties; maintain an active stream monitoring program and advocate for its protection in relation to proposed development, zoning and legislation that might impact the creek, its watershed and the region. The Goose Creek Scenic River Advisory Committee is a state-recognized and designated citizens' committee that also advocates for riparian protections along the creek.