

2023 Annual Water Resources Report

Joint Legislative Oversight Commission on State Water Resources



Prepared by the

West Virginia Department of Environmental Protection

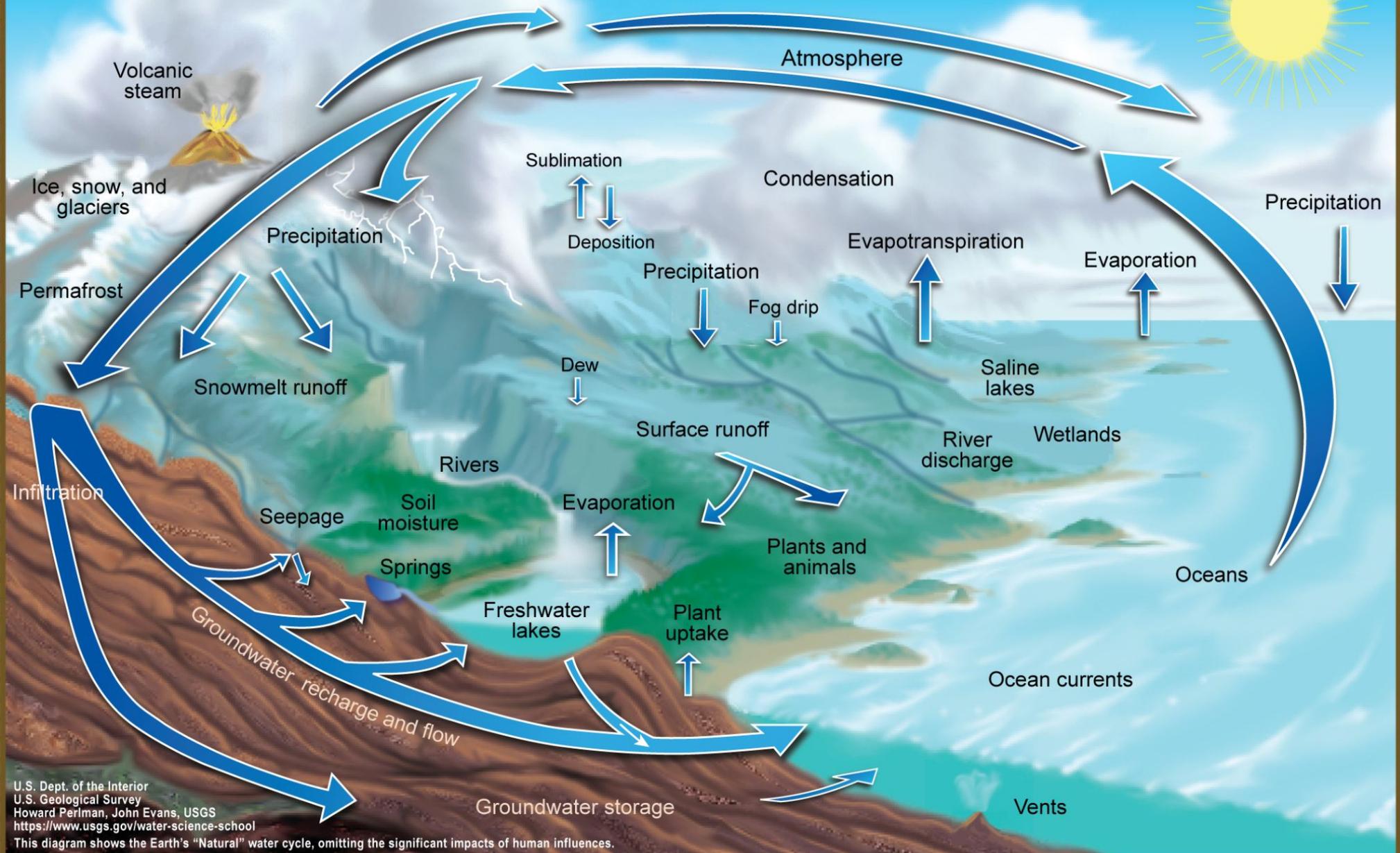
Division of Water and Waste Management

Water Use Section

The story of mankind is the story of water...

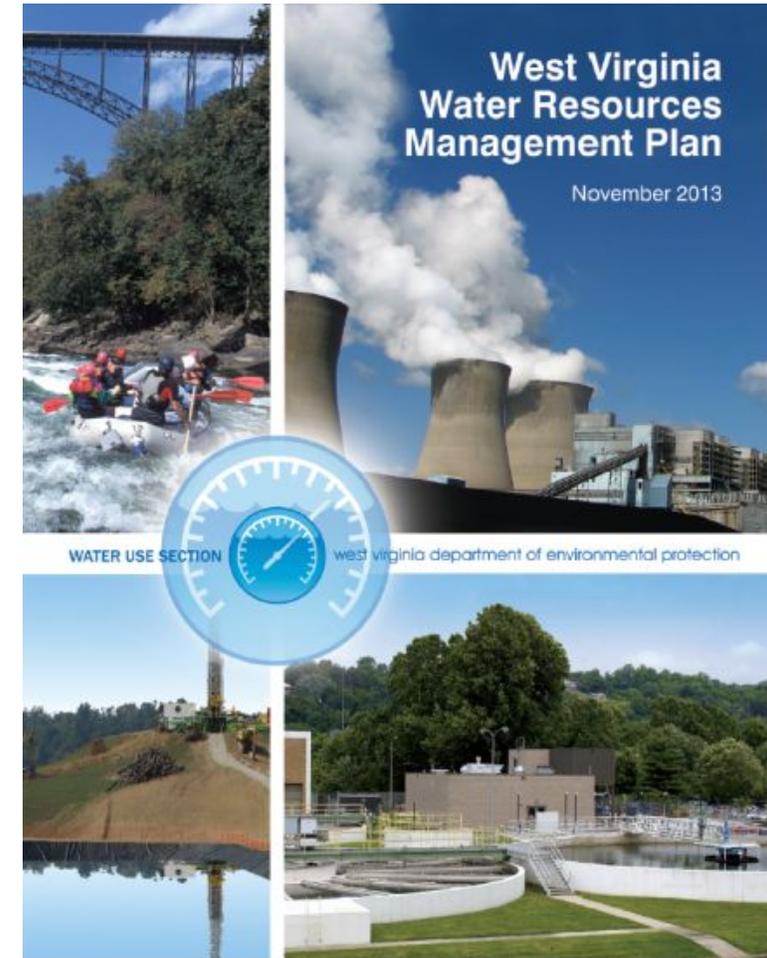


The Water Cycle



Water Resources Management Overview

- W.Va. Code §22-26 originally passed in 2004.
- Senate Bill 641 renamed it the Water Resources Protection and Management Act in 2008.
- The WVDEP Water Use Section was created in 2008 to accomplish the Act's requirements.
- The WV Water Resources Management Plan was submitted in 2013.
- The Plan was adopted as part of Senate Bill 373 in 2014.
- This presentation of the annual report is in accordance with W.Va. Code §22-26-8(e).



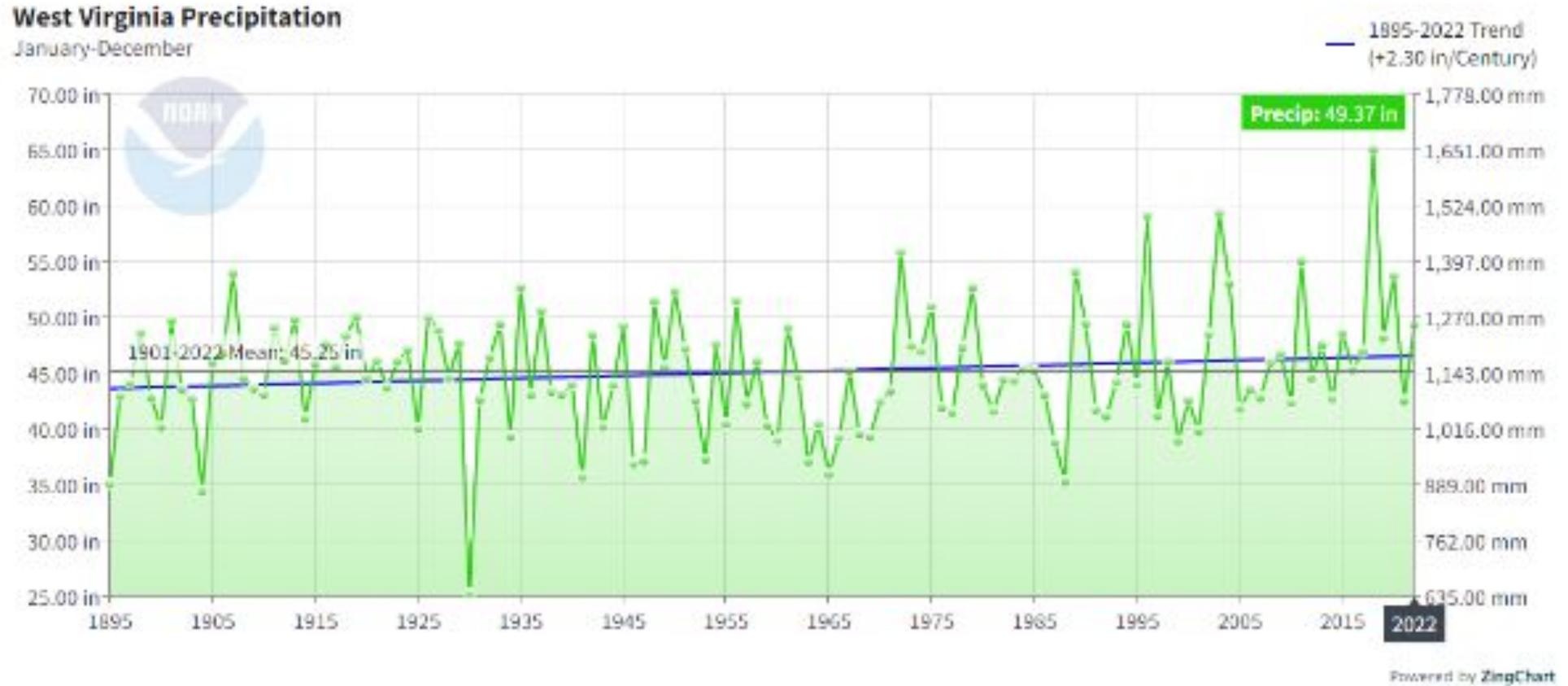
1895-2022 Water Resources Availability

2019
average rainfall
w/dry periods
48"

2020
slightly higher than
average rainfall
54"

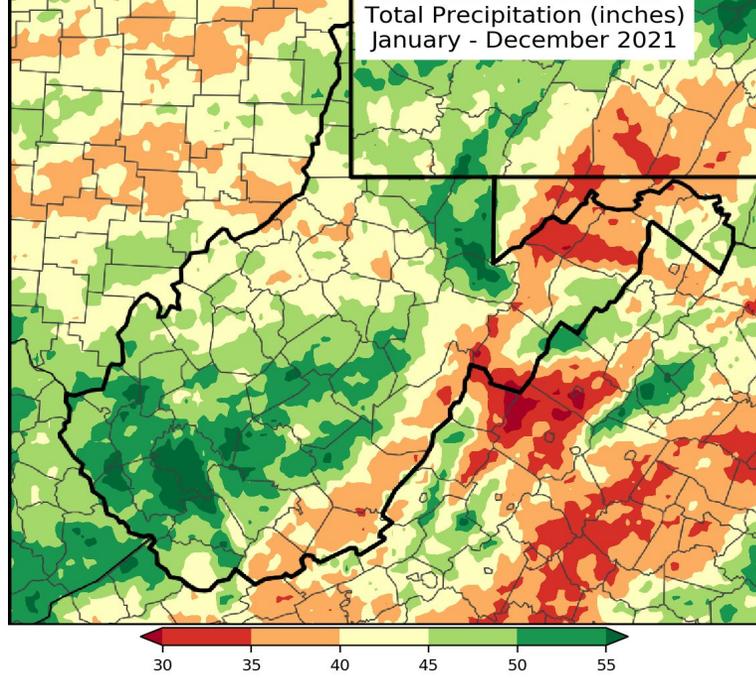
2021
slightly lower than
average rainfall
43"

2022 slightly higher
than average
rainfall 49"

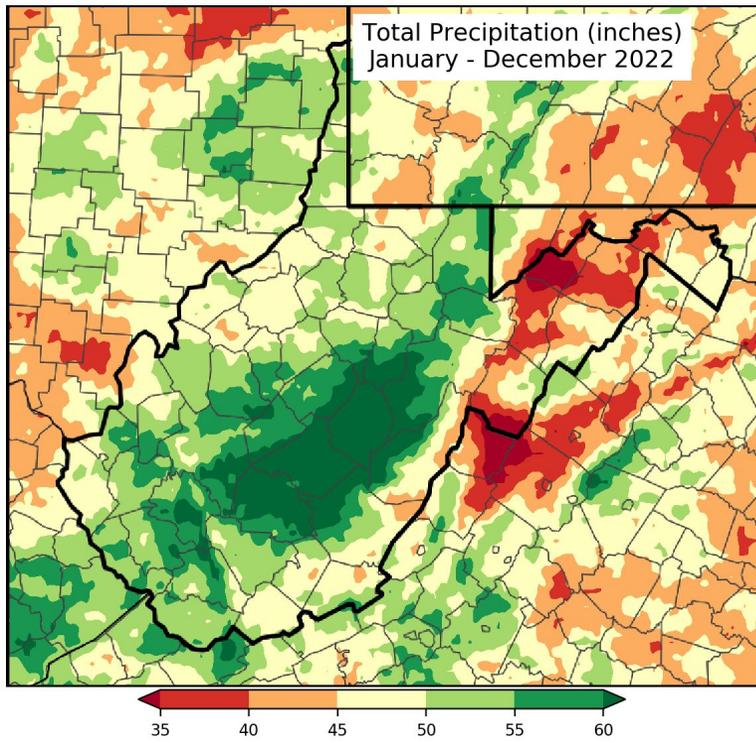


WV's annual precipitation from 1895 – 2022 (from [National Oceanic and Atmospheric Administration](https://www.noaa.gov/)).



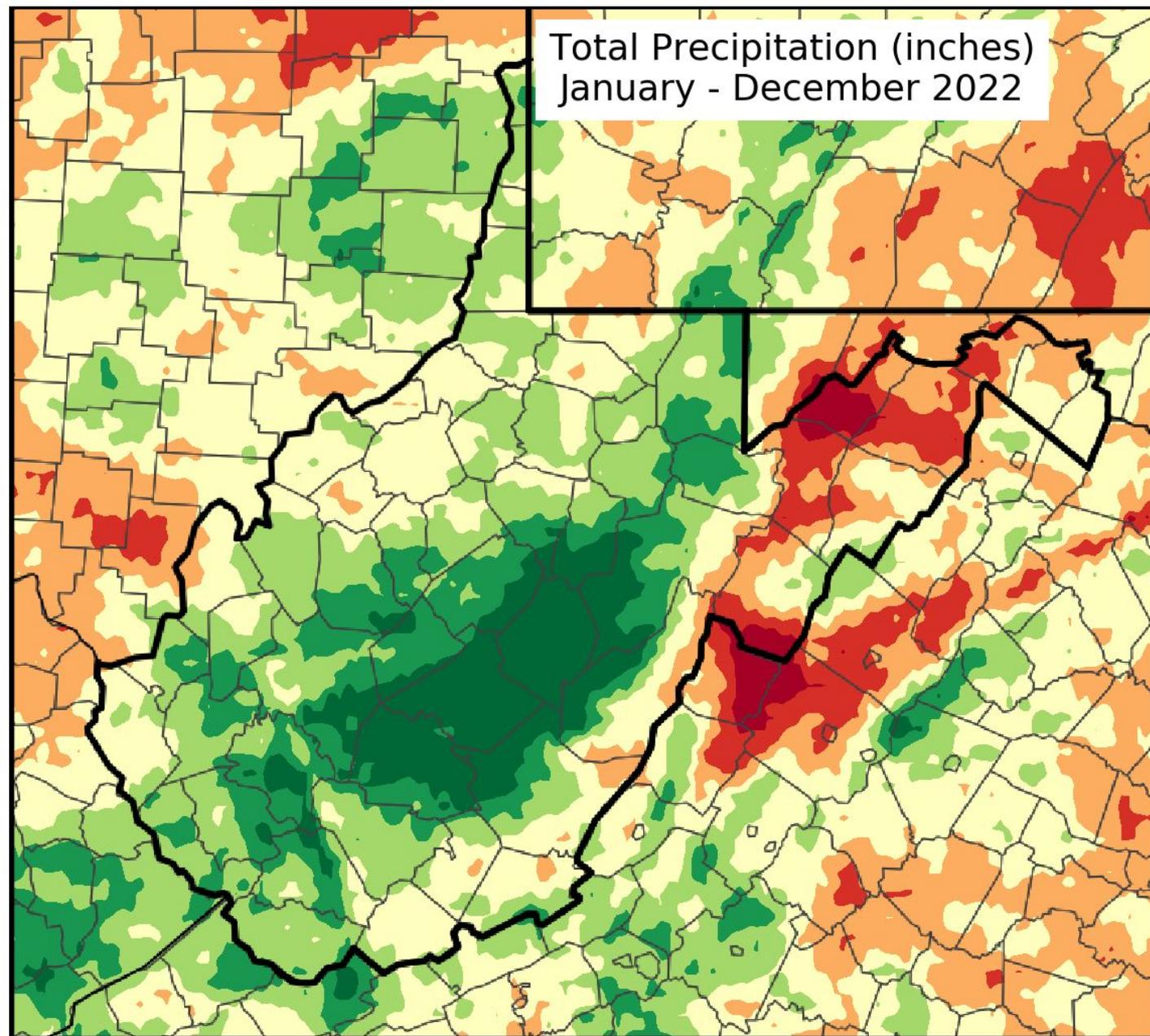


Total 2021 precipitation



Total 2022 precipitation

Recent Water Resources Availability



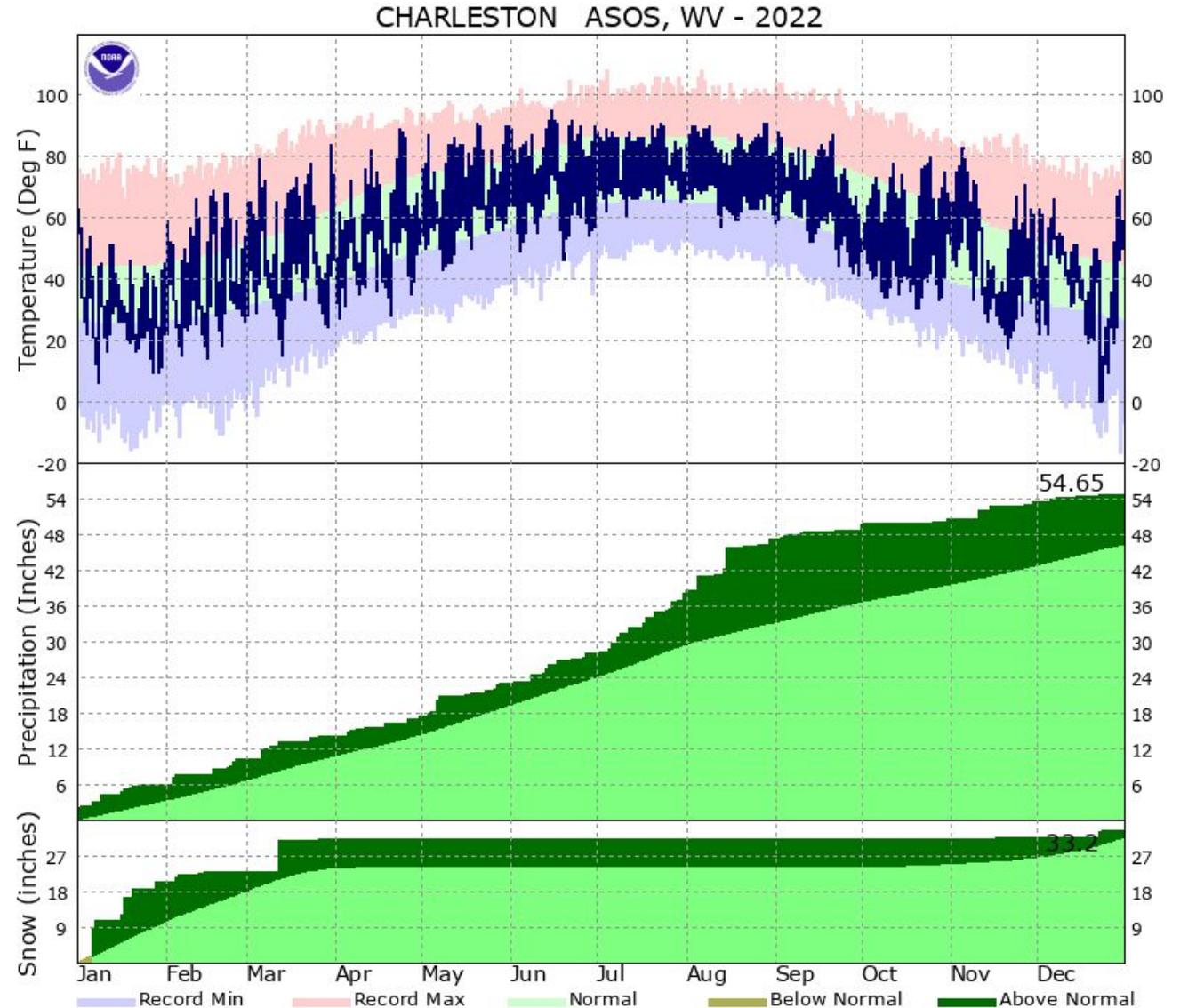
Total 2022 precipitation (from [National Weather Service](#)).



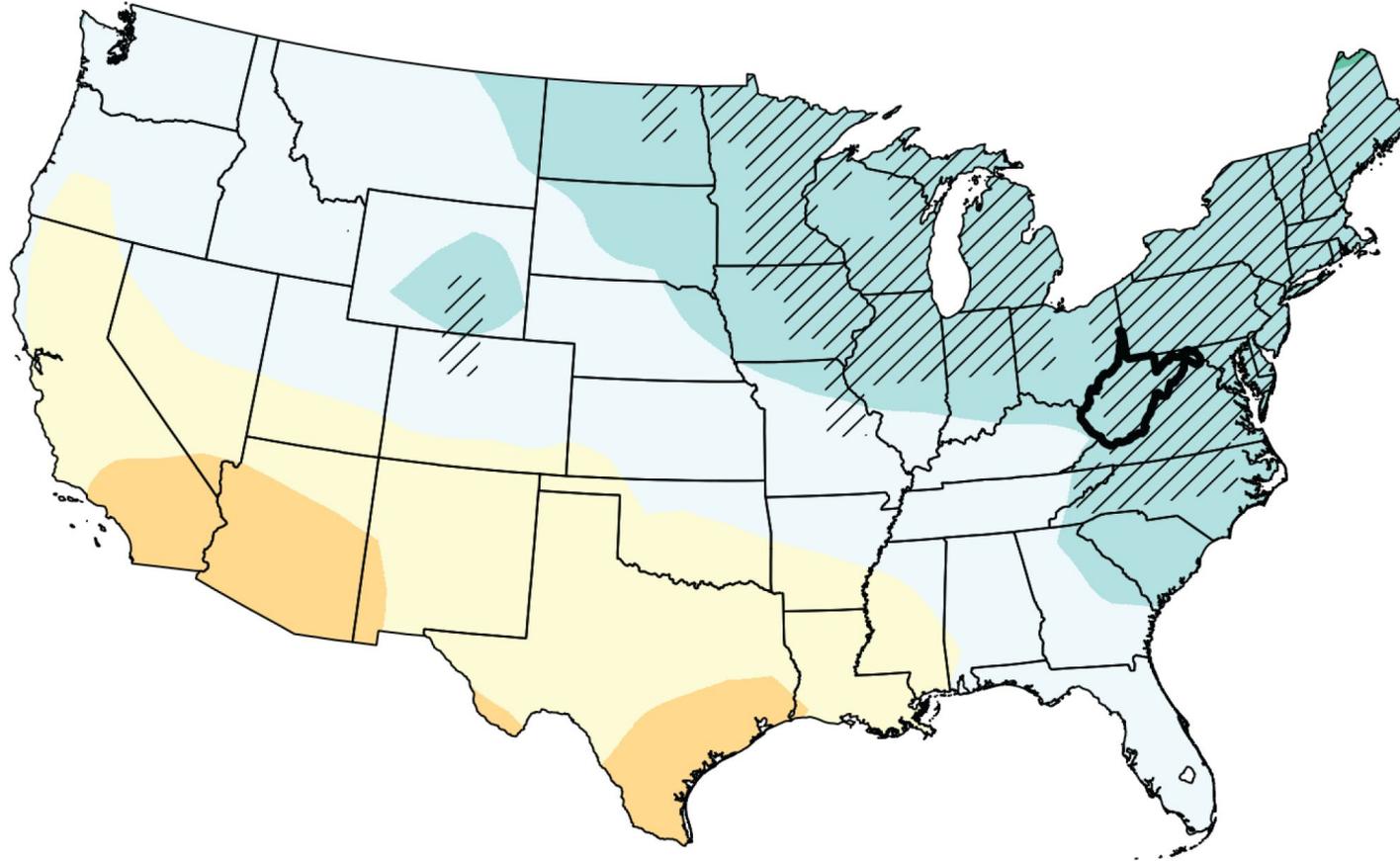
2022 Water Resources Availability

Charleston, WV 2022
above “normal”
precipitation entire
year

Climate data for Charleston, WV
from January – December 2022
(from [National Weather Service](https://www.weather.gov)).



Projected Change in Annual Precipitation



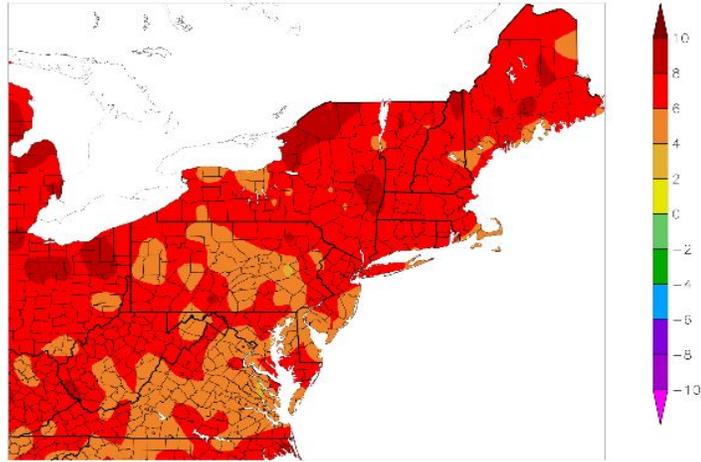
Change in Annual Precipitation (%)



(from [National Oceanic and Atmospheric Administration](#)).



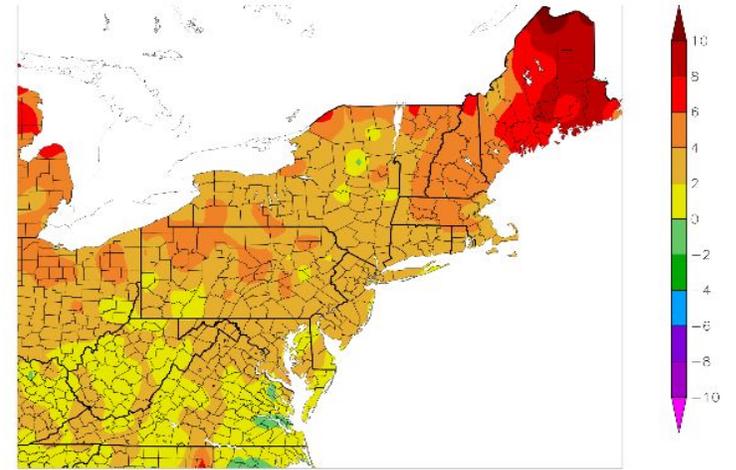
Departure from Normal Temperature (F)
1/1/2020 – 1/31/2020



Generated 2/20/2020 at HPRCC using provisional data.

NOAA Regional Climate Centers

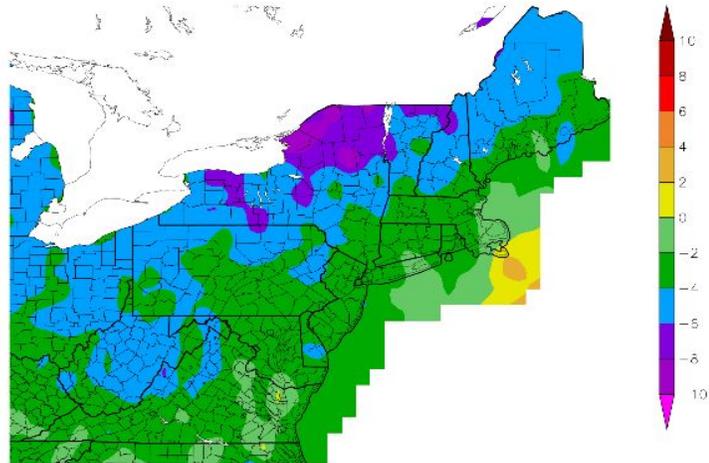
Departure from Normal Temperature (F)
1/1/2021 – 1/31/2021



Generated 2/20/2021 at HPRCC using provisional data.

NOAA Regional Climate Centers

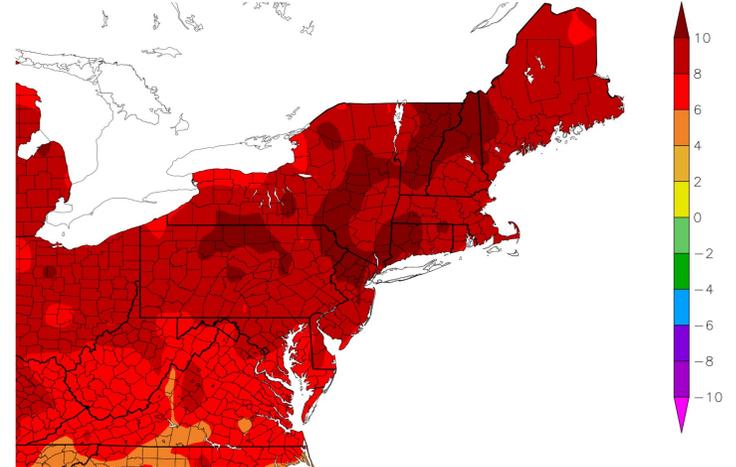
Departure from Normal Temperature (F)
1/1/2022 – 1/31/2022



Generated 3/1/2022 at HPRCC using provisional data.

NOAA Regional Climate Centers

Departure from Normal Temperature (F)
1/1/2023 – 1/31/2023



Generated 2/20/2023 at HPRCC using provisional data.

NOAA Regional Climate Centers

Departure from normal temperature in WV for January 2020-2023 (from [Northeast Regional Climate Center](https://www.norc.nh.gov/)).



2022 Water Resources Availability

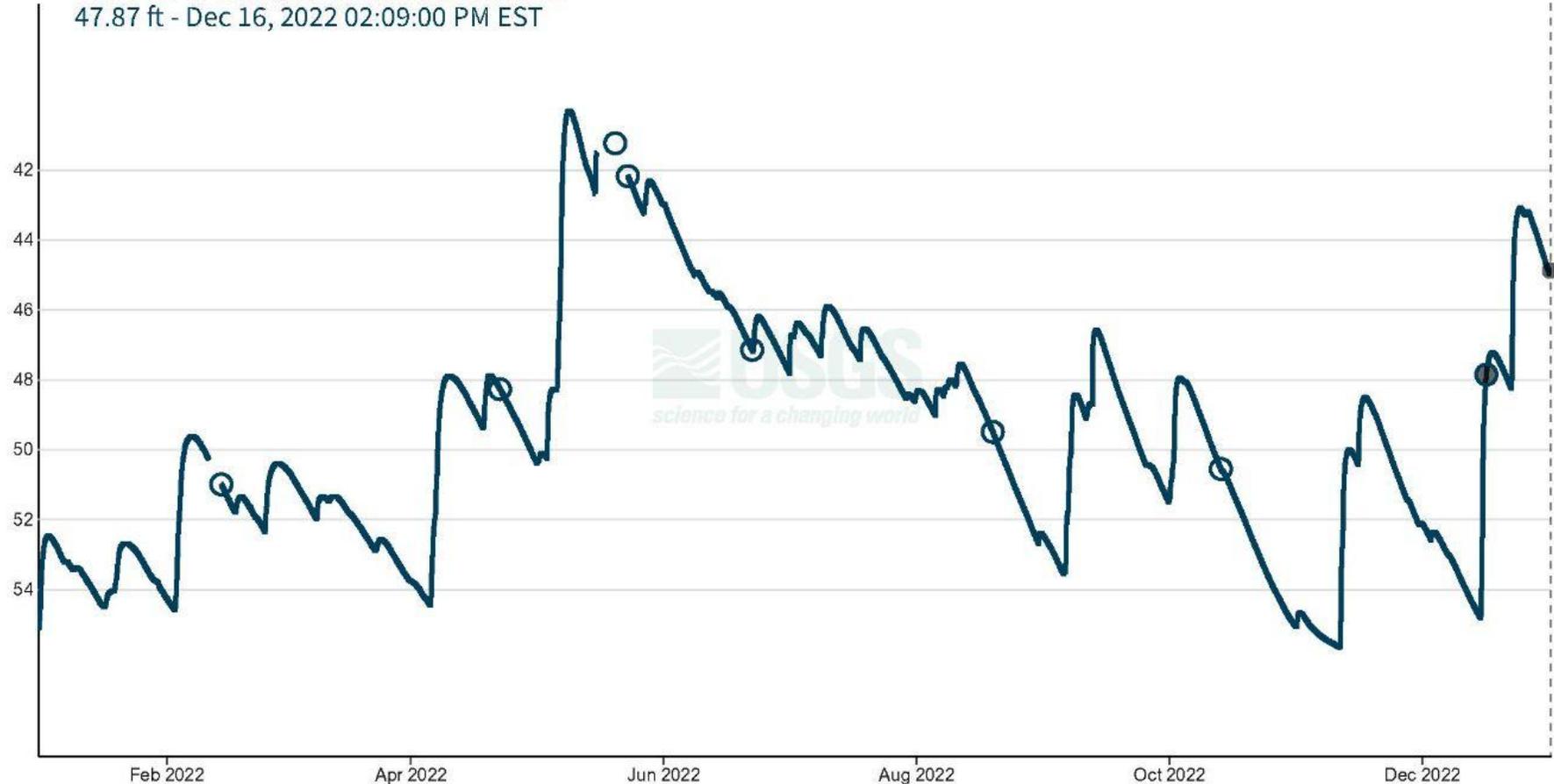
Ber-0445 - 392725077582401

January 1, 2022 - December 31, 2022

Depth to water level, ft below land surface ⓘ

44.89 ft - Dec 31, 2022 11:45:00 PM EST

47.87 ft - Dec 16, 2022 02:09:00 PM EST

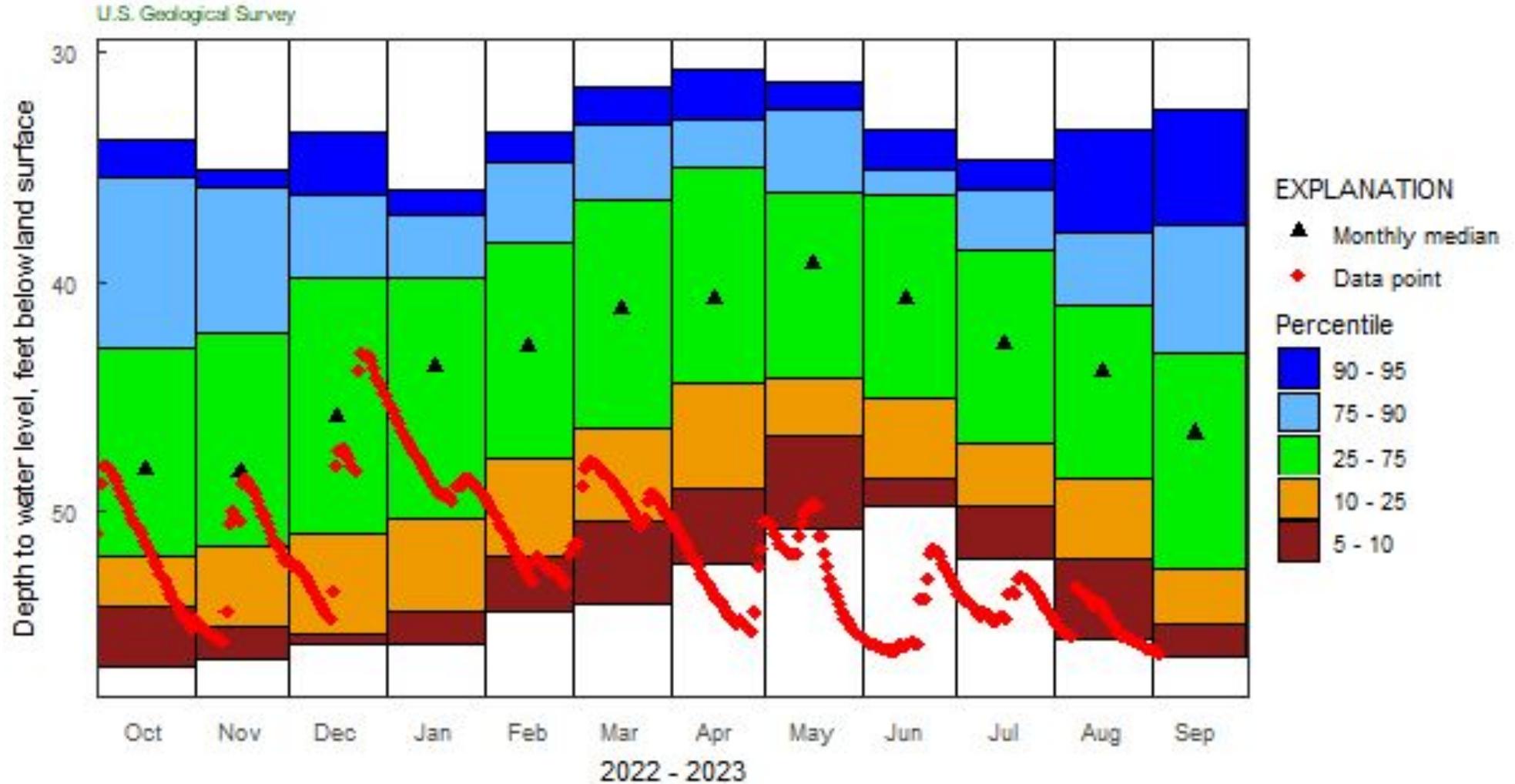


Groundwater levels ranged from high of 40.32 (May 9th) to low of 55.64 (November 10th)

Groundwater levels 2022 in Martinsburg, WV (from [USGS](https://www.usgs.gov/)).

Recent GW Level Statistics

392725077582401 Ber-0445



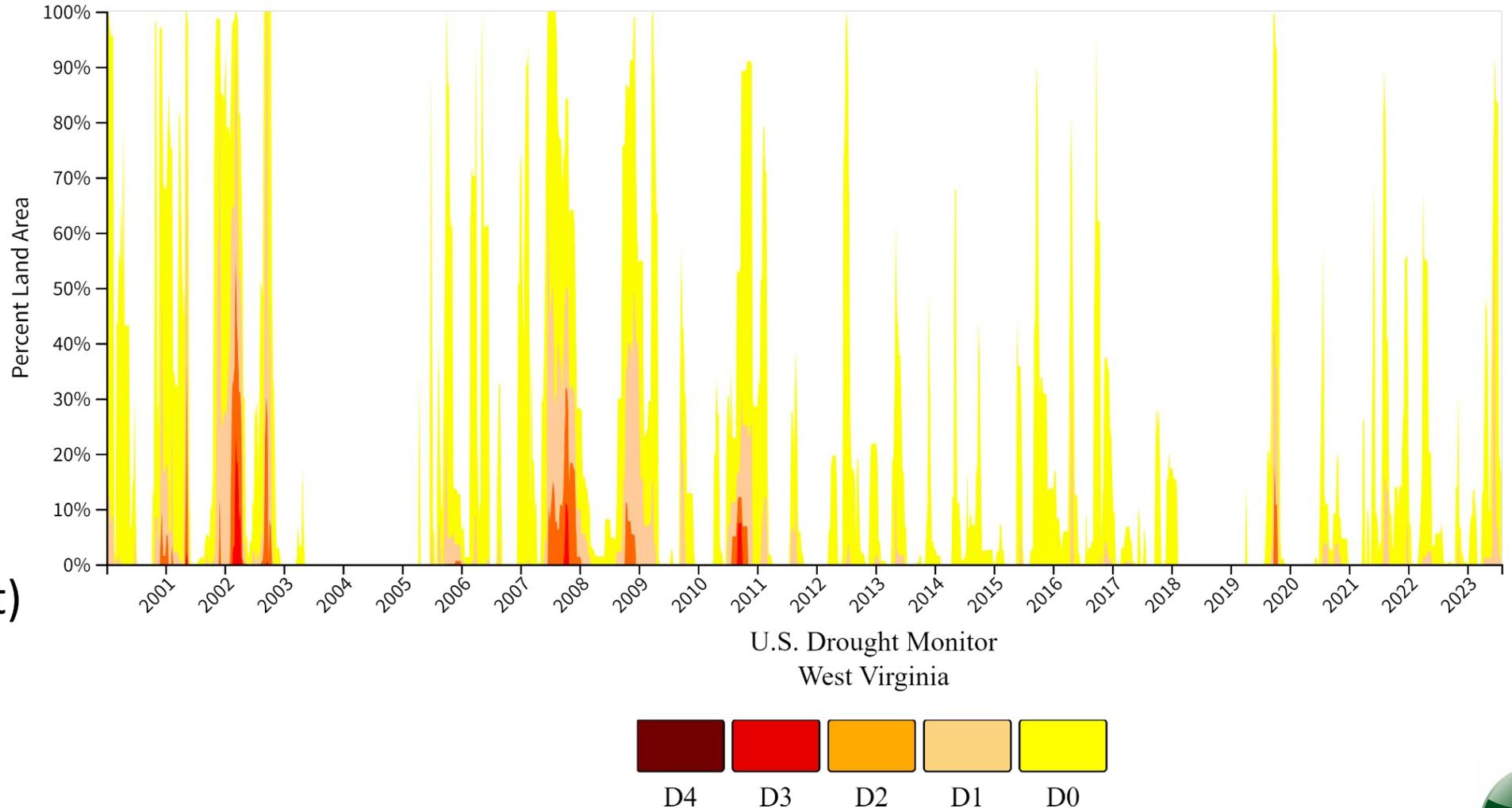
Plot created: 2023-09-05



2000-2023 Water Resources Availability

Some periods
of drought in
2022

(darker colors
indicate higher
level of drought)



Drought conditions in WV since 2000 (from [US Drought Monitor](#)).



<https://www.drought.gov/states/west-virginia>

0 counties with USDA Drought Disaster Designations (primary) — 0 counties since last week	~152,000 West Virginia residents in areas of drought, according to the Drought Monitor ↓ 1.8% since last week	46th driest September on record (since 1895) 2.63 in. total precipitation ↓ 0.62 in. from normal	36th driest January–September on record (since 1895) 32.63 in. total precipitation ↓ 2.62 in. from normal
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[Learn More About These Stats](#)

Current West Virginia Drought Maps

U.S. Drought Monitor | **USDM 1-Week Change** | **Short-Term MIDI** | **Long-Term MIDI**

The U.S. Drought Monitor depicts the location and intensity of drought across the country. The map uses 5 classifications: Abnormally Dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought (D1–D4).

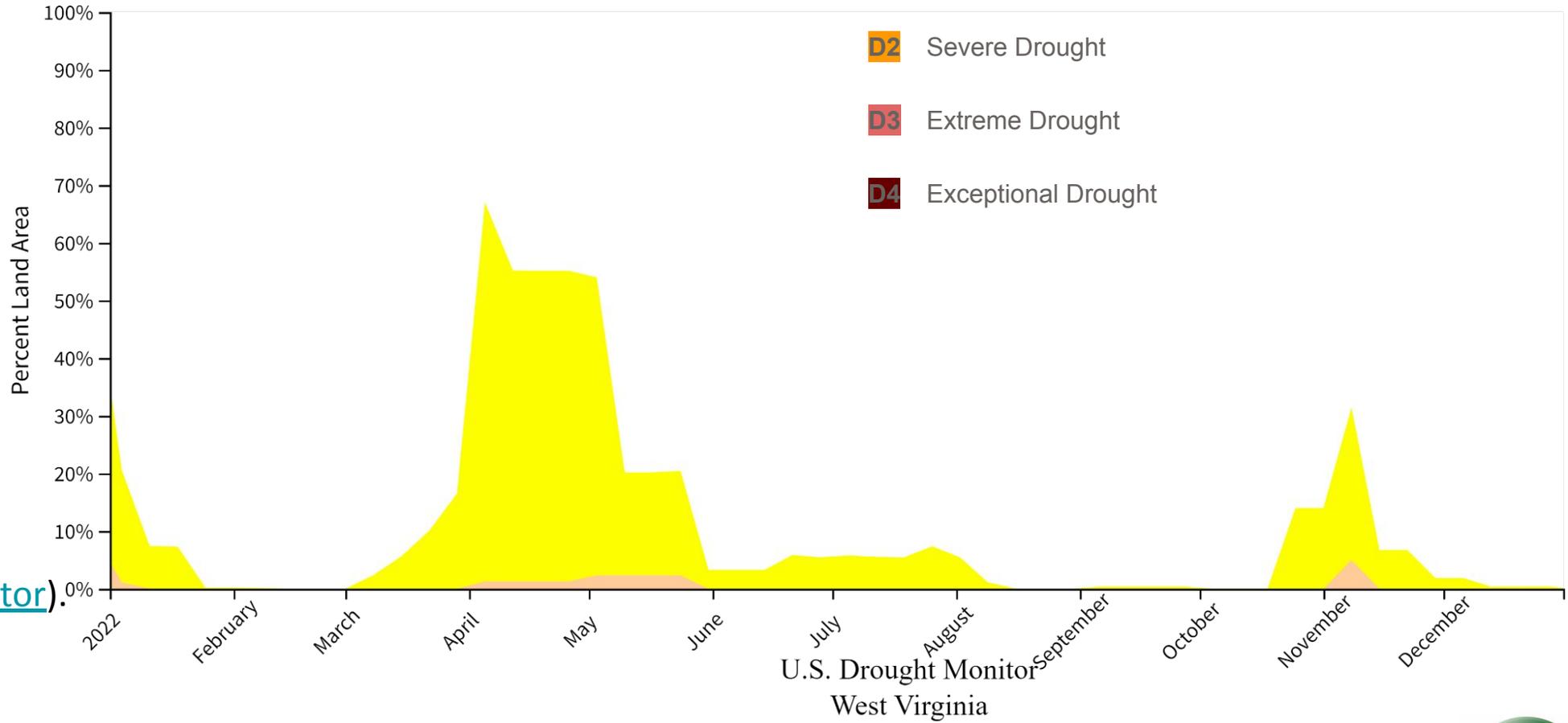
This map is used by the U.S. Department of Agriculture to trigger some disaster declarations and loan eligibility. Individual states and water supply planning may use additional information to inform their declarations and

Drought & Dryness Categories	% of WV
D0 – Abnormally Dry	18.0%
D1 – Moderate Drought	7
D2 – Severe Drought	0

[Feedback](#)

2022 Drought Conditions

(from [US Drought Monitor](#)).



Dryness Categories

D0 Abnormally Dry—used for areas showing dryness but not yet in drought, or for areas recovering from drought.

Drought Intensity Categories

D1 Moderate Drought

D2 Severe Drought

D3 Extreme Drought

D4 Exceptional Drought



D4 D3 D2 D1 D0



2022 Large Quantity User (LQU) Total Withdrawals

WVDEP Water Use Category	LQUs	Total 2022 Withdrawal (Gallons)	Category %	% Change from 2021
Agriculture/aquaculture	12	8,007,907,629	1.30%	-5.27%
Chemical	12	125,115,951,895	20.37%	-11.91%
Industrial	17	12,798,607,849	2.08%	-17.32%
Mining	66	13,527,095,464	2.20%	18.86%
Oil & gas	14	3,212,283,274	0.52%	-10.85%
Petroleum	1	303,478,334	0.05%	4.44%
Public water supply	169	62,857,451,729	10.23%	3.92%
Recreation	22	1,122,240,686	0.18%	19.97%
Thermoelectric (coal)	10	386,531,287,514	62.93%	-2.89%
Timber	3	784,106,590	0.13%	-13.89%
TOTAL	326	614,260,410,964	100.00%	-4.26%
Hydroelectric	10	234,716,322,984,805		

WVDEP Water Use Category	2022 Surface Water (SW) Withdrawal (Gallons)	Category % of SW	2022 Groundwater (GW) Withdrawal (Gallons)	Category % of GW
Agriculture/aquaculture	7,790,075,229	1.33%	217,832,400	0.76%
Chemical	116,040,580,511	19.82%	9,075,371,384	31.50%
Industrial	12,108,274,386	2.07%	690,333,463	2.40%
Mining	8,207,454,246	1.40%	5,319,641,218	18.47%
Oil & gas	3,103,995,033	0.53%	108,288,241	0.38%
Petroleum	1,752,828	0.00%	301,725,506	1.05%
Public water supply	50,684,573,064	8.66%	12,172,878,665	42.26%
Recreation	803,668,776	0.14%	318,571,910	1.11%
Thermoelectric (coal)	385,939,996,835	65.92%	591,290,679	2.05%
Timber	773,638,788	0.13%	10,467,802	0.04%
SUB TOTAL	585,454,009,696	100.00%	28,806,401,268	100.00%
Breakdown % of Total Withdrawal		95.31%		4.69%
Hydroelectric	234,716,322,984,805		0	

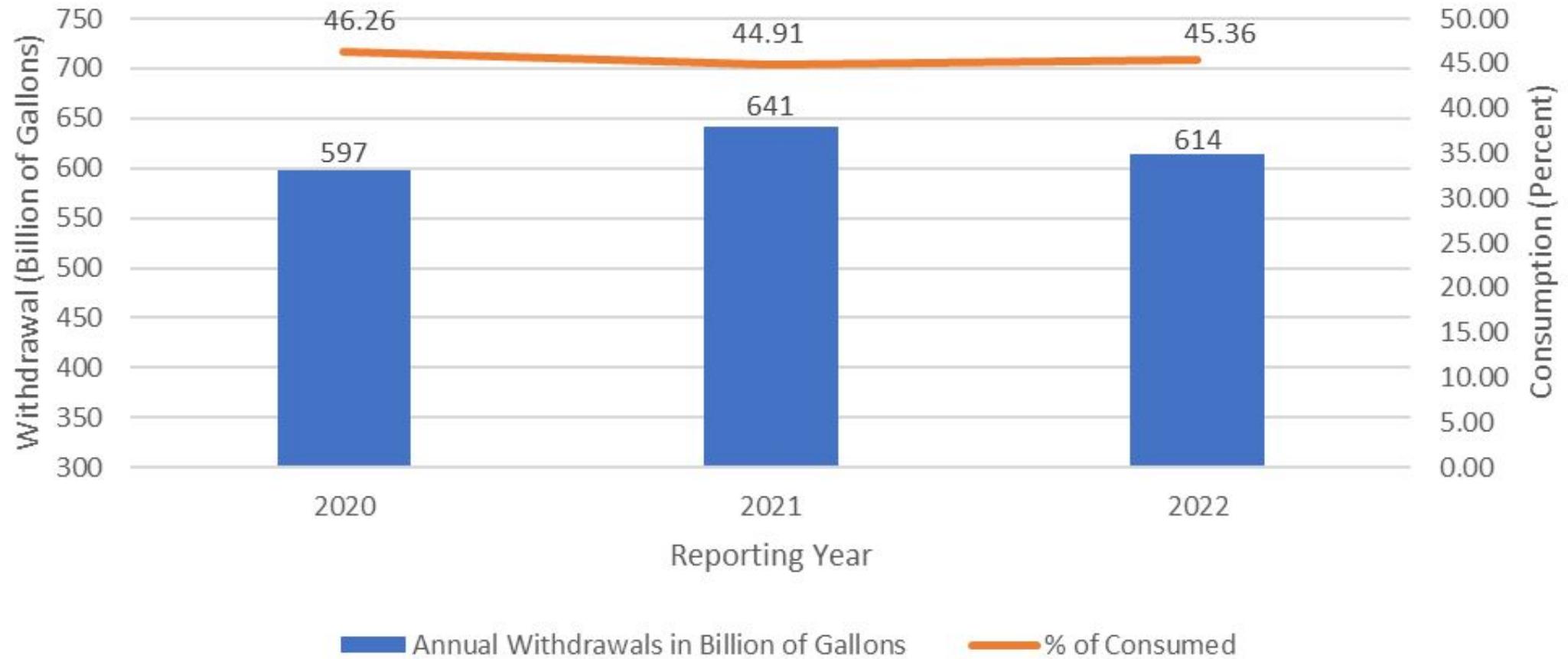


2022 Consumptive Use

WVDEP Water Use Category	2022 Total Gallons Withdrawal	Consumptive Coefficient	2022 Calculated Gallons Consumed	Category % of Consumed
Agriculture/aquaculture	8,007,907,629	0.03	240,237,229	0.09%
Chemical	125,115,951,895	0.12	15,013,914,227	5.39%
Industrial	12,798,607,849	0.59	7,551,178,631	2.71%
Mining	13,527,095,464	0.48	6,493,005,823	2.33%
Oil & Gas	3,212,283,274	1	3,212,283,274	1.15%
Petroleum	303,478,334	0.16	48,556,533	0.02%
Public water supply	62,857,451,729	0.15	9,428,617,759	3.39%
Recreation	1,122,240,686	0.41	460,118,681	0.17%
Thermoelectric (coal)	386,531,287,514	0.61	235,784,085,384	84.65%
Timber	784,106,590	0.39	305,801,570	0.11%
TOTAL	614,260,410,964		278,537,799,112	100.00%
			Consumption 45.36%	
Hydroelectric	236,309,036,343,208			

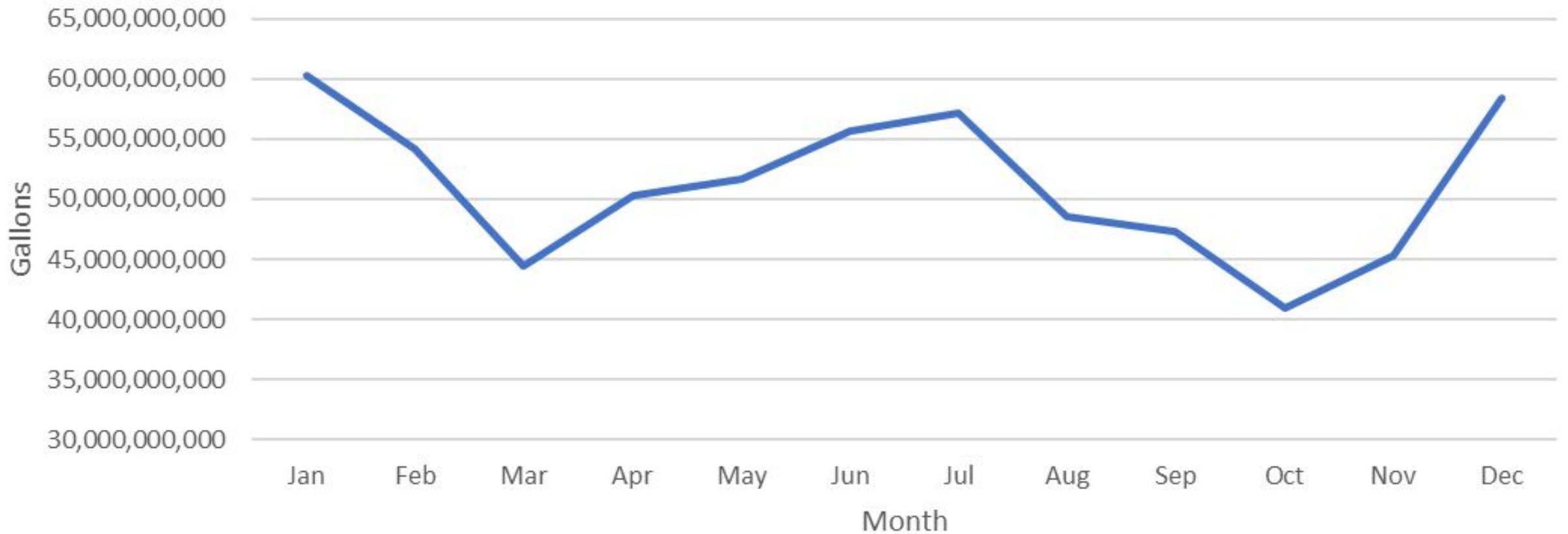


Water Withdrawal and Consumption 2020-2022 (Based on Current Consumption Coefficients)



Seasonal Withdrawal Trends

2022 Monthly Water Withdrawal

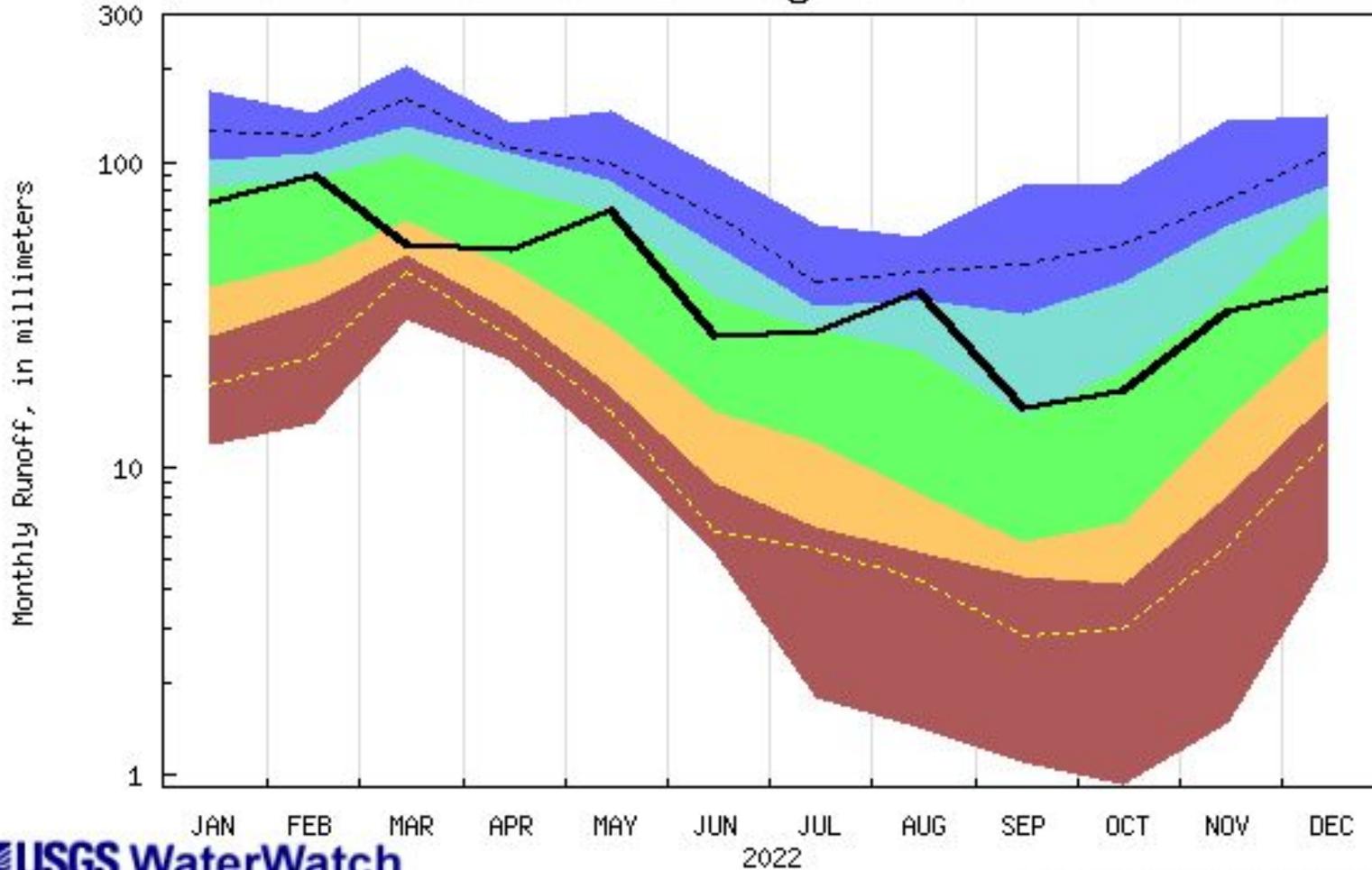


2022 trends in total withdrawal based on the LQU database (from WVDEP).



Seasonal Precipitation Trends

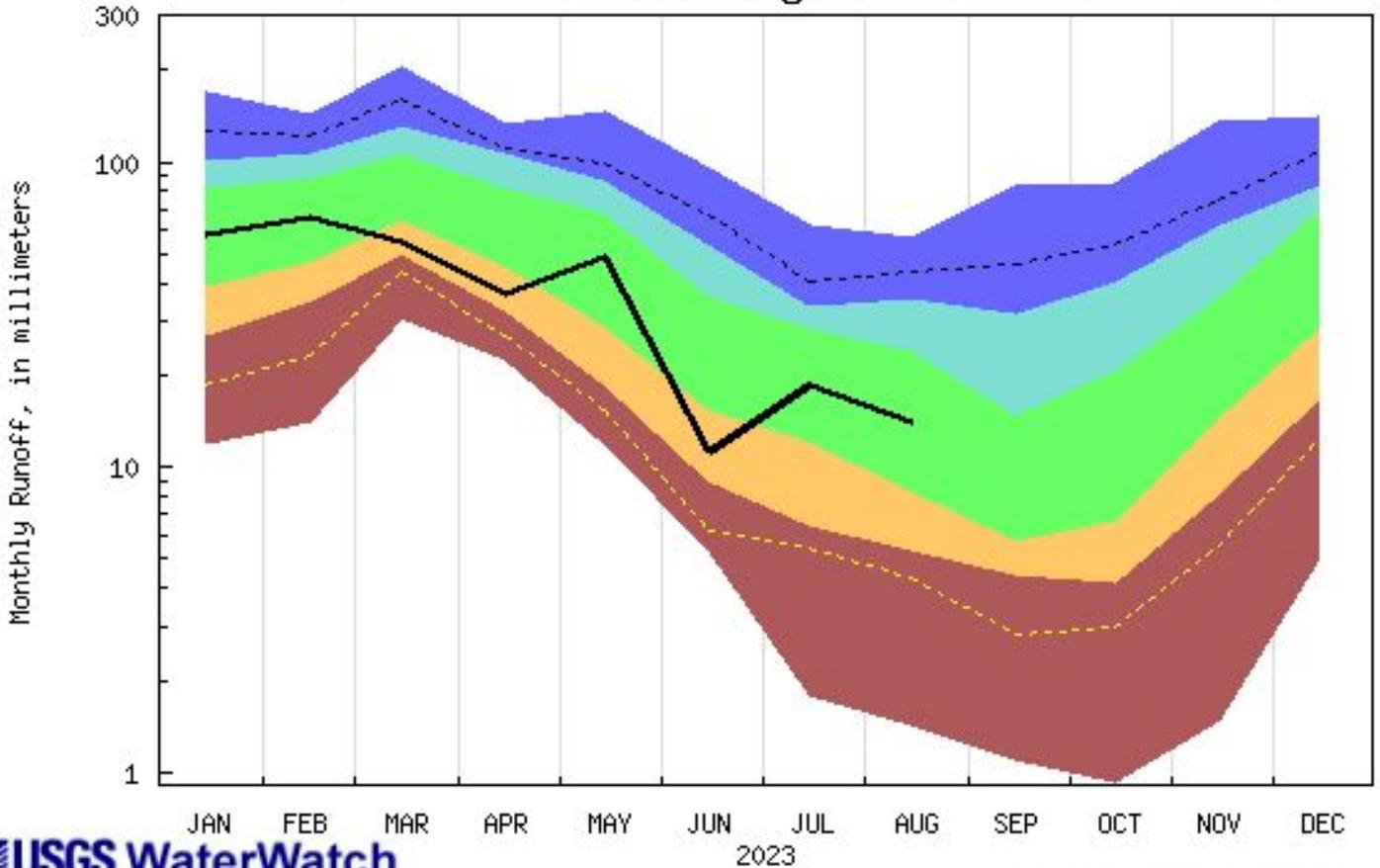
Duration hydrograph of monthly runoff for West Virginia



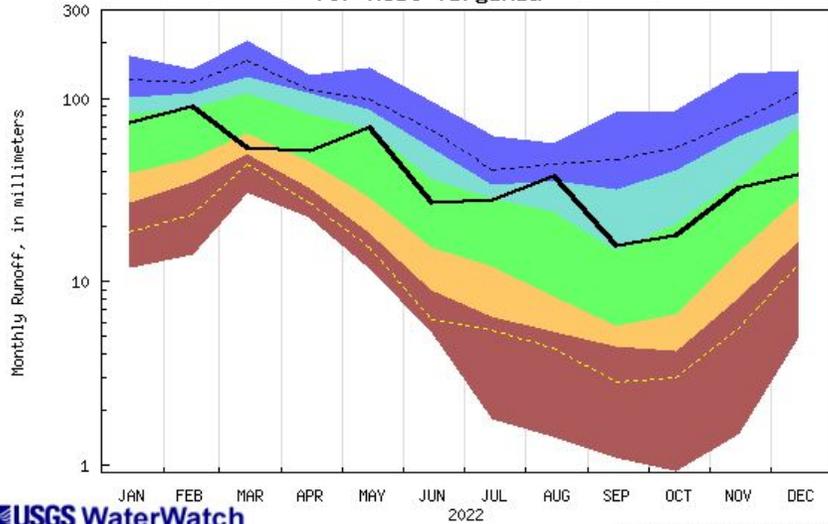
Explanation - Percentile classes						
lowest-10th percentile	5	10-24	25-75	76-90	95	90th percentile -highest
Much below Normal		Below normal	Normal	Above normal	Much above normal	Runoff

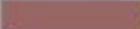
WV 2023 Monthly Hydrograph so far...

Duration hydrograph of monthly runoff for West Virginia



Duration hydrograph of monthly runoff for West Virginia



Explanation - Percentile classes						
						
lowest-10th percentile	5	10-24	25-75	76-90	95	90th percentile -highest
Much below Normal	Below normal	Normal	Above normal	Much above normal		Runoff



Water Management Plans

The Water Use Section reviews all WMPs required for Oil & Gas industry in WV.

Each proposed water source is evaluated

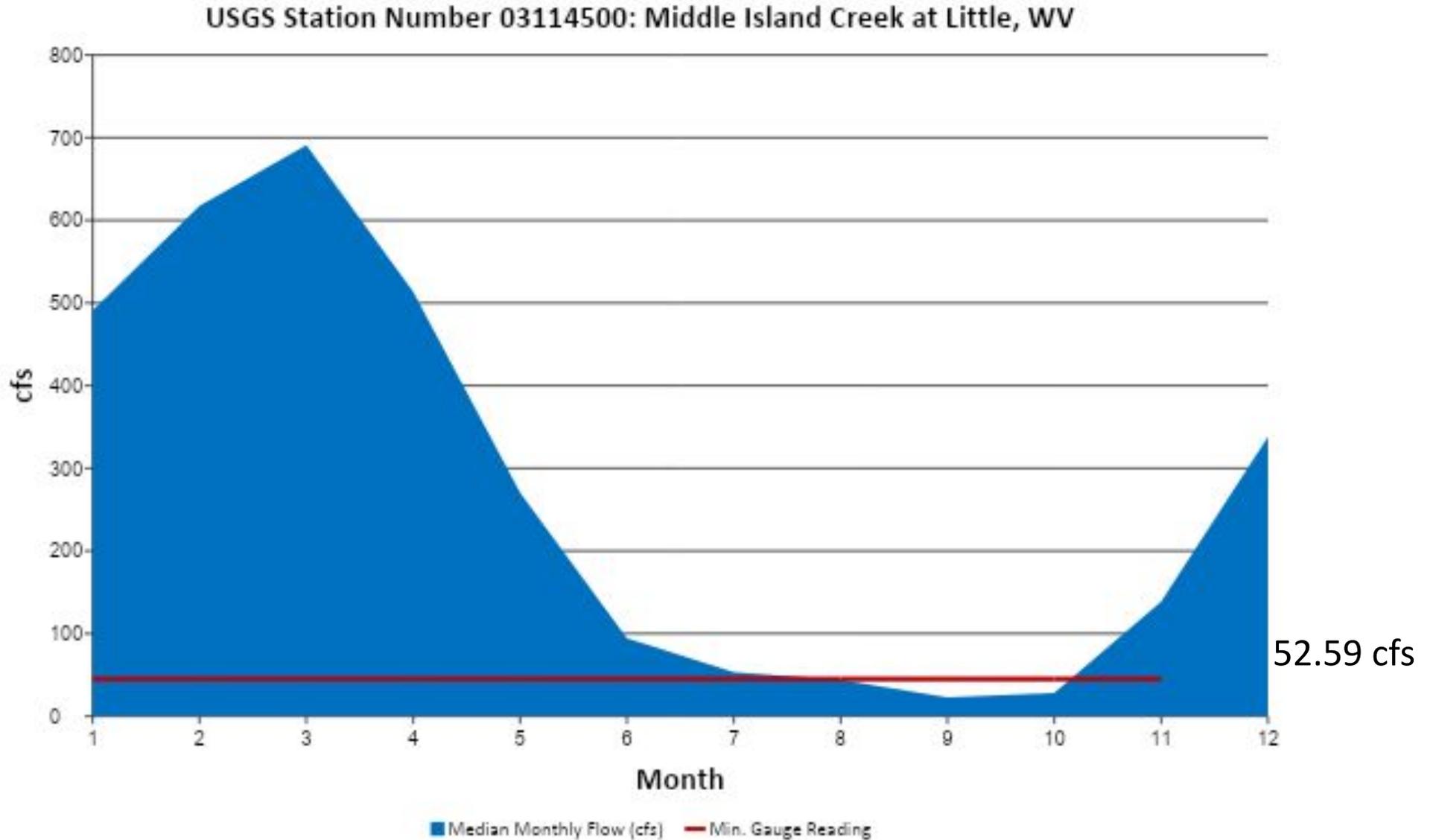
- Surface water
- Ground water
- Purchased water
- Recycled water

Thresholds for withdrawal are set at the 75th percentile.

The use of recycled frac water is always encouraged.



Establishing Limits



WHEELING CREEK AT ELM GROVE, WV



<https://waterdata.usgs.gov/wv/nwis/current/?type=flow>

IMPORTANT Legacy real-time page 1

Monitoring location 03112000 is associated with a STREAM in OHIO COUNTY, WEST VIRGINIA. Current conditions of DISCHARGE, GAGE HEIGHT, and PRECIPITATION are available. Water data back to 1940 are available online.

7 days 30 days 1 year

Change time span | Retrieve data

Streamflow, ft³/s 1

107 ft³/s Nov 23, 2022 02:15:00 PM EST



107 > 49.23
Can withdraw

The operator is reminded that 24-48 hours prior to withdrawing (or purchasing) water, DEP must be notified by email at DEP.water.use@wv.gov. Signage requirements must be satisfied within 24 hours of activating this Water Management Plan.

• Big Wheeling Creek @ Hogg

Type:	Stream/River
County:	Marshall
Owner:	Don Hogg
Intake Latitude:	39.984529
Intake Longitude:	-80.634106
HUC-8 Code:	5030106
Drainage Area (sq miles):	201.69
Regulated Stream:	NO
PWS Within 1 Mile:	NO

Gauged Stream:	YES
Ref Gauge ID:	3112000
Ref Gauge Name:	WHEELING CREEK AT ELM GROVE, WV
Minimum Gauge Reading (cfs):	49.23
Minimum Passby (cfs):	27.28
Endangered Species:	NO
Mussel Stream:	YES
Maximum Pump Rate (gpm):	5040

Daily Streamflow, ft³/s for Wed Nov 23 2022 based on 82 years of data.

Latest Value	Lowest Value (1964)	25th Percentile	Median	75th Percentile	Mean	Highest Value (2012)
107	1.8	45	116	211	206	3560

Comments:

Example:

Citizen inquiry regarding water withdrawal at Fish Creek @ Gribben (ID#03112000 Wheeling Creek @ Elm Grove, WV).

From 7/22/23 @ 10:45am to 7/23/23 @ 7 am, flow decreased from 88 to 58.7 cfs.

Flow did not drop below the established minimum threshold of 56.96 cfs until after 7:15 am based on the USGS website data.

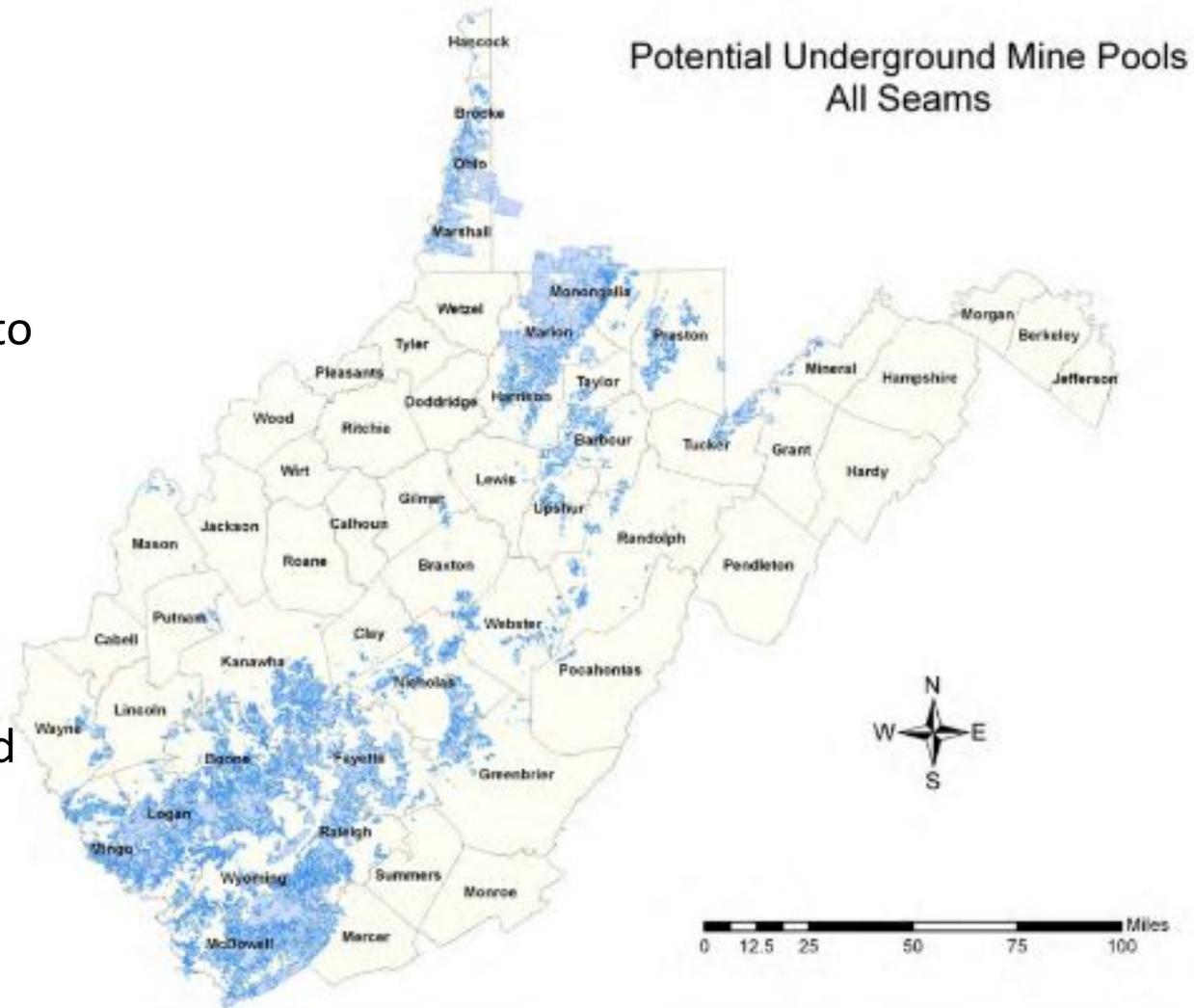
Type:	Stream/River
County:	Marshall
Owner:	Revocable Living Trust of M. Peggy Gribben
Intake Latitude:	39.753271
Intake Longitude:	-80.597913
HUC-8 Code:	5030106
Drainage Area (sq miles):	141.61
Regulated Stream:	NO
PWS Within 1 Mile:	NO

Gauged Stream:	NO
Ref Gauge ID:	3112000
Ref Gauge Name:	WHEELING CREEK AT ELM GROVE, WV
Minimum Gauge Reading (cfs):	56.96
Minimum Passby (cfs):	23.94
Endangered Species:	NO
Mussel Stream:	YES
Maximum Pump Rate (gpm):	5250



Key References

- DEP WV Water Laws, Water Regulations and Water Rights 2013.
- WVGES WV Mine Pool Atlas - location and potential storage capacity of mapped mines.
- USGS SIR 2012-5121 equated stream flow statistics to base flow to identify interconnection of surface and groundwater. The mean summer base flow is approximately equal to the annual 75th duration flow.
- USGS SIR 2012-5186 summarized GW quality.
- USGS SIR 2010-5185 provided Estimation of Selected Seasonal Streamflow Statistics Representative of 1930-2002 in WV.
- USGS SIR 2008-5105 developed regional equations and procedures for estimating stream flow statistics at ungaged locations.



February 2023 WVU Report

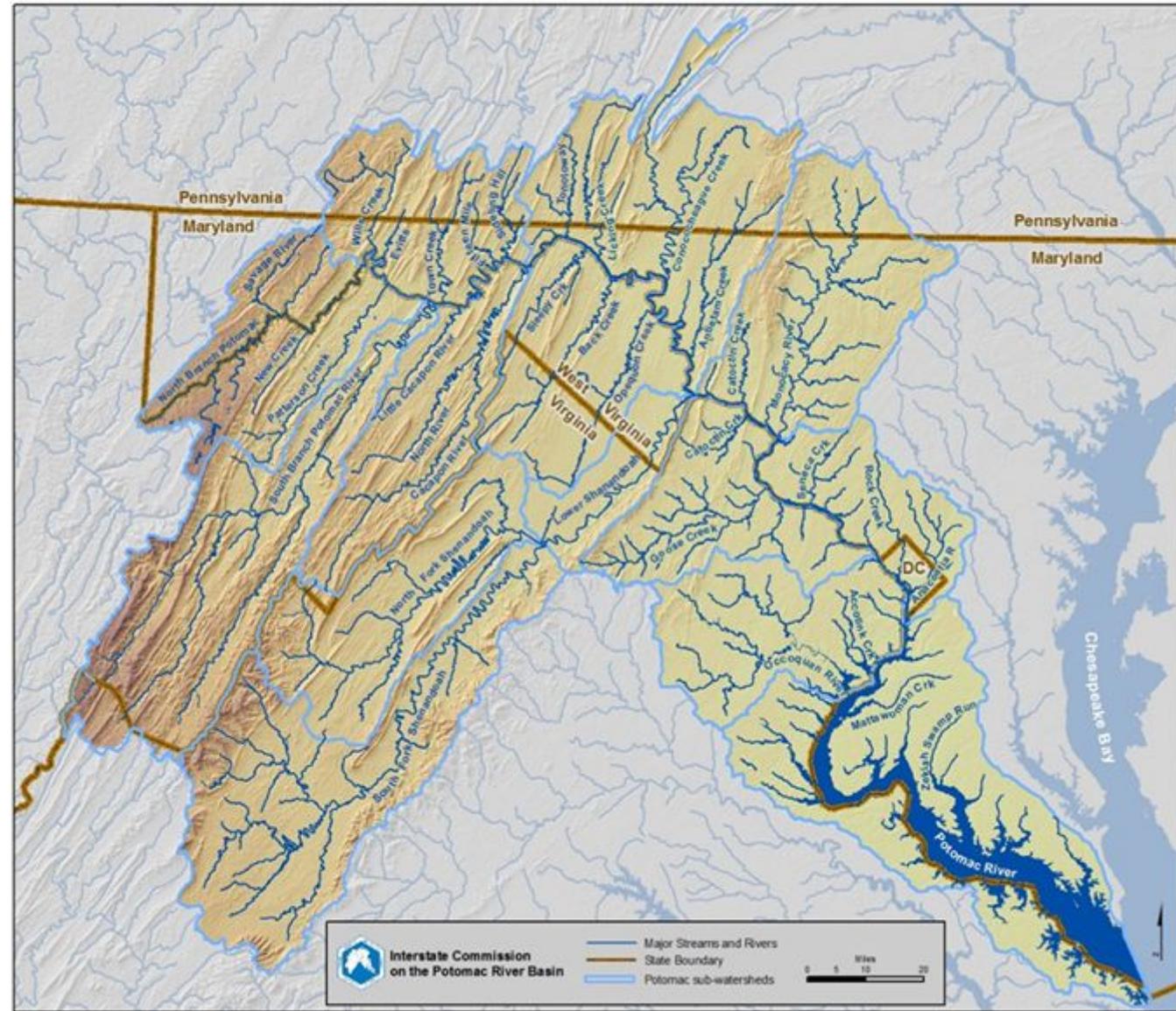
Quantifying Water Security in WV and the Potomac River Basin
(Sjostedt, Strager and Zegre)

MS Thesis:

- Compared existing water use data sets accounting to identify strengths and improvement recommendations.
- Built a community-scale water tower model of the Potomac River basin to better quantify the Washington DC metropolitan areas hydrologic dependency.

Insights

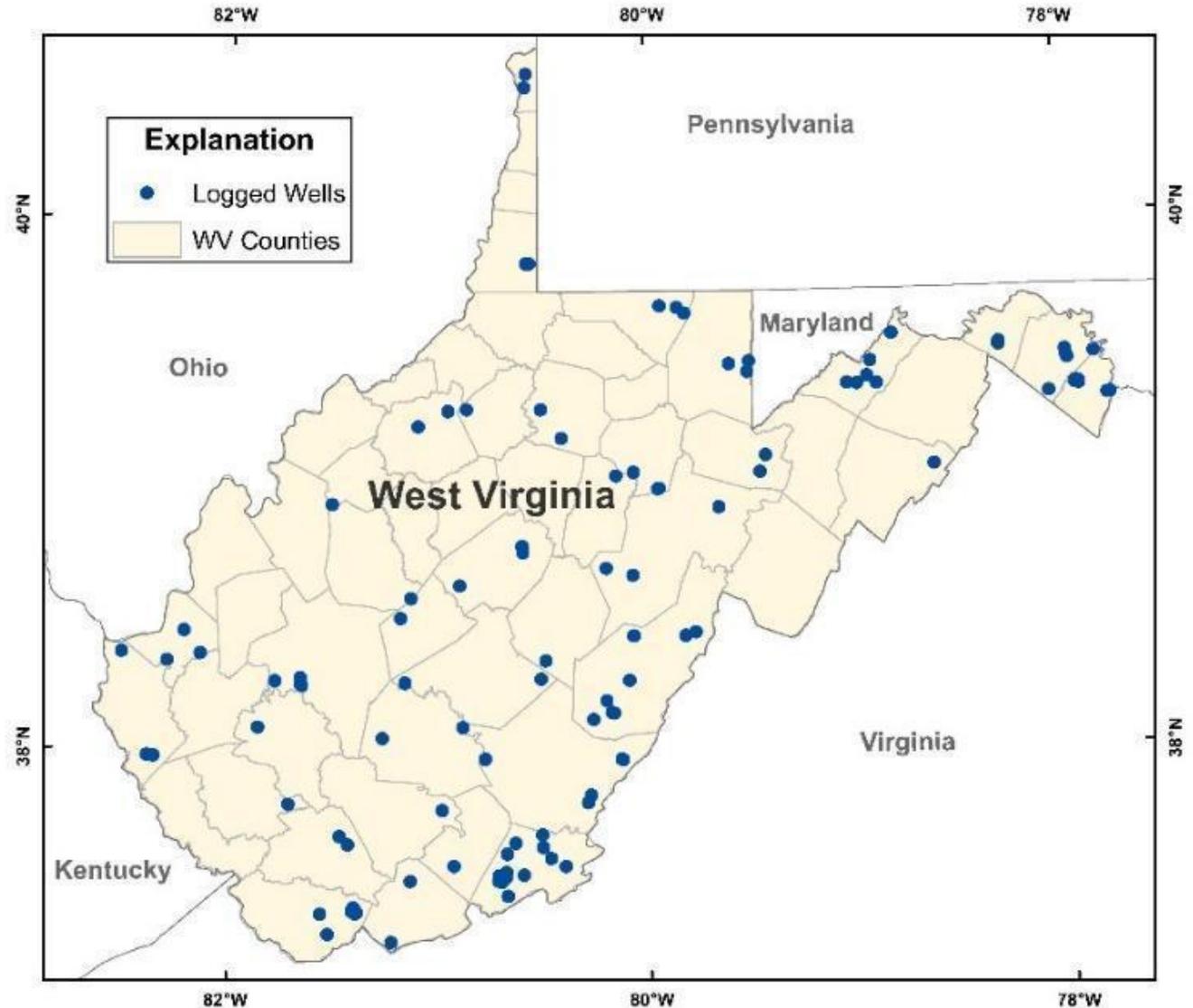
- LQU represents the majority of contemporary water use in WV.
- Would be a benefit to also account for smaller users (e.g., agriculture sector, domestic supplies).
- High elevation and heavily forested areas in the hinterland produced the most disproportional runoff generation for the lowland area emphasizing WV as a vital headwater state.



Continued Research

In support of DWWM's responsibility:

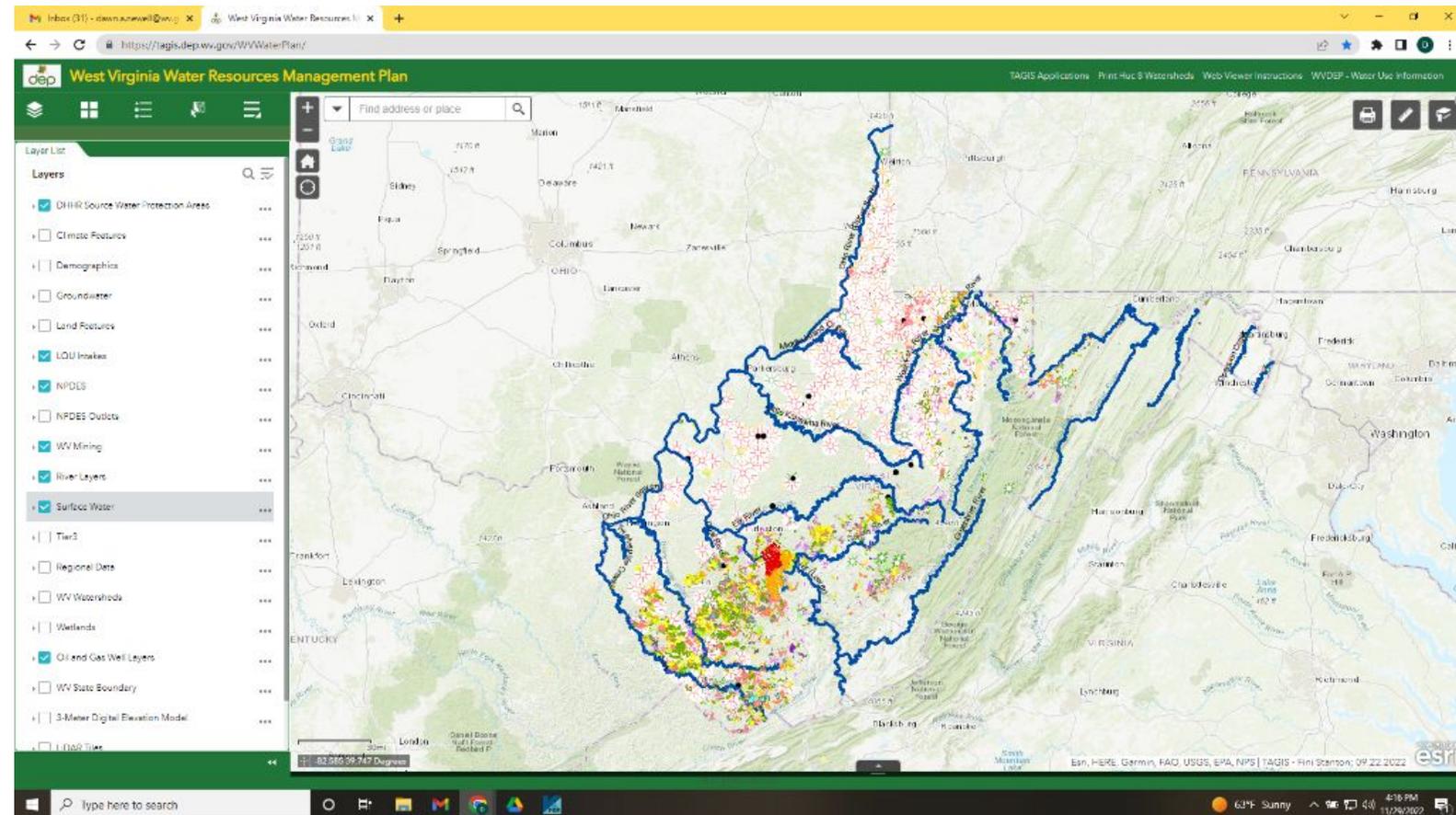
- USGS ~ Winter 2024, Monroe County Hydrogeologic Assessment
- USGS ~ Spring 2024, Geophysical Groundwater Well Logging
- USGS Draft proposal for a Jefferson and Berkeley County water-use study and development of a predictive groundwater flow model



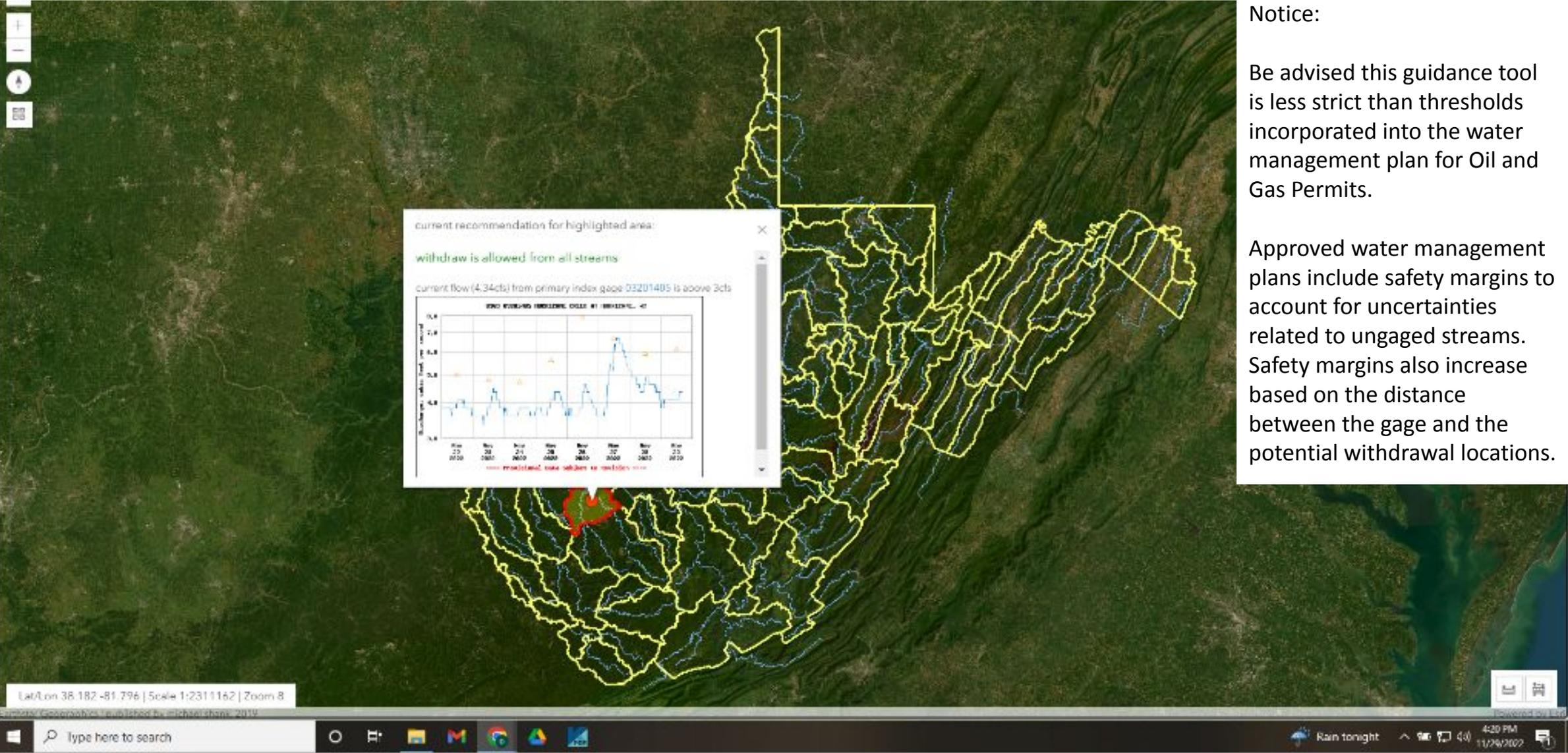
Water Resources Management Mapping Tool

- Acts as a clearinghouse for all data relevant to water management, including LQUs, watershed delineations, monitoring wells, springs mine pools, source water protection areas, geology and more.
- As more data becomes available, it'll be added to this tool.

<https://tagis.dep.wv.gov/WVWaterPlan/>



Water Withdrawal Tool



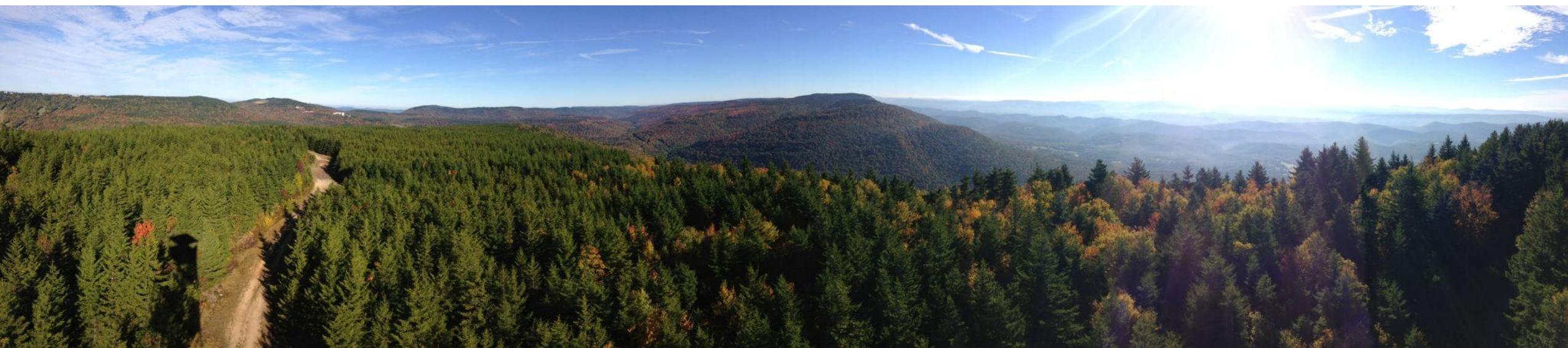
Notice:

Be advised this guidance tool is less strict than thresholds incorporated into the water management plan for Oil and Gas Permits.

Approved water management plans include safety margins to account for uncertainties related to ungaged streams. Safety margins also increase based on the distance between the gage and the potential withdrawal locations.

Plans and Priorities

- Continue to update GIS layers associated with LQU and water resources related data.
- Continue with transition for new LQU database platform.
- Continue to fill section vacancy.
- Continue to collaborate with the WV Stream Gaging Council (member since started in 2005) because our water resource models responsible for answering the questions posed by the Act are dependent on data collected by the USGS.



USGS Streamgaging Network

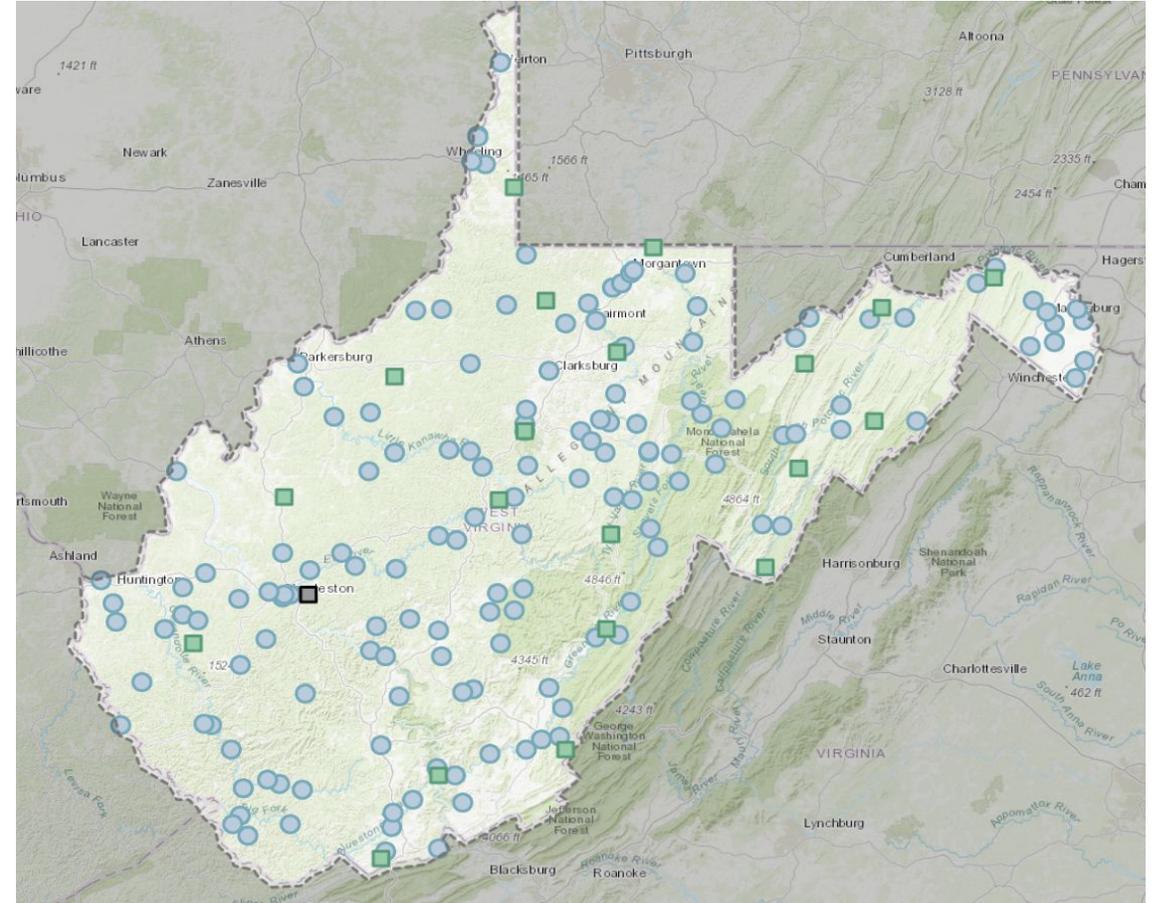
- <https://www.usgs.gov/mission-areas/water-resources/science/usgs-streamgaging-network>
- National experts with over 10,000 gages and 1,800 partners.
- Funded in partnership AKA shared costs = more gages and data for WV.
- Consistent, quality assured data served online-most in near real time.
- Many users with diverse needs:
 - Emergency responders,
 - Water managers,
 - Environmental and transportation agencies,
 - Universities,
 - Utilities,
 - Recreational enthusiasts, and
 - Consulting firms.



The streamgage network is a vital resource for water managers and the public.

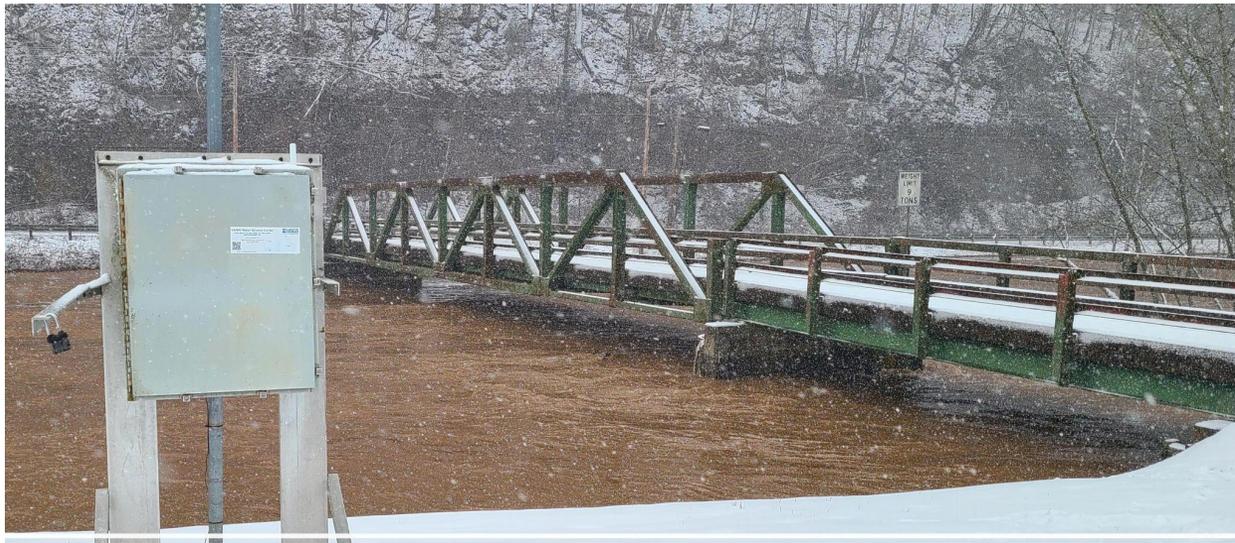
Provides information related to:

- Flood and drought warnings and predictions,
- Recreational use and public safety,
- Pollution control,
- Bridge and highway design,
- Water use and availability, and
- Economic development.



Program Needs:

- Support from the Legislature and all concerned state agencies regarding funding and cost sharing solutions for the 183 stream gages and 19 GW level monitoring wells.
- Stable, appropriate funding with the line item in the annual state budget administered through the WV Emergency Management Division to cover known annual increases related solely to operational costs, enabling the local network to be maintained at least at the current streamgage locations.



WV Streamgaging Network Cost

Fiscal Year	West Virginia	USGS	Other	Total Annual Funding	Percent Annual Increase
2020	\$800,000	\$560,234	\$827,730	\$2,187,964	2.9
2021	\$800,000	\$561,765	\$846,740	\$2,208,505	0.9
2022	\$820,000	\$562,800	\$892,880	\$2,275,680	3.0
2023	\$891,780	\$575,230	\$952,090	\$2,419,100	6.3
2024	\$938,000	\$575,230	\$984,333	\$2,497,563	3.2
2025	~\$965,000	\$575,230	~\$1,033,550	~\$2,573,780	3.1
2026	~\$990,000	\$575,230	~\$1,085,227	~\$2,650,457	3.0



Continue to Use National Resources

- Without state request or additional funding, USGS commonly provides new tools.
- There is also potential to develop more helpful applications upon request.
- WaterWatch WV Dashboard
<https://waterwatch.usgs.gov/index.php?st=wv&id=wwsa4state&full=1&ct=wwsa4state>

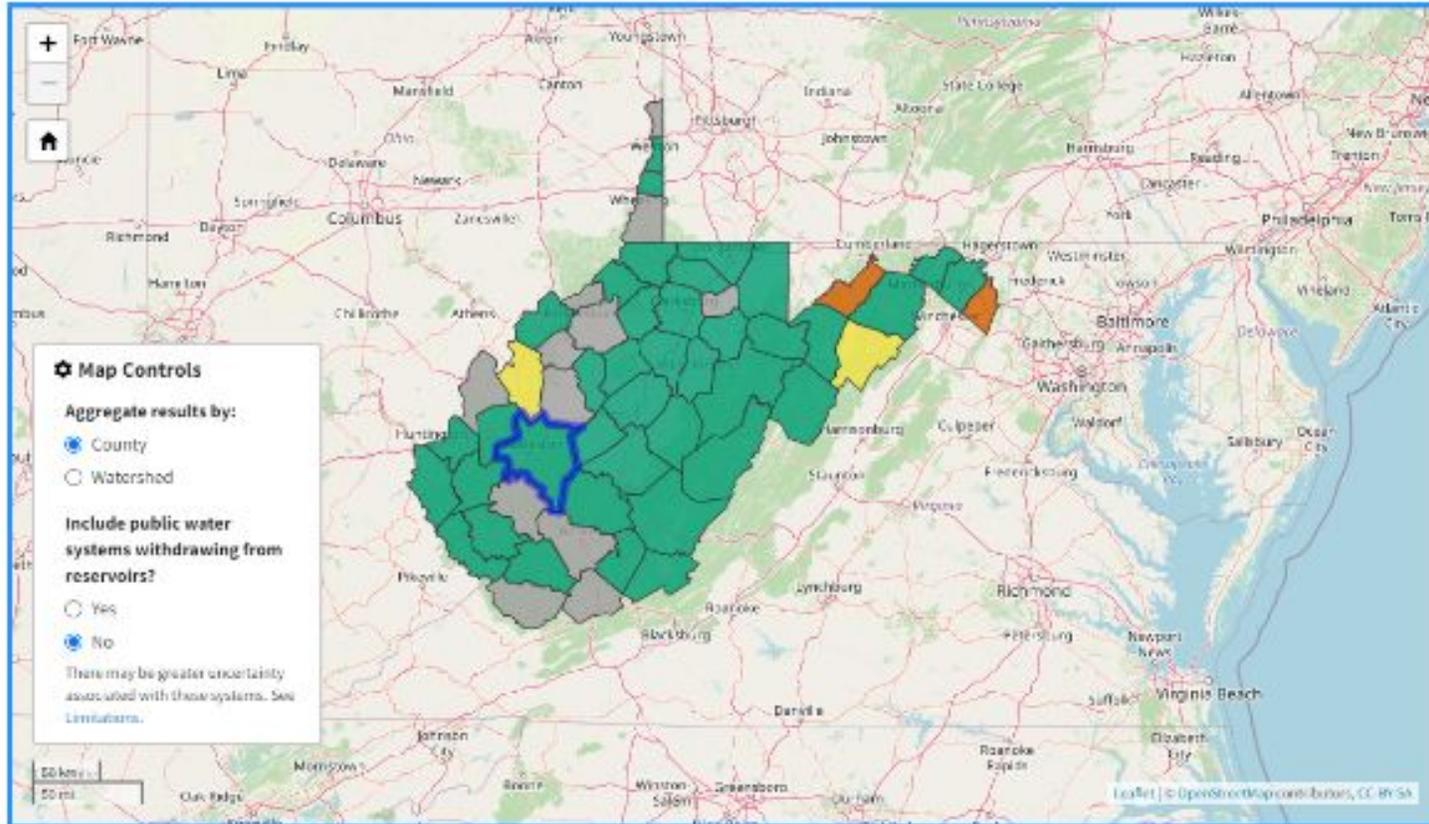
The screenshot displays the USGS WaterWatch website interface. At the top, there is a navigation bar with the USGS logo and the tagline "science for a changing world". Below this, the "WaterWatch" title is prominently displayed. A vertical menu on the left side lists various features: Home, Special Features, Current Streamflow, Flood, Drought, Past Flow/Runoff, Animation, Toolkit, Annual Summaries, Data Services, Additional Information, and About WaterWatch. The main content area is titled "State Dashboard" and includes a dropdown menu for "West Virginia". Two primary map widgets are visible: "Streamflow Conditions Map" and "State Map". The "Streamflow Conditions Map" shows a map of West Virginia with streamflow data points, dated "Tuesday, September 01, 2023 13:08:13". The "State Map" shows streamgages across the state, with a legend and a "Map data download" link. Other visible widgets include "Area-based Streamflow Map" and "Streamflow Summary".

WV Public Water System Drought Risk

<https://www.usgs.gov/tools/interactive-map-west-virginia-public-water-system-drought-risk>

West Virginia Public Water System Drought Risk

Map Legend Data Table About



Map Information Panel

Updates hourly. Last updated: 14:00 UTC 2023-10-20.

Use the Data Table to see the status of all public water systems or to download the data. See the User Guide for additional details.

Kanawha County Public Water System Surface Water Withdrawals

4 public water system(s) considered in this county, information for each system is detailed below.

Public water system: Intake on ELK RIVER 19325151

Indicator status: ■ < 10% of estimated streamflow withdrawn from source waters

Estimated streamflow withdrawn: 4.03% (based on a October 75th quantile withdrawal rate of 42.7575 cubic feet per second)

Estimated streamflow for reach associated with intake: 1060.14 cubic feet per second (based on National Water Model short-range forecast)

Do the source waters have on-stream storage? No

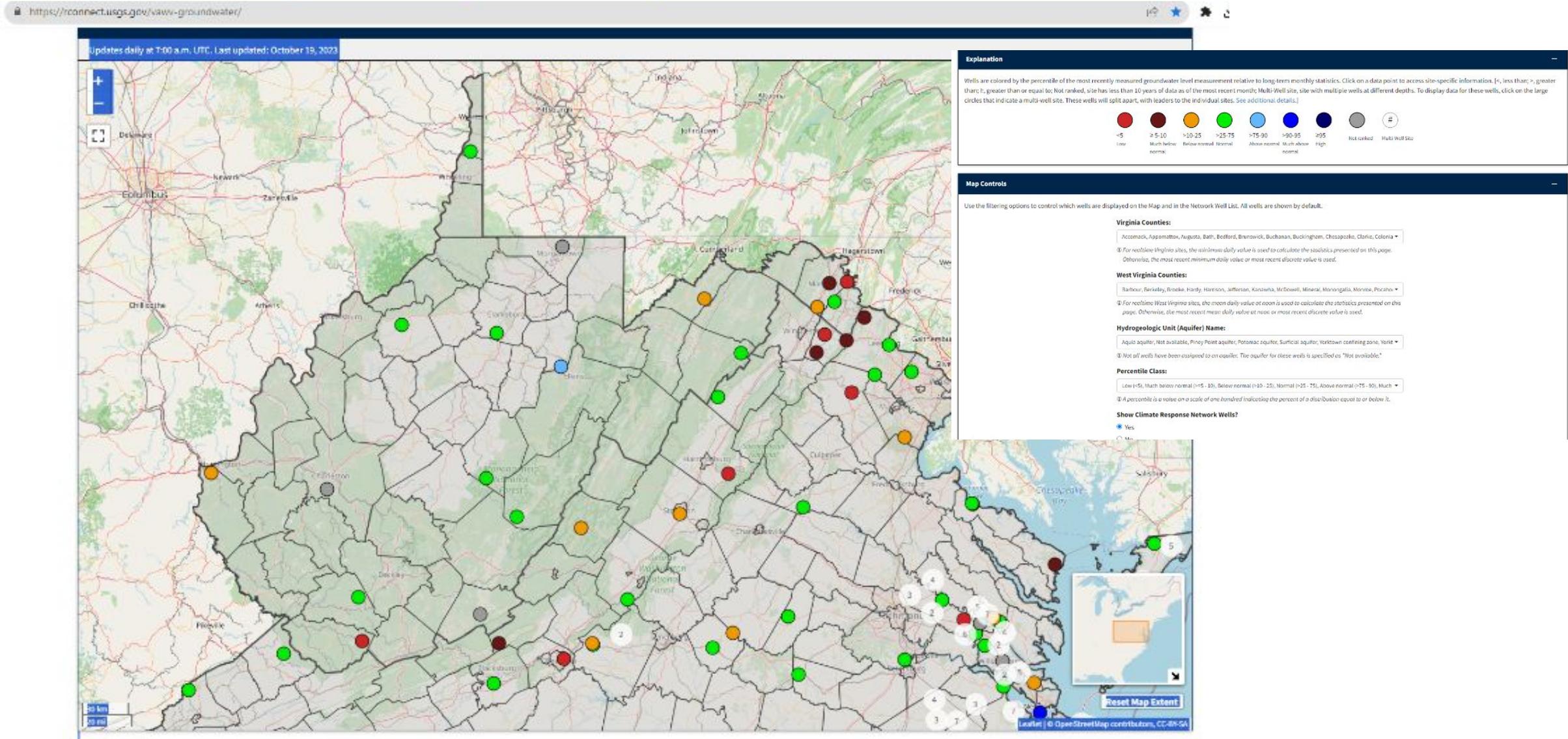
Do the source waters have regulated flow? Yes (minimum release: 75 cubic feet per second at Sutton Lake Dam)

Explanation

Boundaries (counties or watersheds) are colored by the percent of estimated streamflow of the source waters withdrawn by public water systems within each boundary. The percent of estimated streamflow withdrawn is calculated using the 75th quantile of monthly withdrawal rates for each public water system and National Water Model forecasted streamflows. Use the **Map Controls** to update information shown on the map. Boundaries with multiple public water systems are colored by the classification of the system withdrawing the greatest percent of streamflow. Click on a

VA and WV Groundwater Levels and Trends

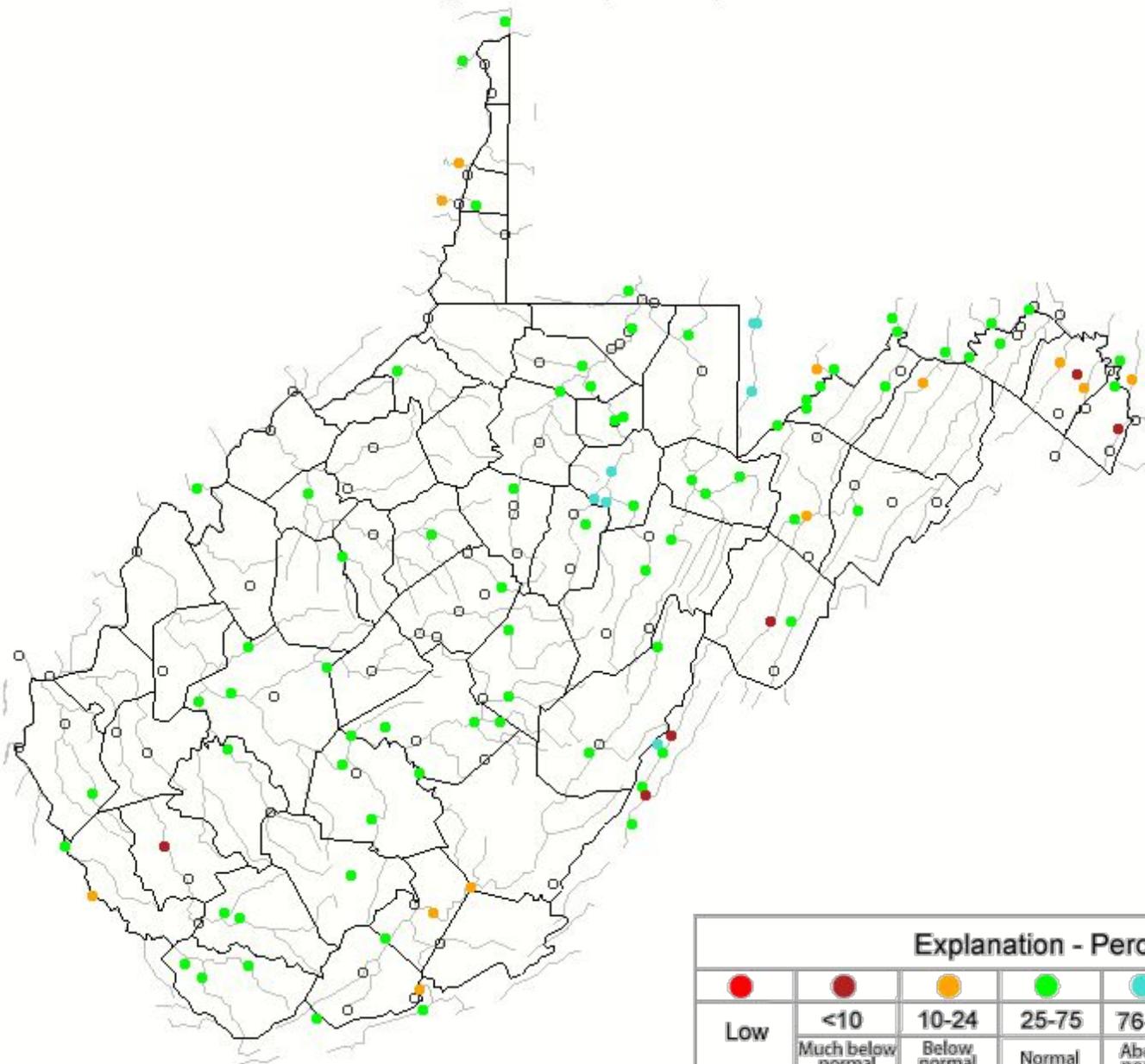
<https://rconnect.usgs.gov/vawv-groundwater/>



StreamStats v4.17.0

<https://streamstats.usgs.gov/ss/>





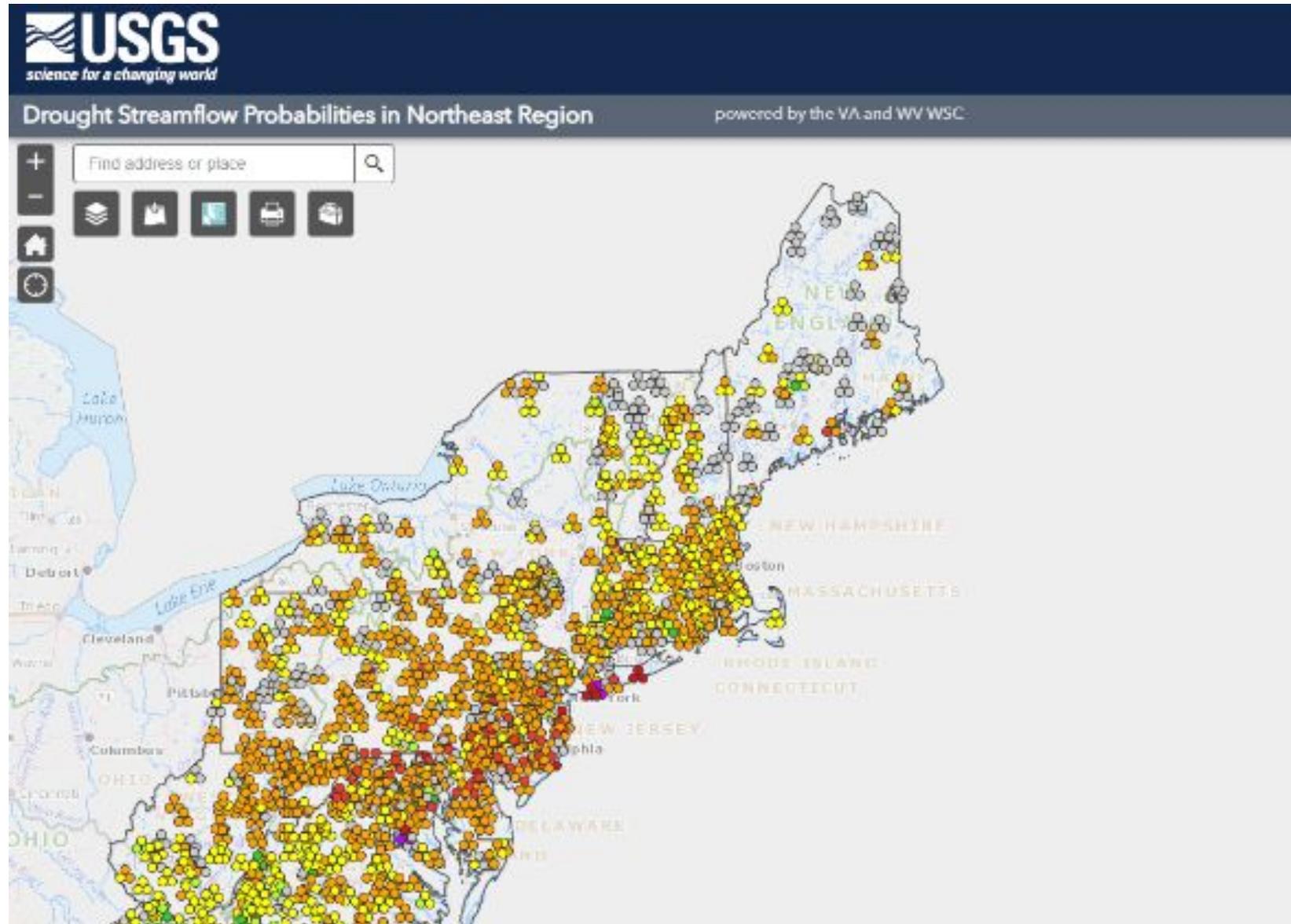
Map of real-time streamflow compared to historical streamflow for the day of the year (West Virginia)

https://waterwatch.usgs.gov/index.php?r=wv&id=ww_curr_ent

Explanation - Percentile classes							
Low	<10	10-24	25-75	76-90	>90	High	Not-ranked
	Much below normal	Below normal	Normal	Above normal	Much above normal		

Northeast Region Drought Streamflow Probabilities

<https://vawv-gis.usgs.gov/webapps/drought-ne/>



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