

2024 Annual Water Resources Report

Joint Legislative Oversight Commission on State Water Resources



Prepared by the

West Virginia Department of Environmental Protection
Division of Water & Waste Management
Water Use Program

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Emiko Hori, ERS 3

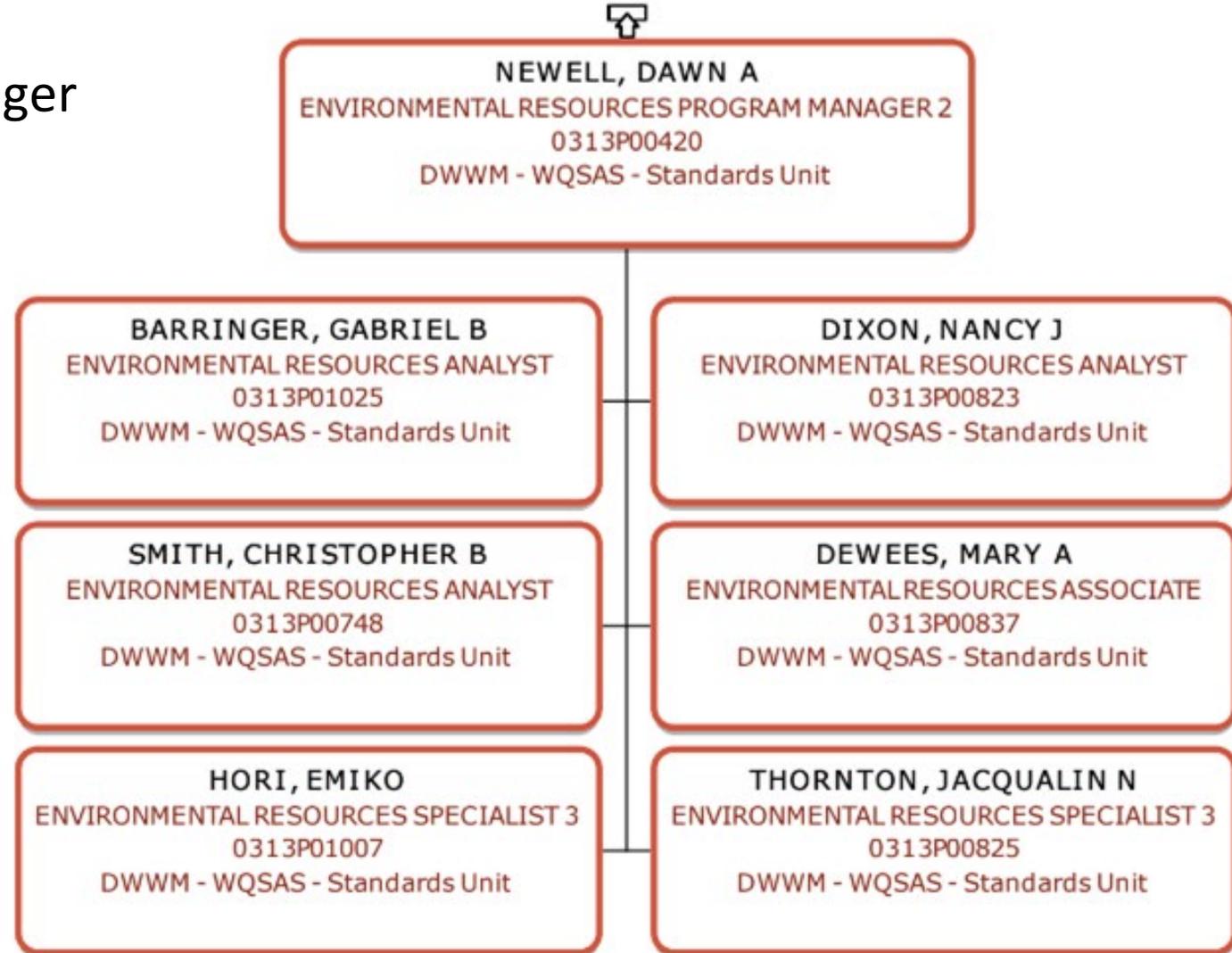
Large Quantity Use

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Water Management Plans

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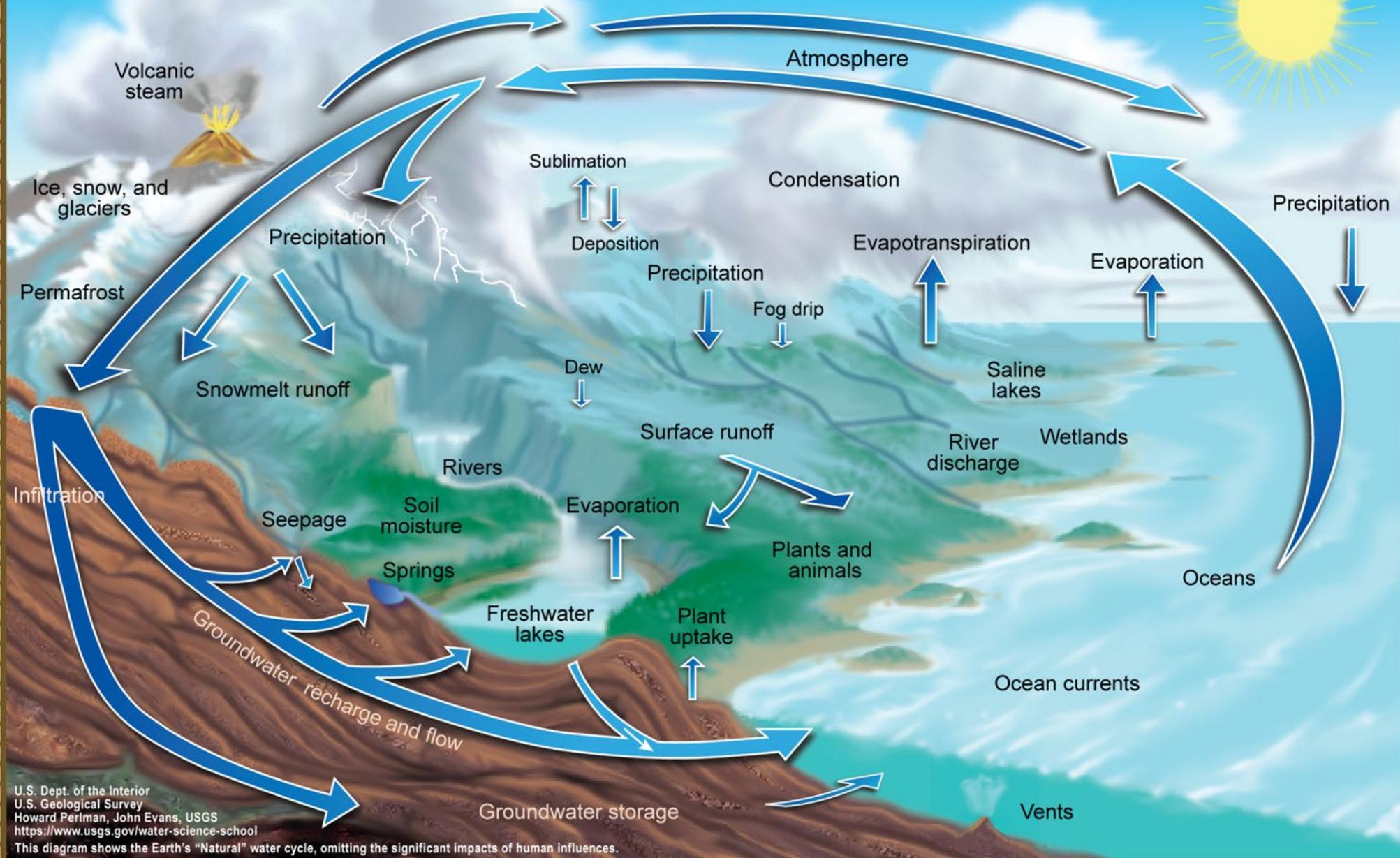
Presentation Content

- Water Overview
- 2023 Data
- Recent Events
- Resources
- Research
- Moving Forward
- Q&A



Importance of Water

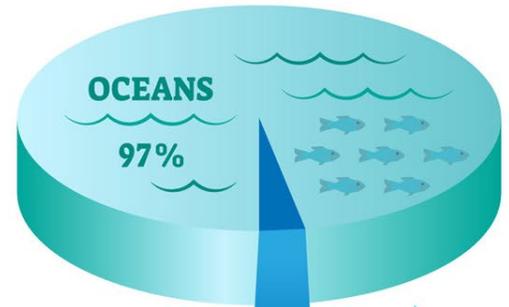
The Water Cycle



EARTH'S WATER

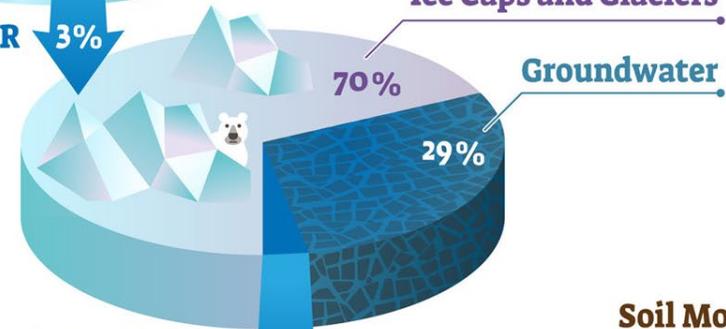


WATER SUPPLY
SUMMED UP



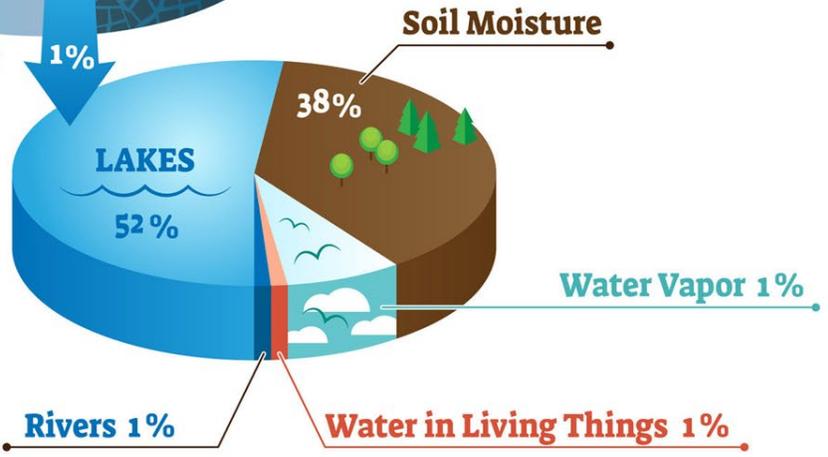
FRESHWATER

3%

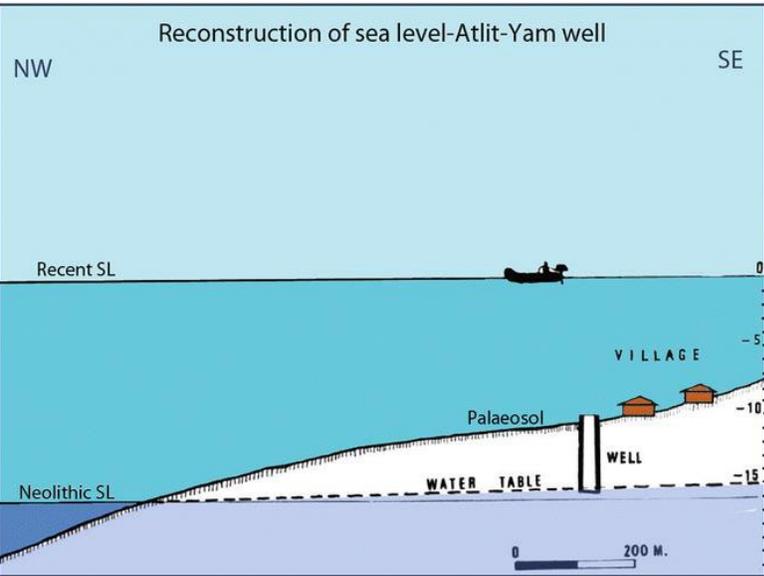


EASILY ACCESSIBLE
FRESHWATER

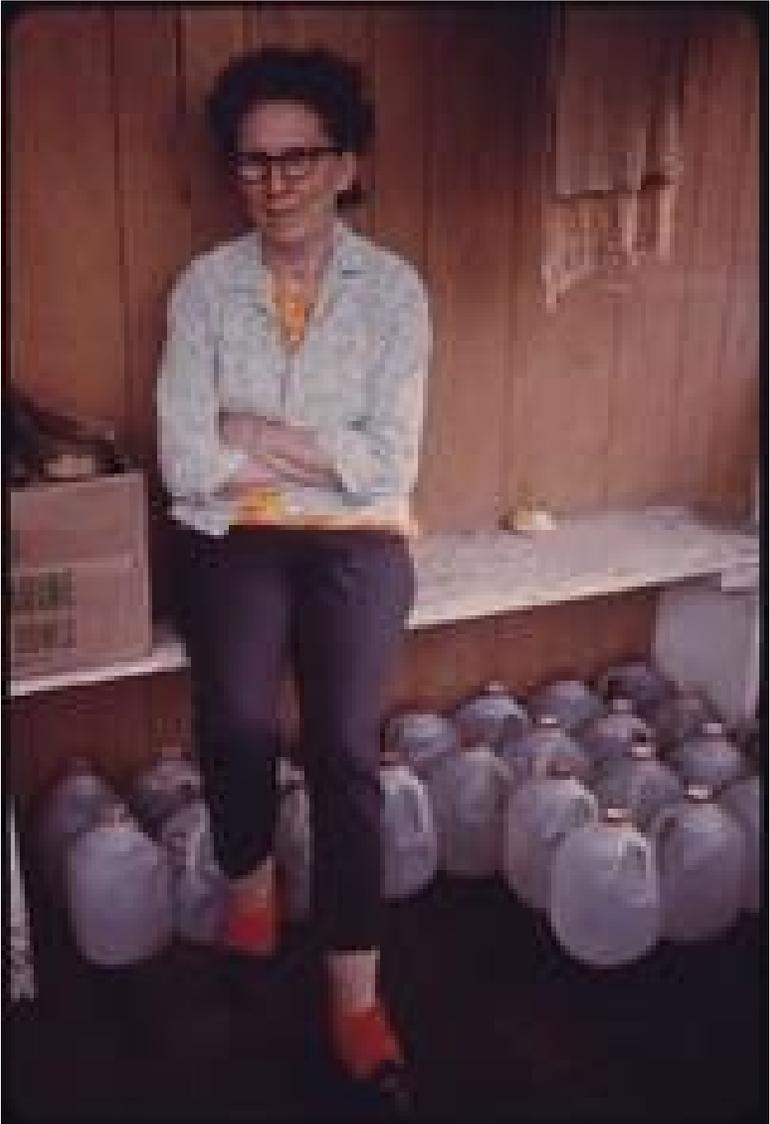
1%



The story of mankind will always have a chapter on water...



DOCUMERICA collection



Water Availability in the News

COUNCIL ON FOREIGN RELATIONS

Foreign Affairs CFR Education Newsletters

China RealEcon Topics Regions Explainers Research & Analysis Communities Events



Backgrounder

Water Stress: A Global Problem That's Getting Worse

Water scarcity threatens the health and development of communities around the globe. Climate change is intensifying the problem, pushing governments to find more innovative, collaborative ways to address water stress.

New Delhi residents fill containers with drinking water from a municipal tanker in June 2018. Adnan Abidi/Reuters

WRITTEN BY
Claire Klobucista and Kall Robinson

UPDATED
Last updated April 3, 2023 10:35 am (EST)

[f](#) [x](#) [t](#) [r](#)

America is in a water crisis, but help is on the way

9/17/2024

3

6 MIN READ

Water Availability in WV

NEWS

Nicholas County declares state of emergency over low water supply

By MetroNews Staff

September 17, 2024 - 2:29 pm



Richwood's main water supply typically from the North Fork of Cherry River which is dangerously low.

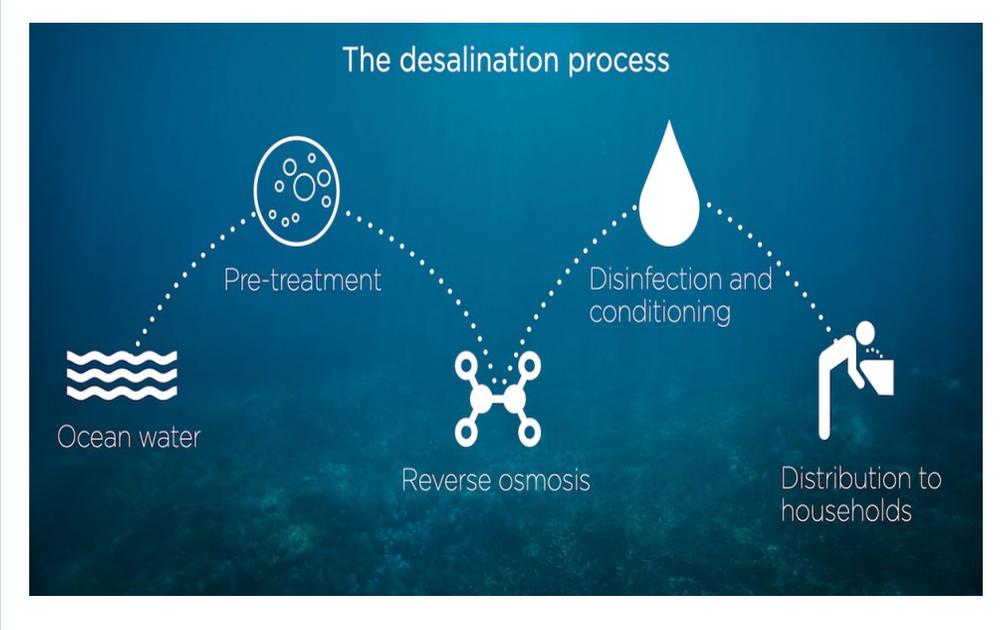
PHOTO: WCHS TV

- How “threatened” are “our” water resources?
- How “optimal” is their use?
- “We” continue to define “adequacy & sustainability.”

Water Options



Conservation



Desalination



Recycling

WV CODE: §22-26-3.

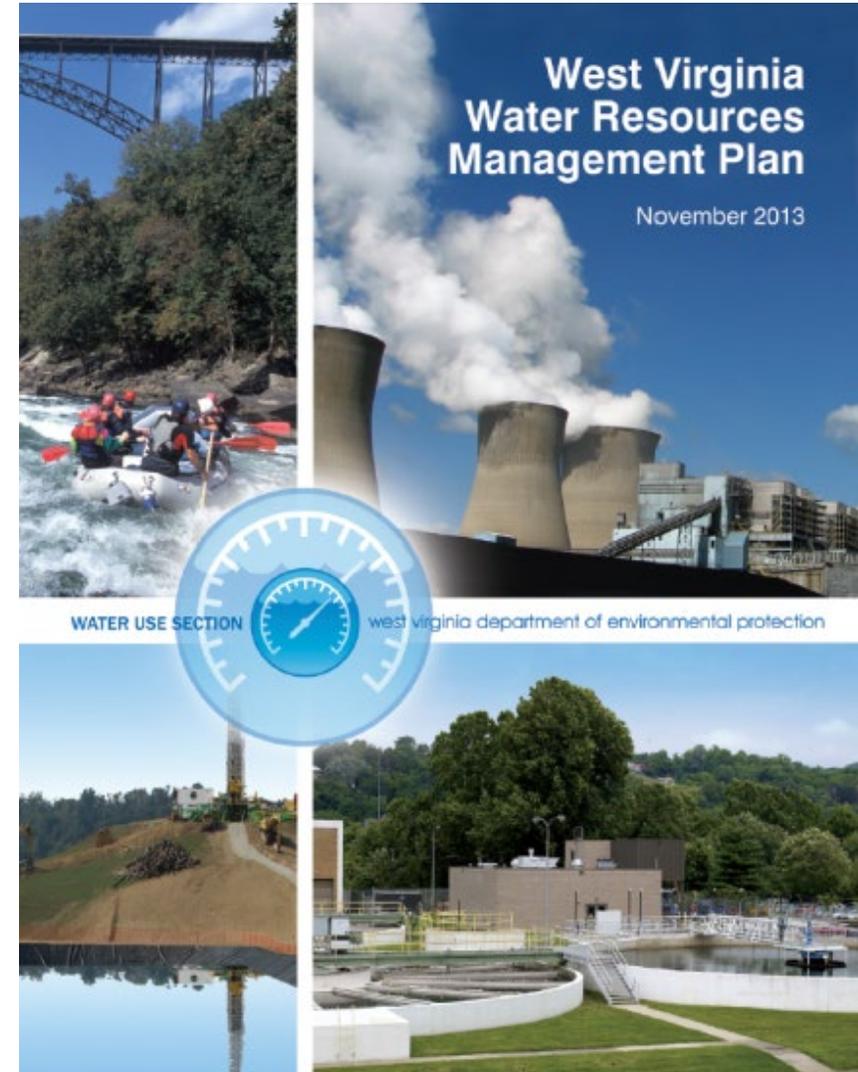
(a) The waters of the State of West Virginia are claimed as valuable public natural resources held by the state for the use and benefit of its citizens. The state shall manage and protect its waters effectively for present and future use and enjoyment and for the protection of the environment.

Therefore, it is necessary for the state to determine the nature and extent of its water resources, the quantity of water being withdrawn or otherwise used and the nature of the withdrawals or other uses: Provided, That no provisions of this article may be construed to amend or limit any other rights and remedies created by statute or common law in existence on the date of the enactment of this article.



Water Resources Management Overview

- W. Va. Code §22-26 originally passed in 2004.
- Senate Bill 641 renamed it the Water Resources Protection & Management Act in 2008.
- WVDEP Water Use Section created in 2008.
- WV Water Resources Management Plan adopted in 2014.
- This presentation of the annual report is in accordance with W. Va. Code §22-26-8(e).



How abundant are freshwater resources in WV?

- It's the foundation of healthy ecosystems, economies & communities.
- It's security defined as capability to safeguard sustainable access to adequate quantities of acceptable quality.
- Water resources accounting furthers sustainable water resources management policies & practices.
- WV is presumed to be water secure - Challenged in 2024 drought.
- Must look at water systems as coupled human-natural systems.
 - Anthropogenic & climatic factors impact the future water availability.

2023 Data & Recent Events

1895-2023 Water Resources Availability

2019
average rainfall
w/dry periods 48"

2020
slightly higher than
average rainfall 54"

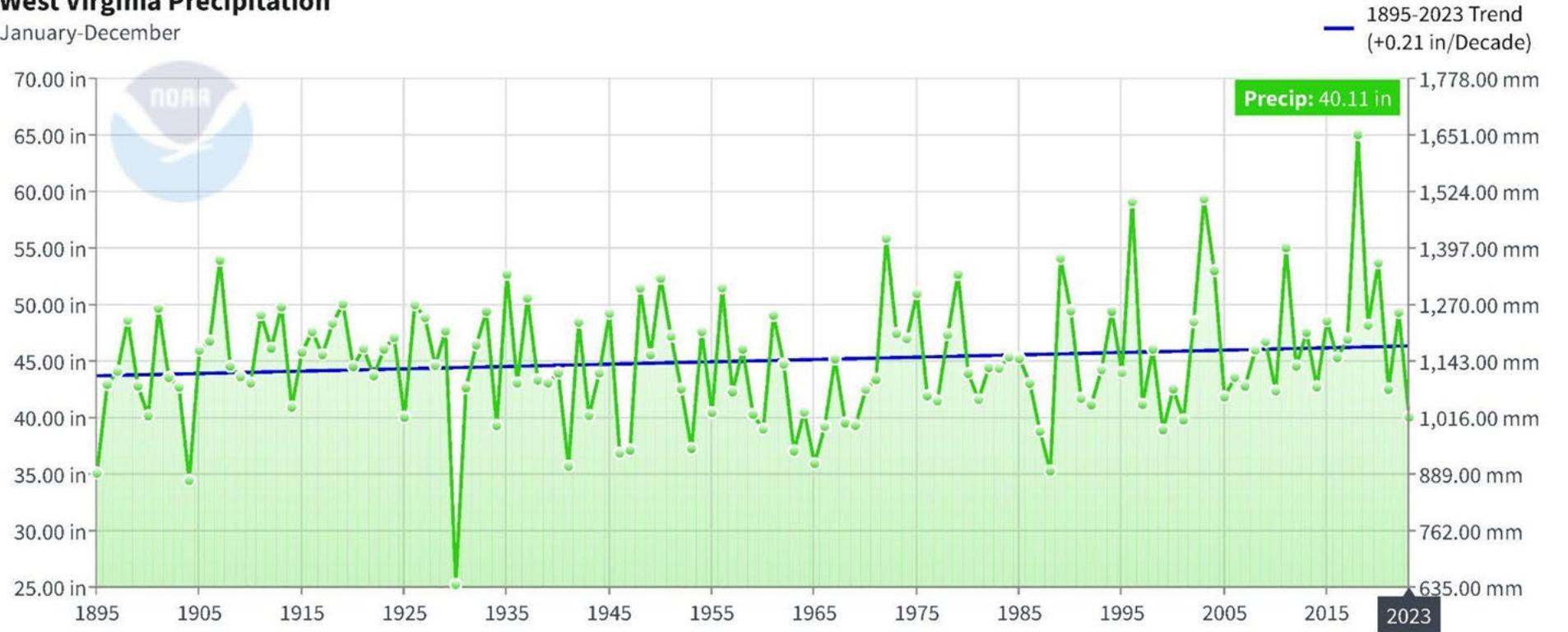
2021
slightly lower than
average rainfall 43"

2022 slightly higher
than average rainfall
49"

2023 lower than
average rainfall 40"

West Virginia Precipitation

January-December



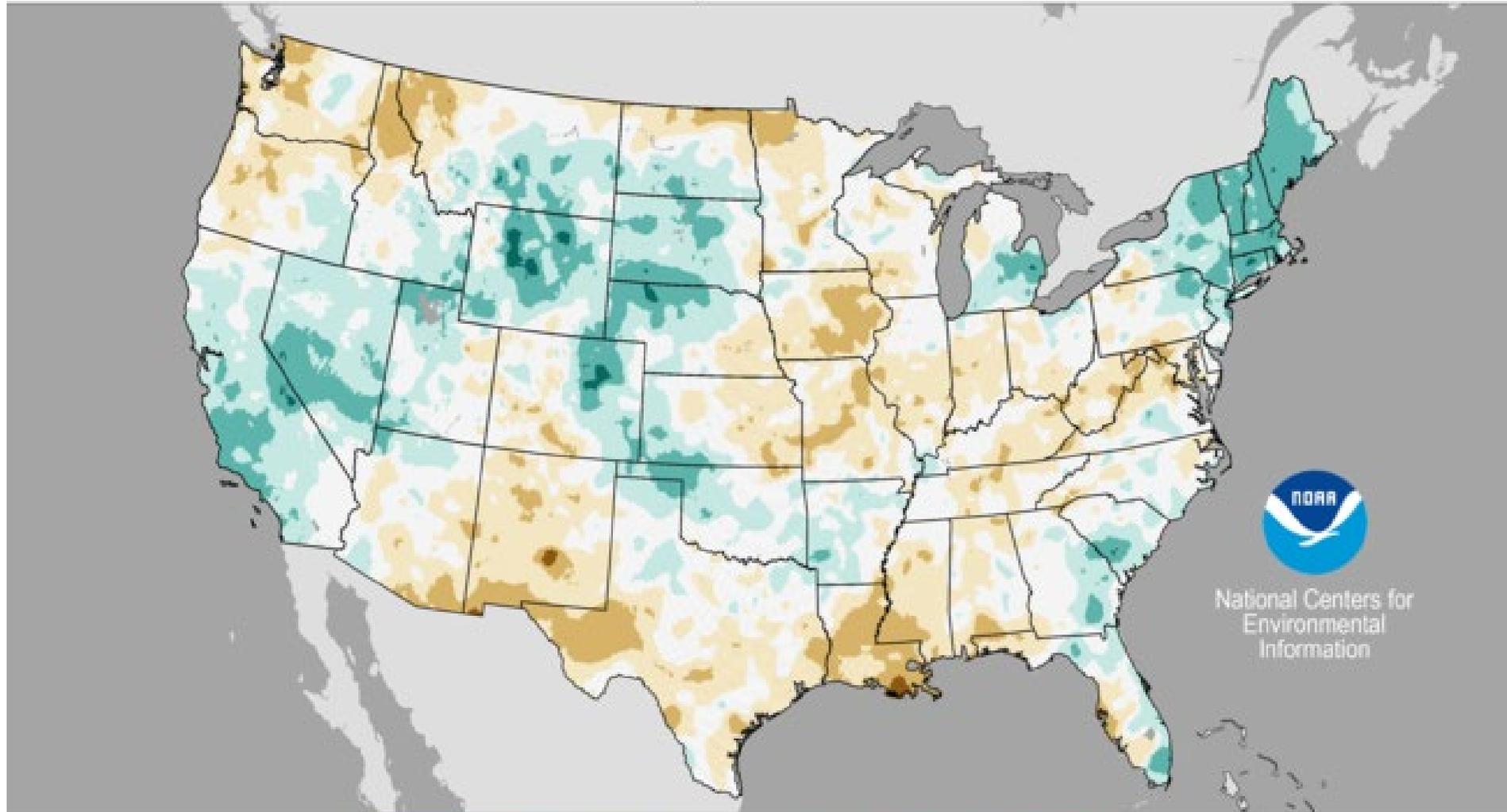
Powered by ZingChart

WV's annual precipitation from 1895 – 2023 (from [National Oceanic and Atmospheric Administration](https://www.noaa.gov/)).

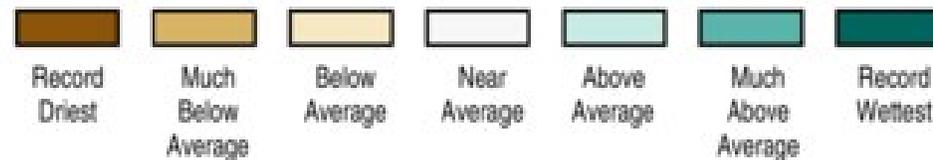
Total Precipitation Percentiles

January–December 2023

Ranking Period: 1895–2023



National Centers for
Environmental
Information



<https://www.ncei.noaa.gov/news/national-climate-202312>

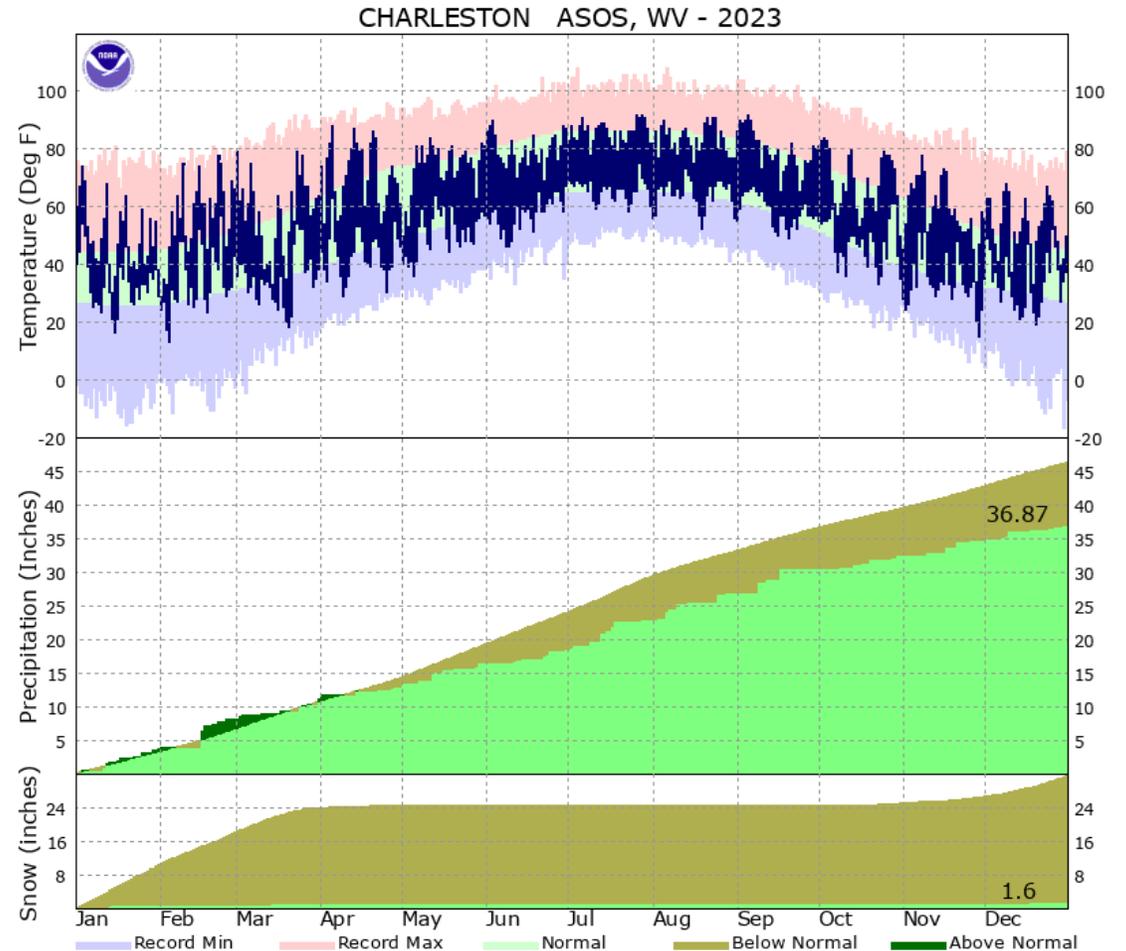
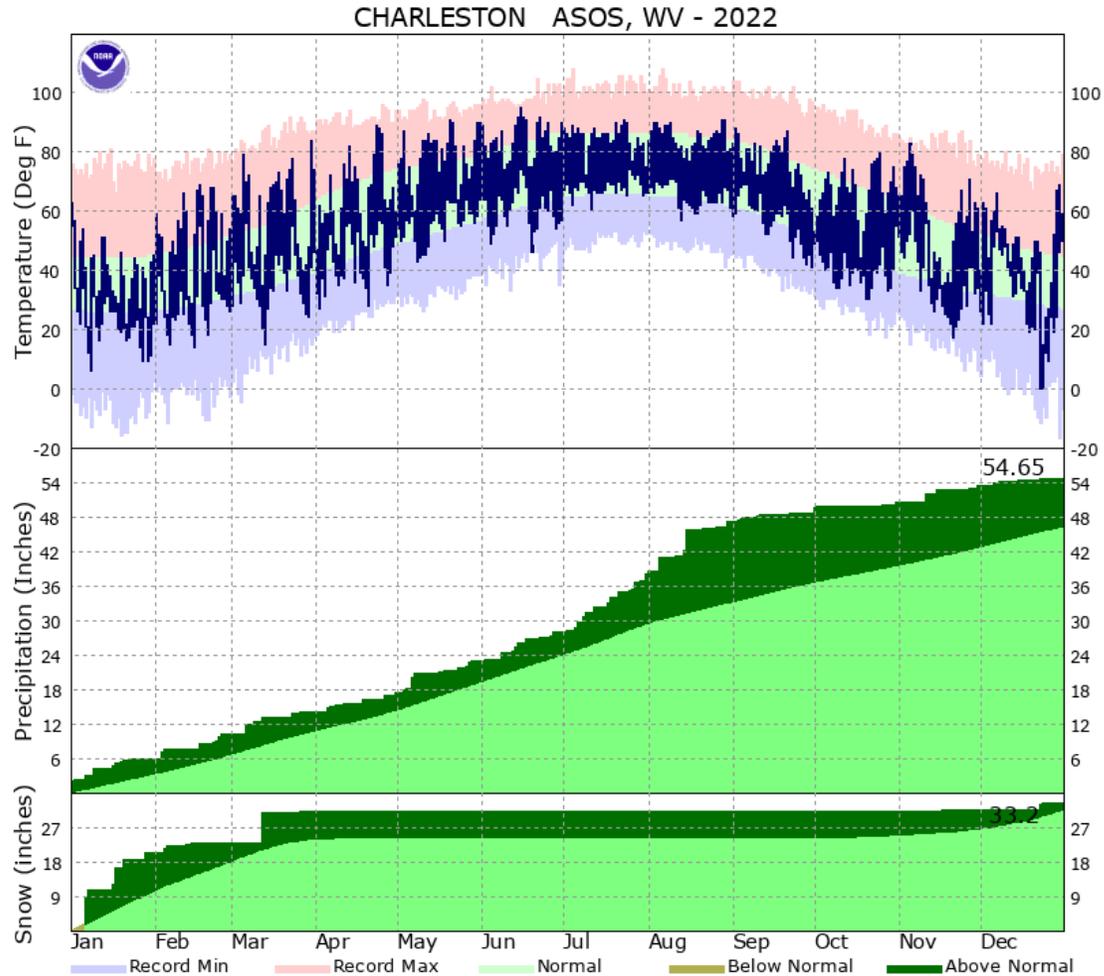
Created: Fri Jan 05 2024

Data Source: nClimGrid

2023 Water Resources Availability - Precip in Charleston

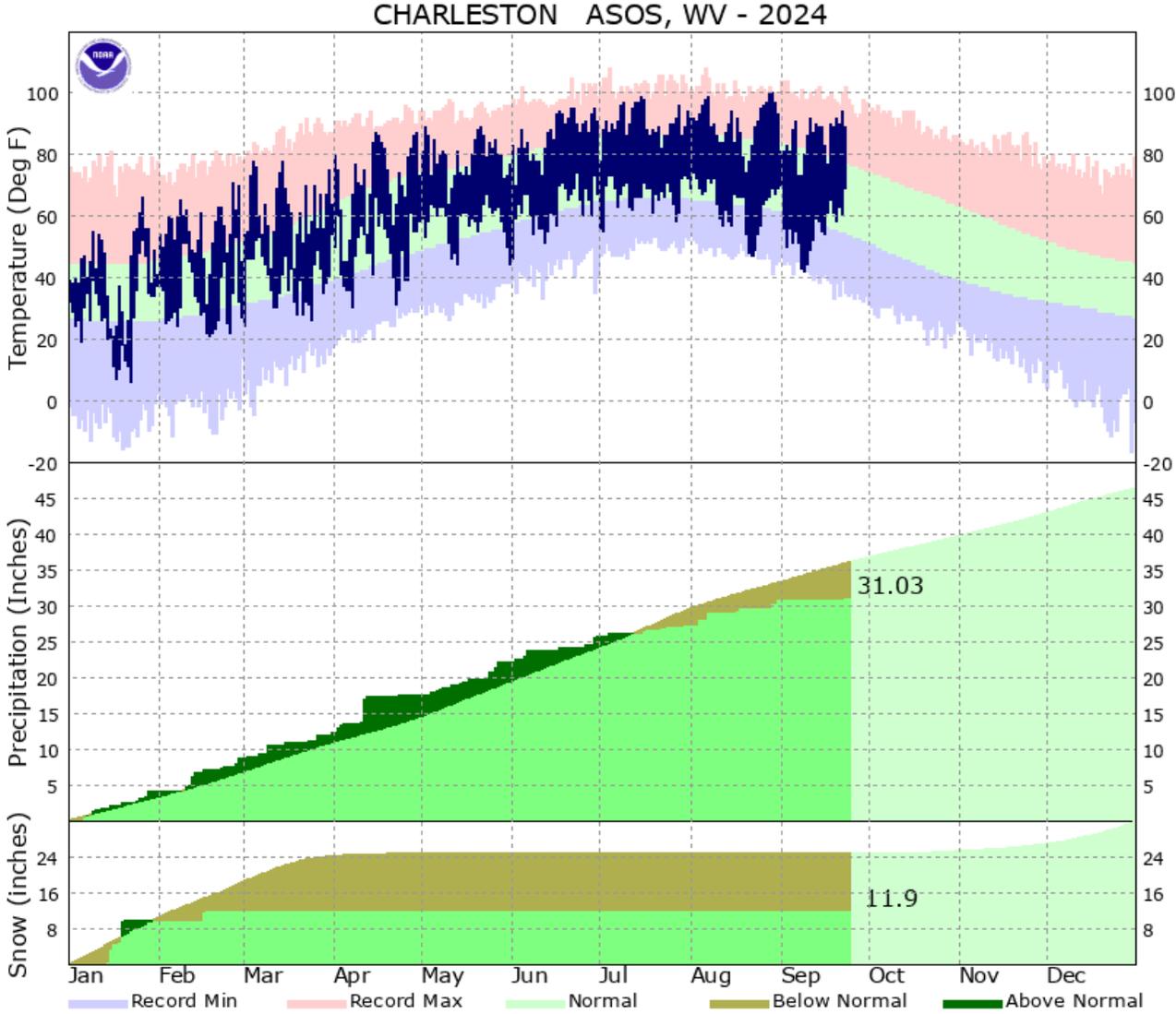
2022 - Above Normal

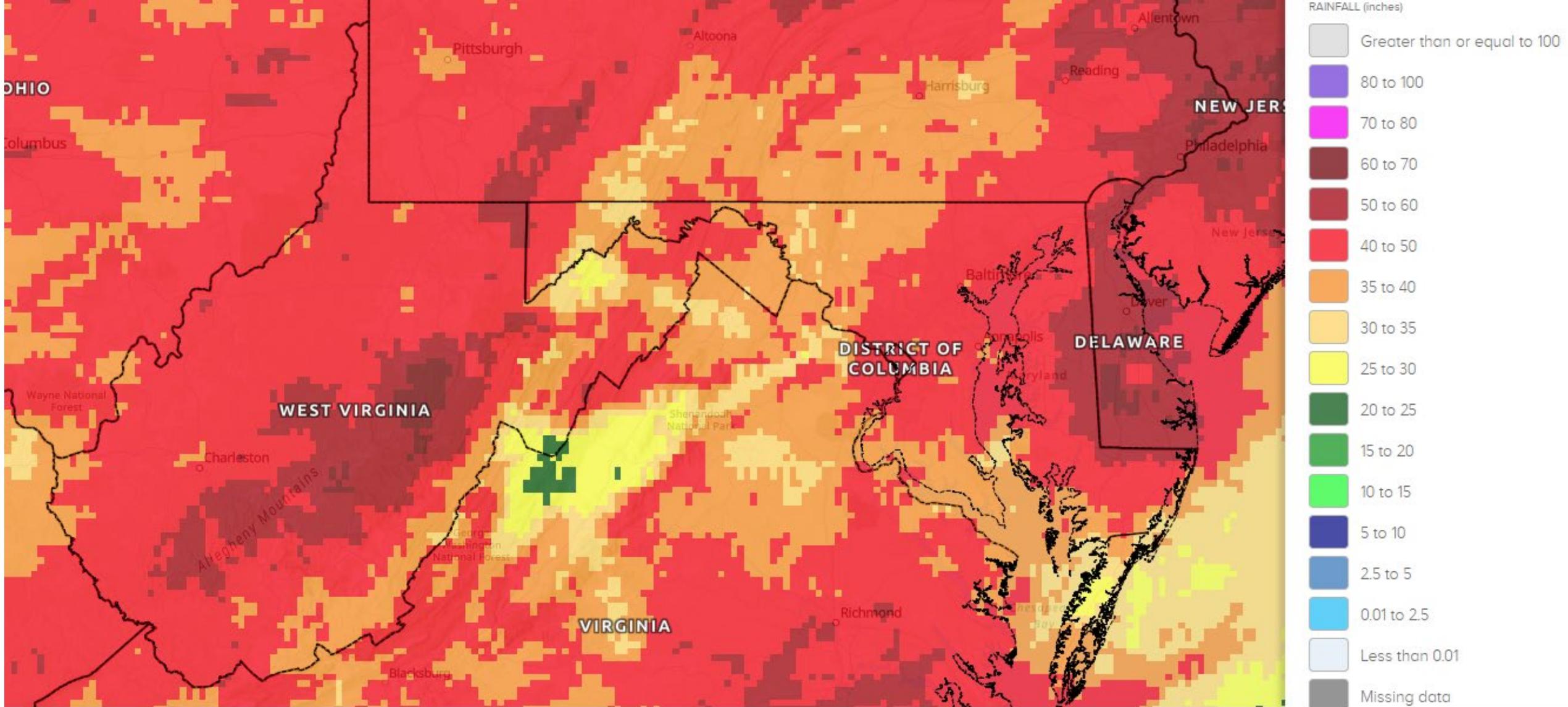
vs. 2023 - Below normal precipitation



Climate data for Charleston, WV from January – December 2023 (from [National Weather Service](https://www.weather.gov)).

2024 Water Resources Availability - Precip in Charleston



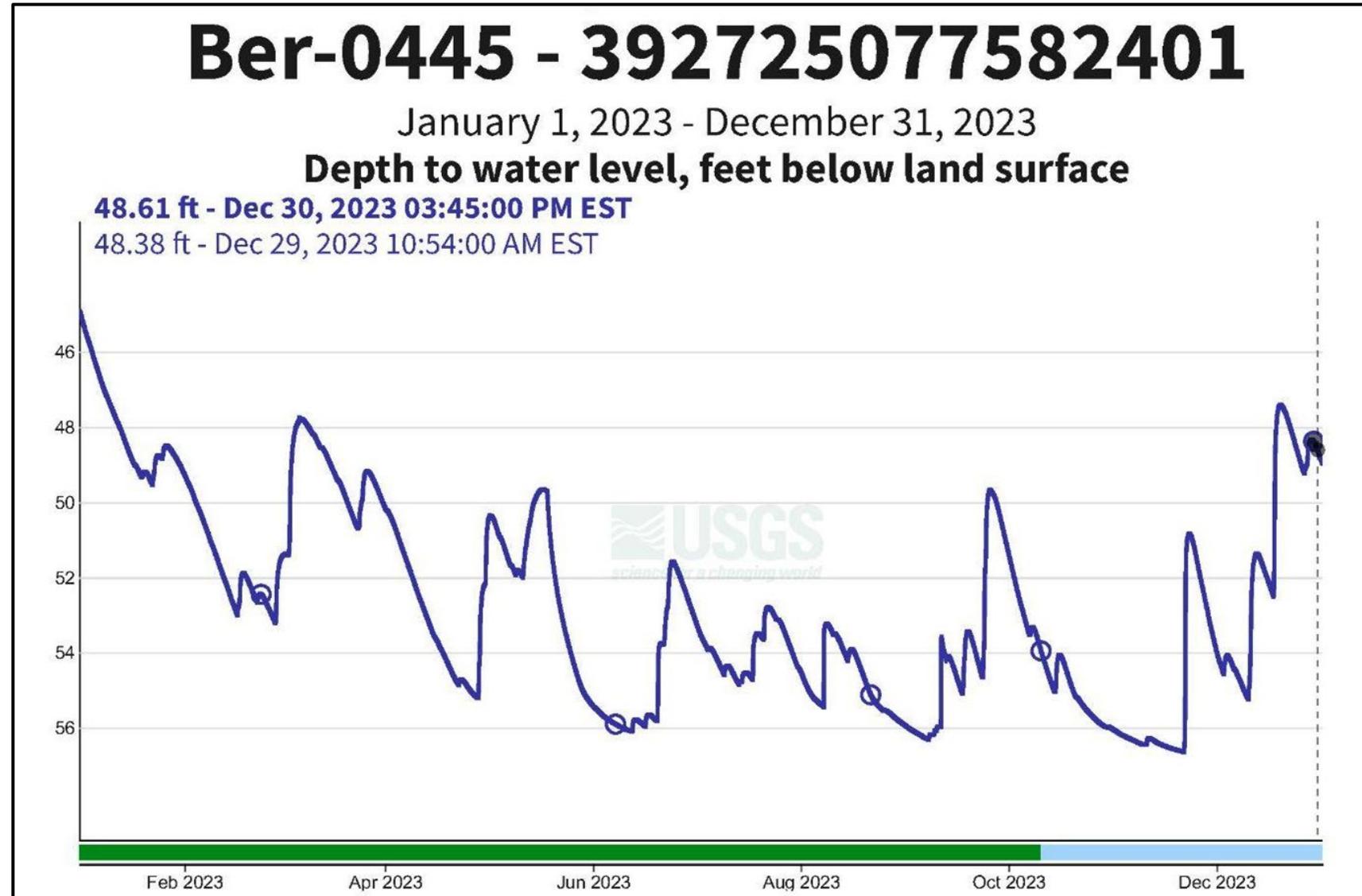


Observed 2023 Precipitation
(from [National Weather Service](#))

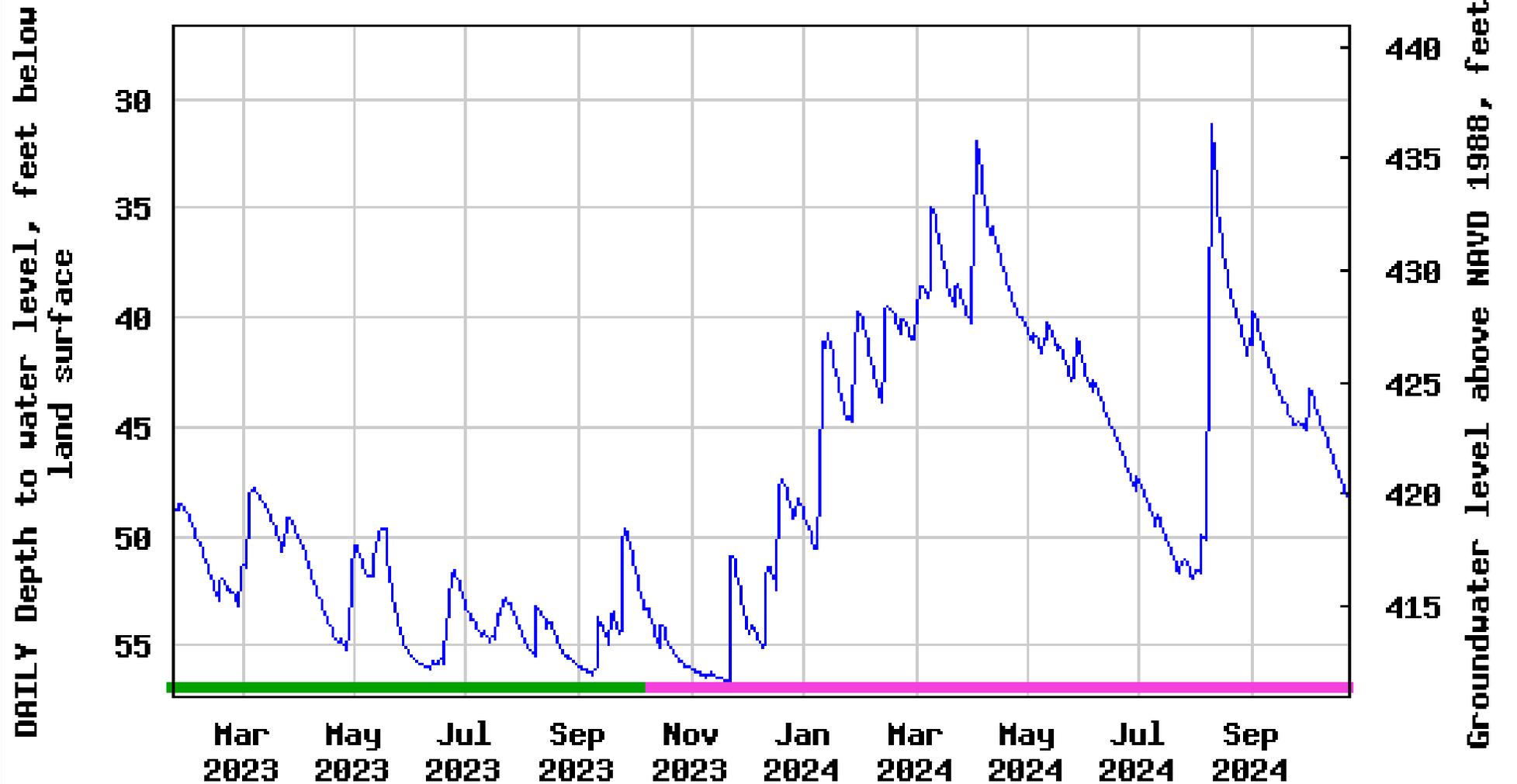
2023 Water Resources Availability - Martinsburg Well

GW levels:

- High of 44.92 (January 1)
- Low of 56.64 (November 21)



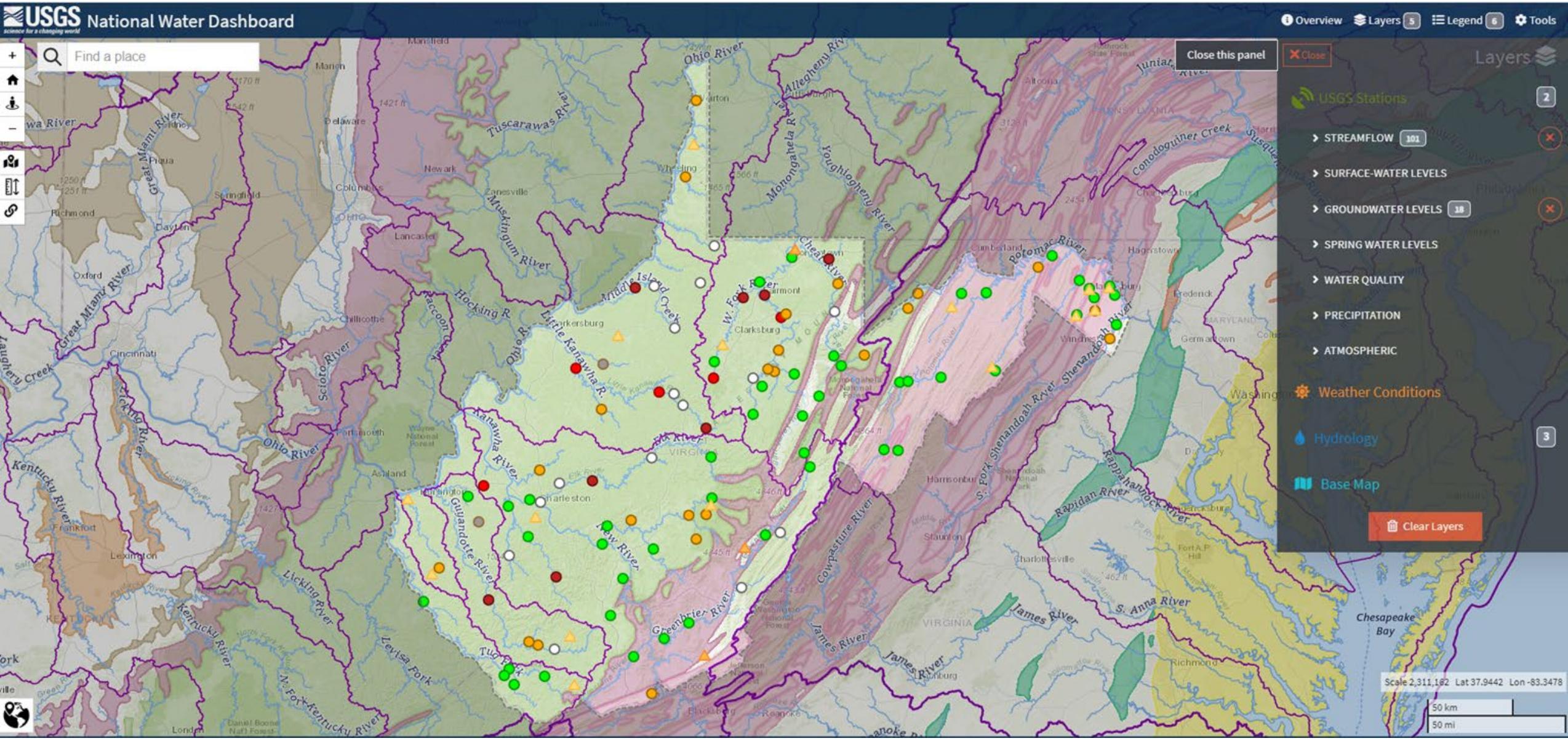
USGS 392725077582401 Ber-0445



- Daily observation at noon depth to water level
- Period of approved data
- Period of provisional data

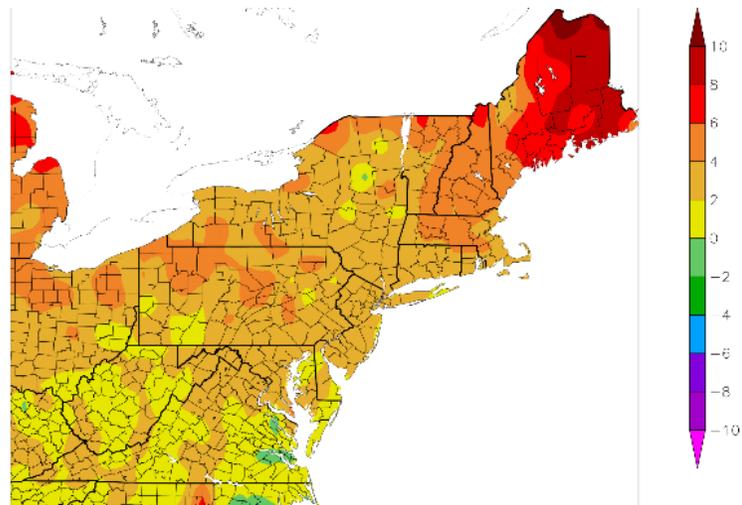
2024 Drought Impacts Martinsburg Well Levels

<https://dashboard.waterdata.usgs.gov/app/nwd/en/>



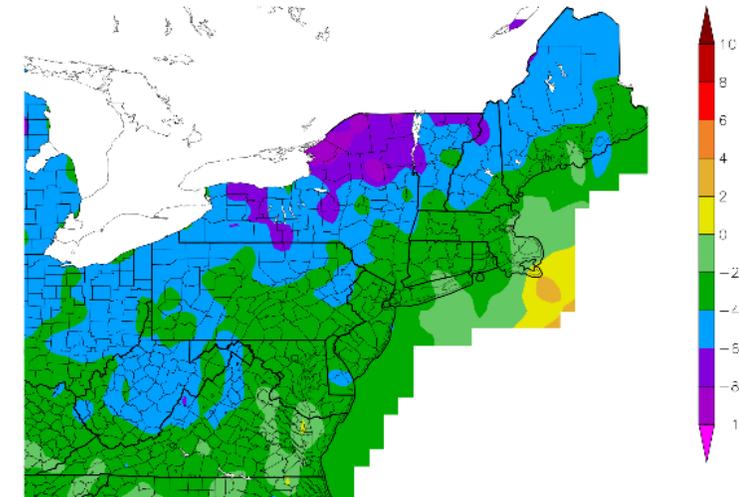
Departure from normal temperature in WV for January 2021-2024
(from [Northeast Regional Climate Center](#)).

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



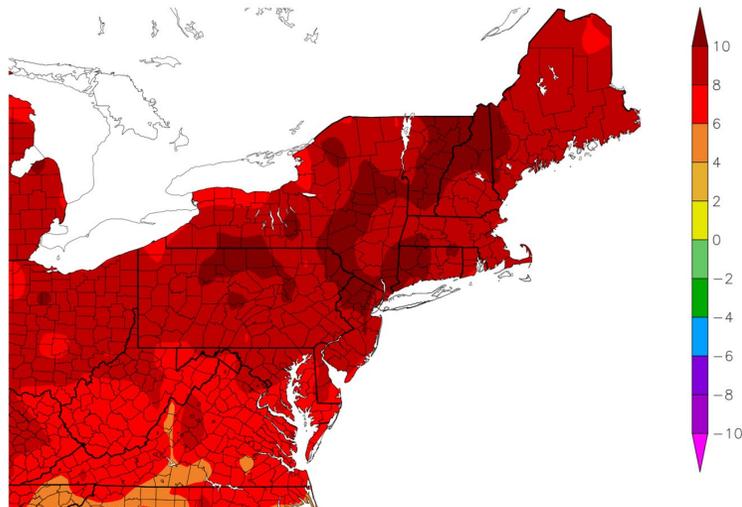
Generated 2/20/2021 at HPRCC using provisional data. NOAA Regional Climate Centers

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



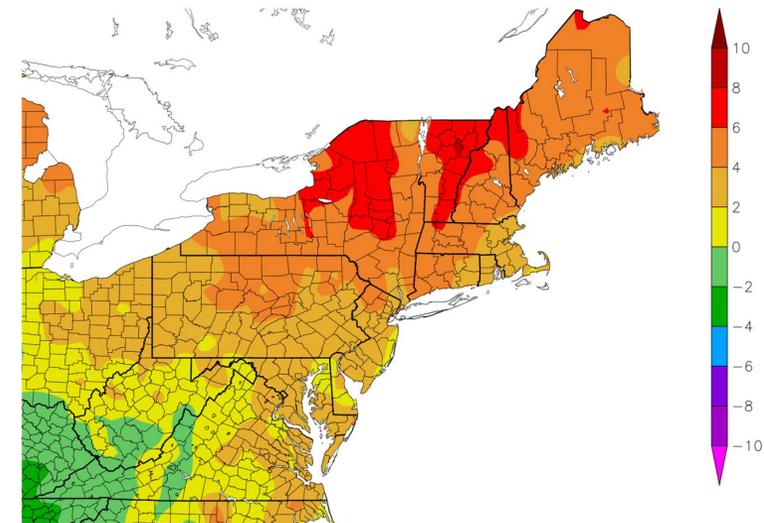
Generated 3/1/2022 at HPRCC using provisional data. NOAA Regional Climate Centers

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



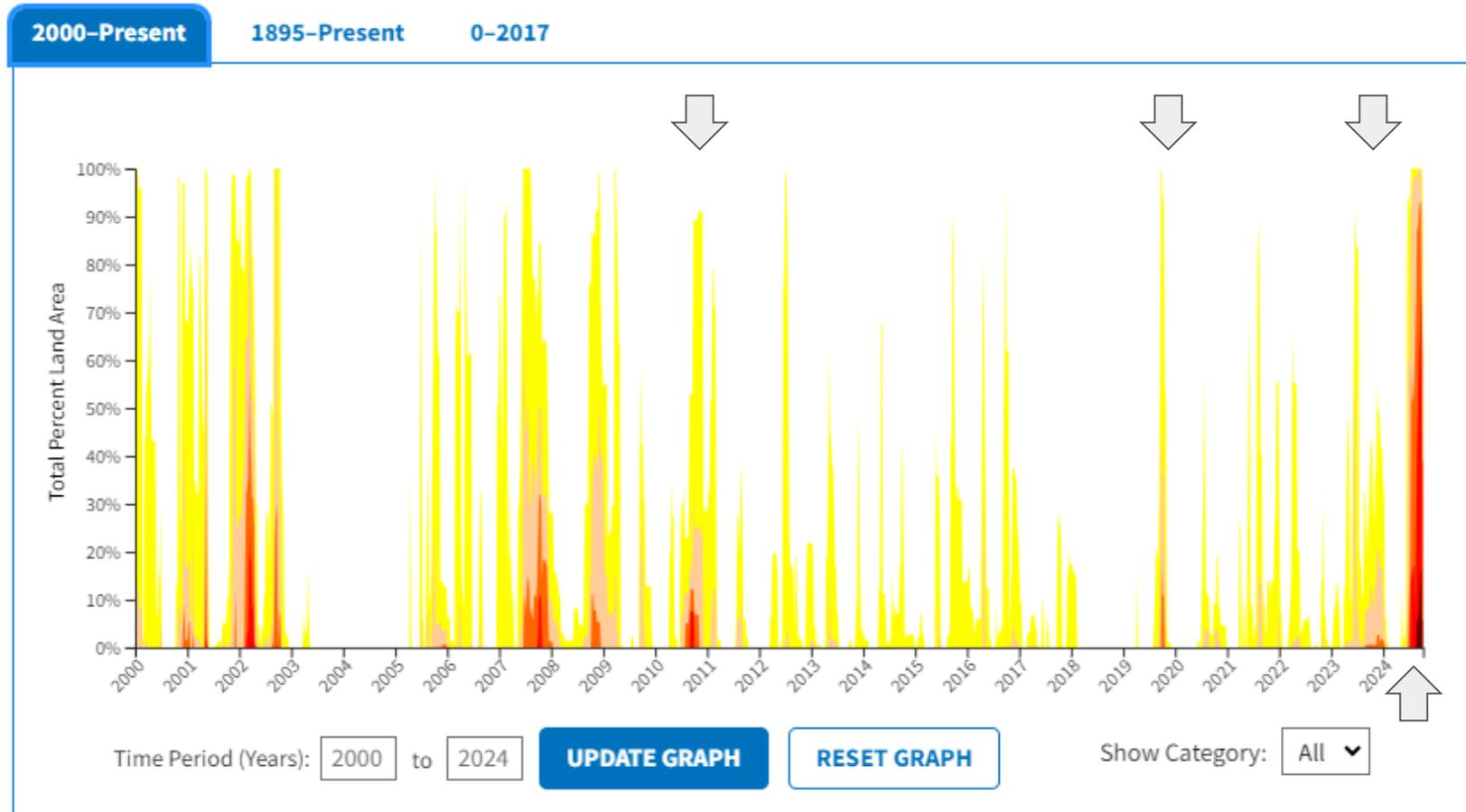
Generated 2/20/2023 at HPRCC using provisional data. NOAA Regional Climate Centers

Departure from Normal Temperature (F)
1/1/2024 – 1/31/2024



Generated 2/20/2024 at HPRCC using provisional data. NOAA Regional Climate Centers

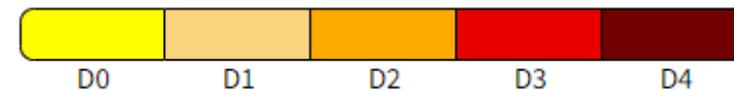
2000-2024 Drought Conditions in WV



The U.S. Drought Monitor (2000–present) depicts the location and intensity of drought across the country. Every Thursday, authors from NOAA, USDA, and the National Drought Mitigation Center produce a new map based on their assessments of the best available data and input from local observers. The map uses five categories: Abnormally Dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought (D1–D4). [Learn more.](#)

Legend

(from [US Drought Monitor](#))



Majority of 2023 experienced drought (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.

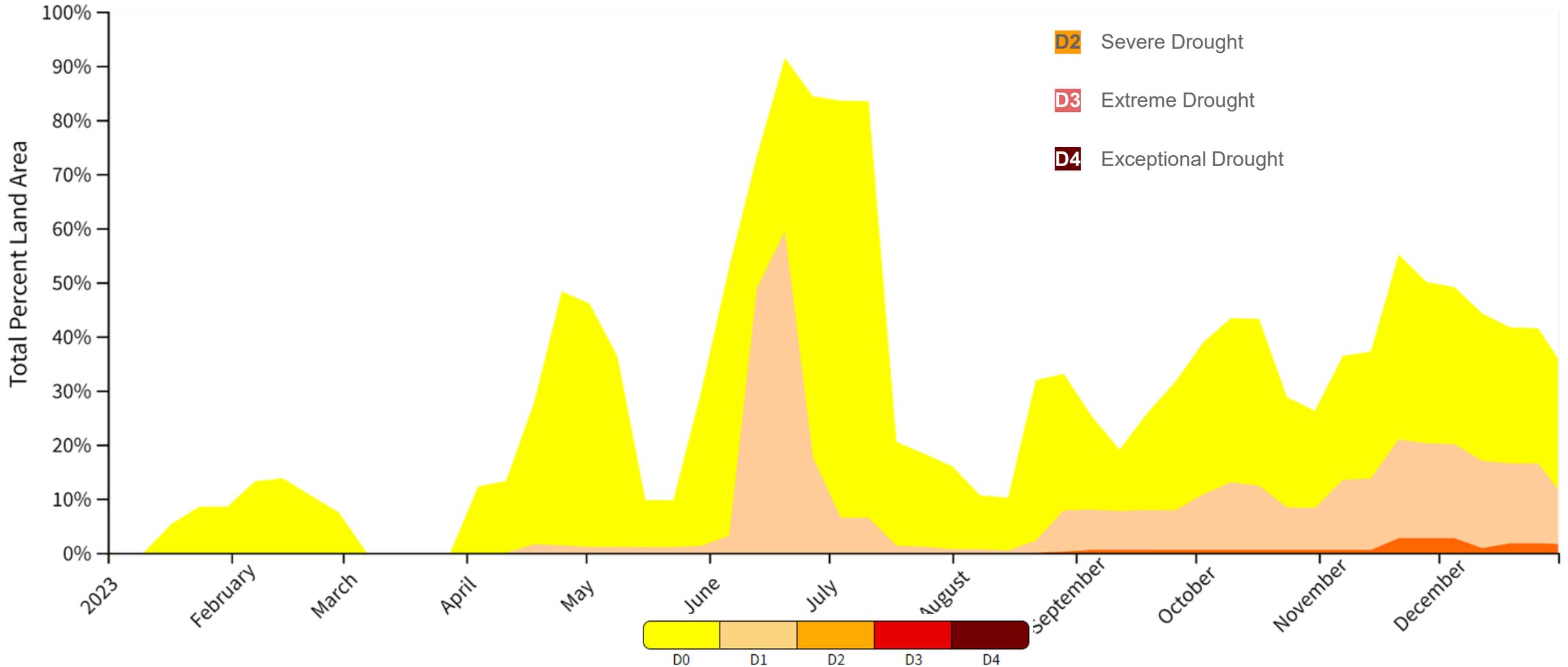
Drought Intensity Categories

D1 Moderate Drought

D2 Severe Drought

D3 Extreme Drought

D4 Exceptional Drought



11
counties with USDA
Drought Disaster
Designations (primary)

— 0 counties since last
week

1.9 Million
West Virginia residents in
areas of drought,
according to the Drought
Monitor

↑ 0.4% since last week

26th
driest August on record
(since 1895)

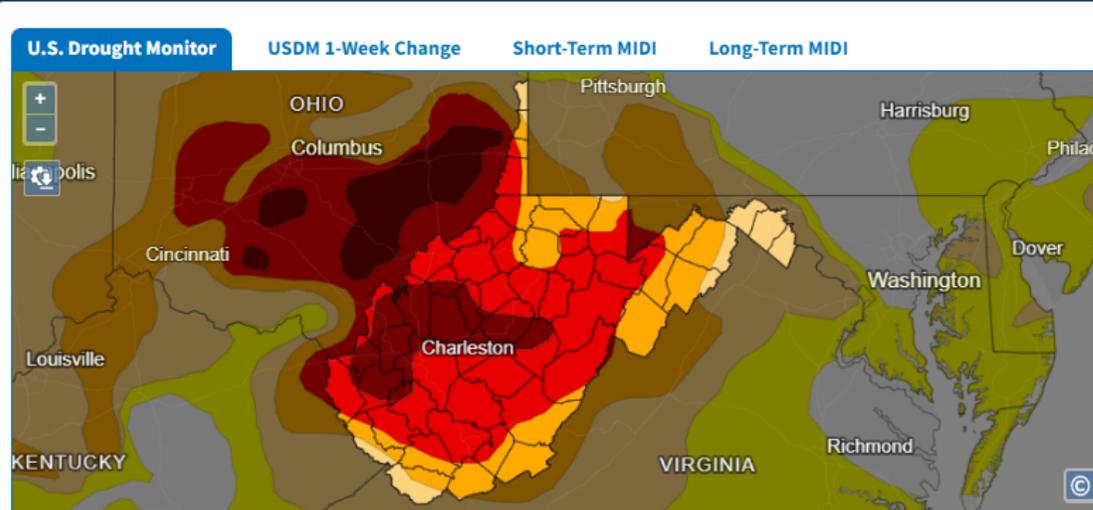
3.07 in. total precipitation
↓ 1.11 in. from normal

37th
driest January–August on
record (since 1895)

29.65 in. total
precipitation
↓ 2.34 in. from normal

[Learn More About These Stats](#)

Current West Virginia Drought Maps



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 actions. [Learn more](#) ↗.

How has drought impacted this state in the past? View [examples of past drought impacts](#) or explore [historical Drought Monitor maps](#).

Source(s): [NDMC](#), [NOAA](#), [USDA](#)

Legend

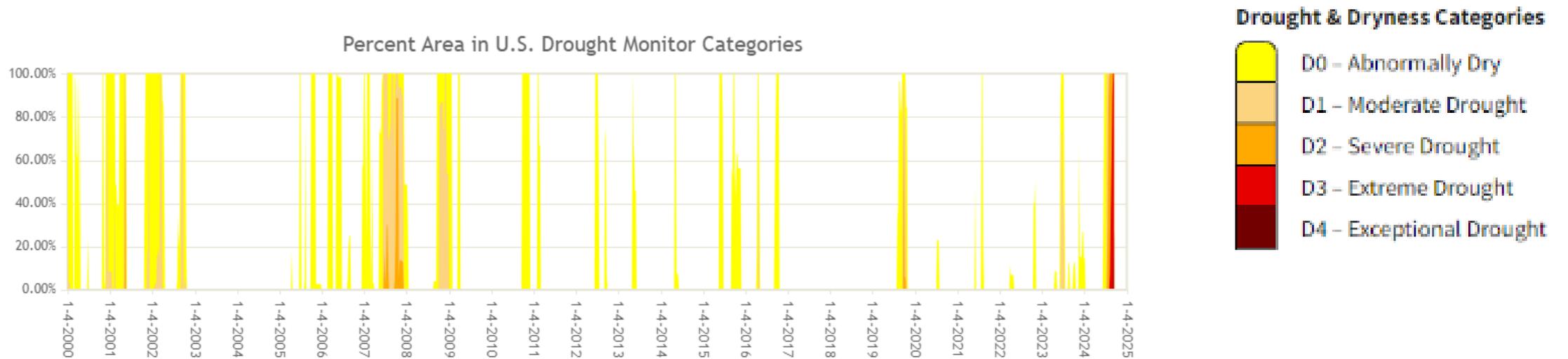
Drought & Dryness Categories	% of WV
D0 – Abnormally Dry	0.0%
D1 – Moderate Drought	7.0%
D2 – Severe Drought	26.7%
D3 – Extreme Drought	51.2%
D4 – Exceptional Drought	15.2%
Total Area in Drought (D1–D4)	100.0%

U.S. Drought Monitor

Statistics type: Cumulative Percent Area ?
Export Table View More Statistics

Week	Date	None	D0-D4	D1-D4	D2-D4	D3-D4	D4	DSCI
Current	2024-09-17	0.00	100.00	100.00	100.00	100.00	28.54	429
Last Week to Current	2024-09-10	0.00	100.00	100.00	100.00	100.00	0.00	400
3 Months Ago to Current	2024-06-18	53.09	46.91	0.00	0.00	0.00	0.00	47
Start of Calendar Year to Current	2023-12-26	72.82	27.18	0.00	0.00	0.00	0.00	27
Start of Water Year to Current	2023-09-26	98.67	1.33	0.00	0.00	0.00	0.00	1
One Year Ago to Current	2023-09-19	100.00	0.00	0.00	0.00	0.00	0.00	0

Estimated Population in Drought Areas: **193,063**



Dryness Categories

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

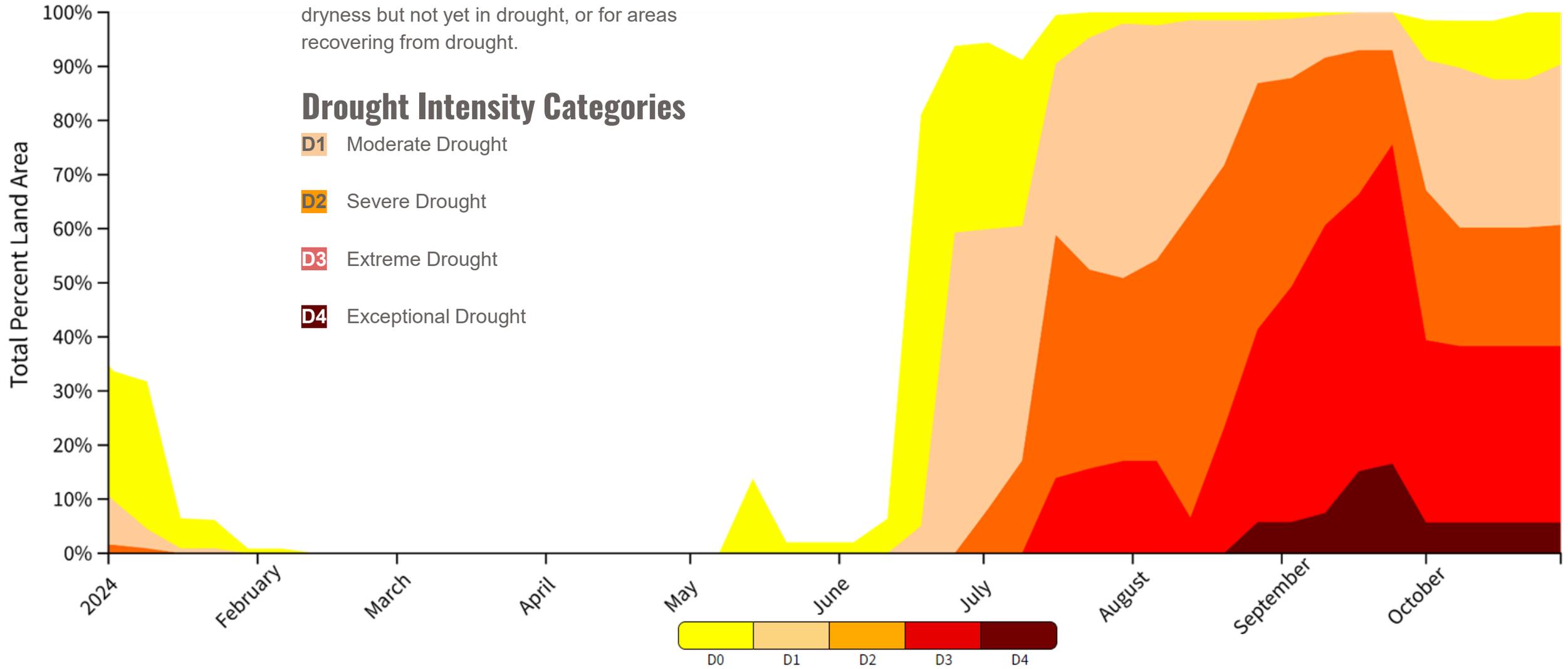
Drought Intensity Categories

D1 Moderate Drought

D2 Severe Drought

D3 Extreme Drought

D4 Exceptional Drought



September 2024

Impacts:

- Hydrology
- Livestock
- Crop production
- Ecology
- Municipal water supply
- Landscapes
- Fire risk



Collaborate & Listen

WV Emergency Management

WV Department of Health

WV Division of Natural Resources

WV Conservation Agency

WV Department of Agriculture

National Oceanic and Atmospheric Administration

National Centers for Environmental Information

Climate Prediction Center

National Integrated Information System

Northeast Regional Climate Center

National Weather Service

US Department of Agriculture & Farm Service Agency

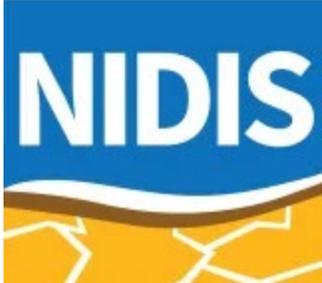
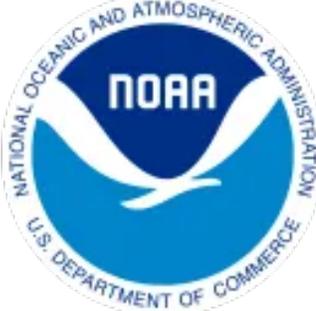
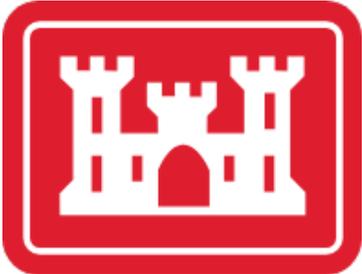
US Forest Service

Federal Emergency Management Agency

US Environmental Protection Agency



West Virginia Conservation Agency



U.S. Small Business Administration

2023 Large Quantity User (LQU) Total Withdrawals

WVDEP Water Use Category	LQUs	Total 2023 Withdrawal (Gallons)	Category %	% Change from 2022
Agriculture/Aquaculture	12	7,236,362,471	1.19%	-9.63%
Chemical	11	131,729,647,028	21.69%	5.29%
Industrial	16	11,227,382,886	1.85%	-12.28%
Mining	64	13,514,251,738	2.23%	-0.09%
Oil & Gas	15	3,034,636,366	0.50%	-5.53%
Petroleum	1	278,082,884	0.05%	-8.37%
Public Water Supply	193	63,212,013,560	10.41%	0.56%
Recreation	21	1,051,066,794	0.17%	-6.34%
Thermoelectric (Coal)	9	375,777,535,623	61.88%	-2.78%
Timber	3	207,807,171	0.03%	-73.50%
TOTAL	345	607,268,786,521	100.00%	-1.14%
Hydroelectric	10	232,057,512,536,992		



WVDEP Water Use Category	2023 Surface Water (SW) Withdrawal (Gallons)	Category % of SW	2023 Groundwater (GW) Withdrawal (Gallons)	Category % of GW
Agriculture/Aquaculture	7,120,140,071	1.23%	116,222,400	0.40%
Chemical	123,728,360,832	21.41%	8,001,286,196	27.22%
Industrial	10,567,374,376	1.83%	660,008,510	2.25%
Mining	8,153,365,735	1.41%	5,360,886,003	18.24%
Oil & Gas	2,922,190,875	0.51%	112,445,491	0.38%
Petroleum	5,679,408	0.00%	272,403,476	0.93%
Public Water Supply	49,115,712,959	8.50%	14,096,300,601	47.95%
Recreation	725,467,266	0.13%	325,599,528	1.11%
Thermoelectric (Coal)	375,338,029,473	64.95%	439,506,150	1.50%
Timber	194,636,922	0.03%	13,170,249	0.04%
SUB TOTAL	577,870,957,917	100.00%	29,397,828,604	100.00%
Breakdown % of Total Withdrawal		95.16%		4.84%
Hydroelectric	232,057,512,536,992		0	

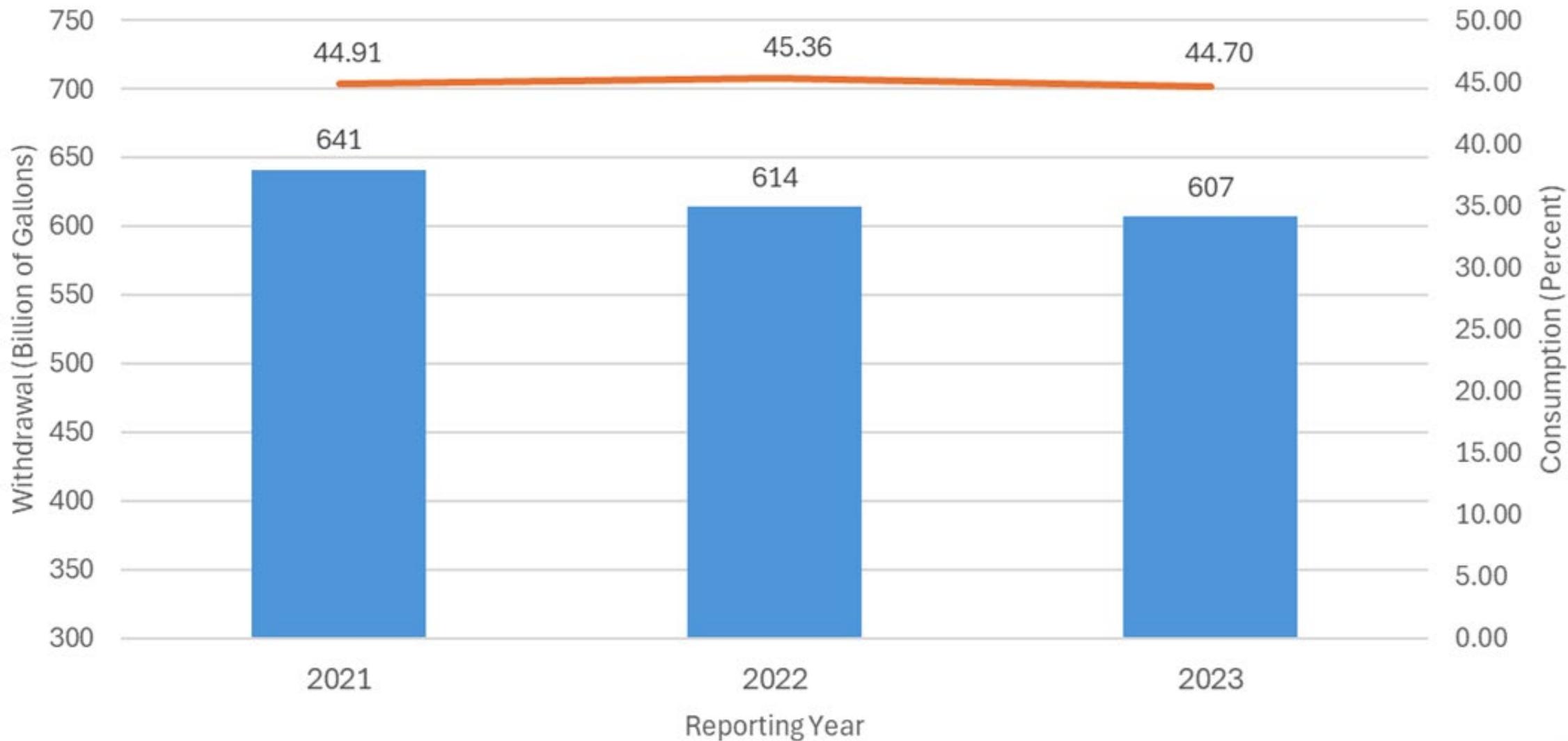


2023 Consumptive Use

WVDEP Water Use Category	2023 Total Gallons Withdrawal	Consumptive Coefficient	2022 Calculated Gallons Consumed	Category % of Consumed
Agriculture/aquaculture	7,236,362,471	0.03	217,090,874	0.08%
Chemical	131,729,647,028	0.12	15,807,557,643	5.82%
Industrial	11,227,382,886	0.59	6,624,155,903	2.44%
Mining	13,514,251,738	0.48	6,486,840,834	2.39%
Oil & Gas	3,034,636,366	1	3,034,636,366	1.12%
Petroleum	278,082,884	0.16	44,493,261	0.02%
Public water supply	63,212,013,560	0.15	9,481,802,034	3.49%
Recreation	1,051,066,794	0.41	430,937,386	0.16%
Thermoelectric (coal)	375,777,535,623	0.61	229,224,296,730	84.45%
Timber	207,807,171	0.39	81,044,797	0.03%
TOTAL	607,268,786,521		271,432,855,828	100.00%
			Consumption 44.7%	
Hydroelectric	232,057,512,536,992			



Water Withdrawal and Consumption 2021-2023

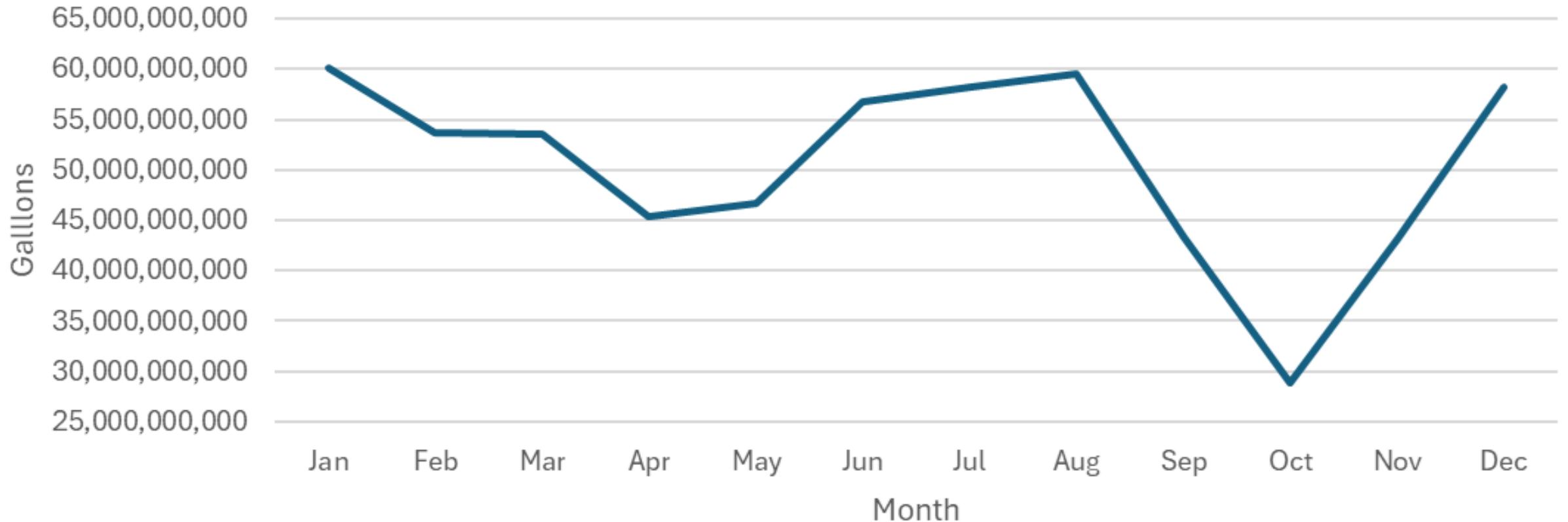


■ Annual Withdrawals in Billion of Gallons — % of Consumed



Seasonal Withdrawal Trends

2023 Monthly Water Withdrawal

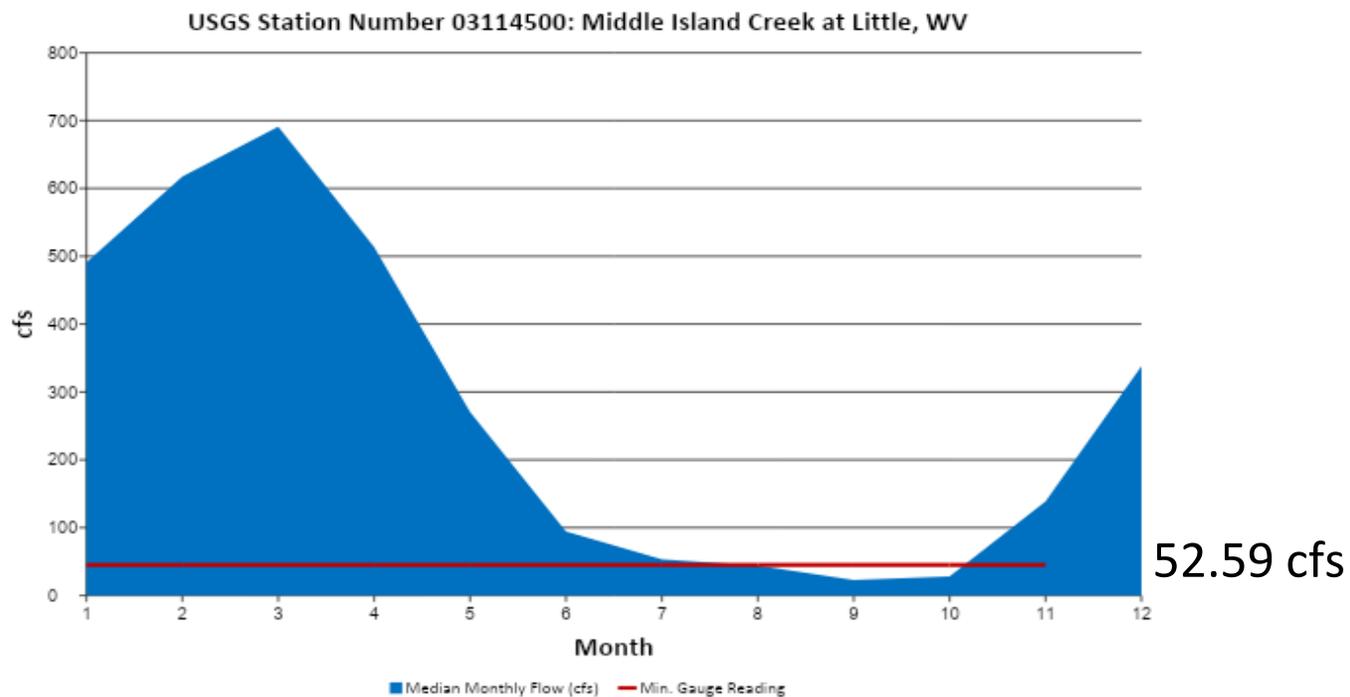


2023 trends in total withdrawal based on the LQU database (from WVDEP).



Water Management Plans

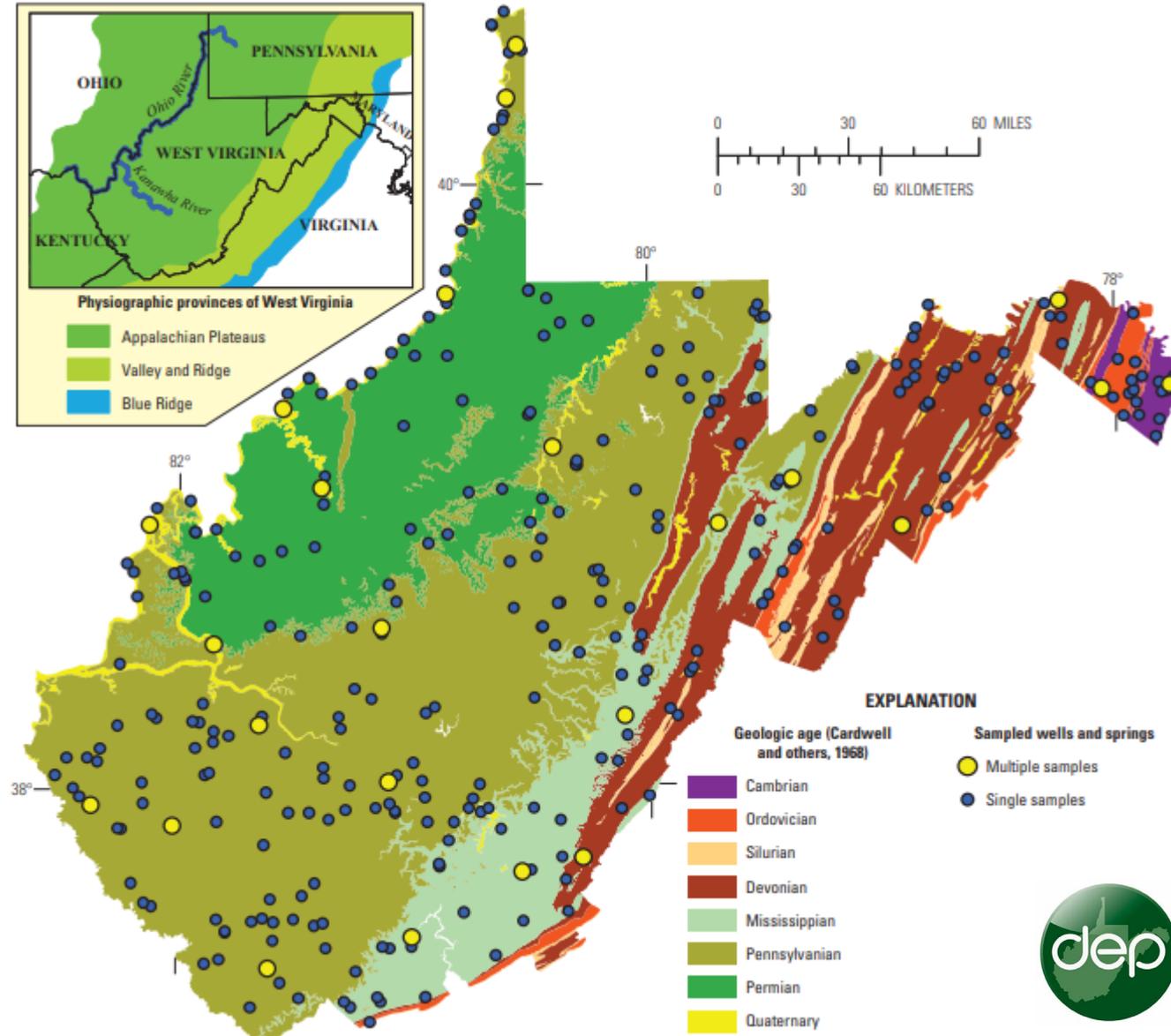
- Water Use continue to issue WMPs required for H6A well development.
- The use of recycled frac water is always encouraged.



Research & Resources

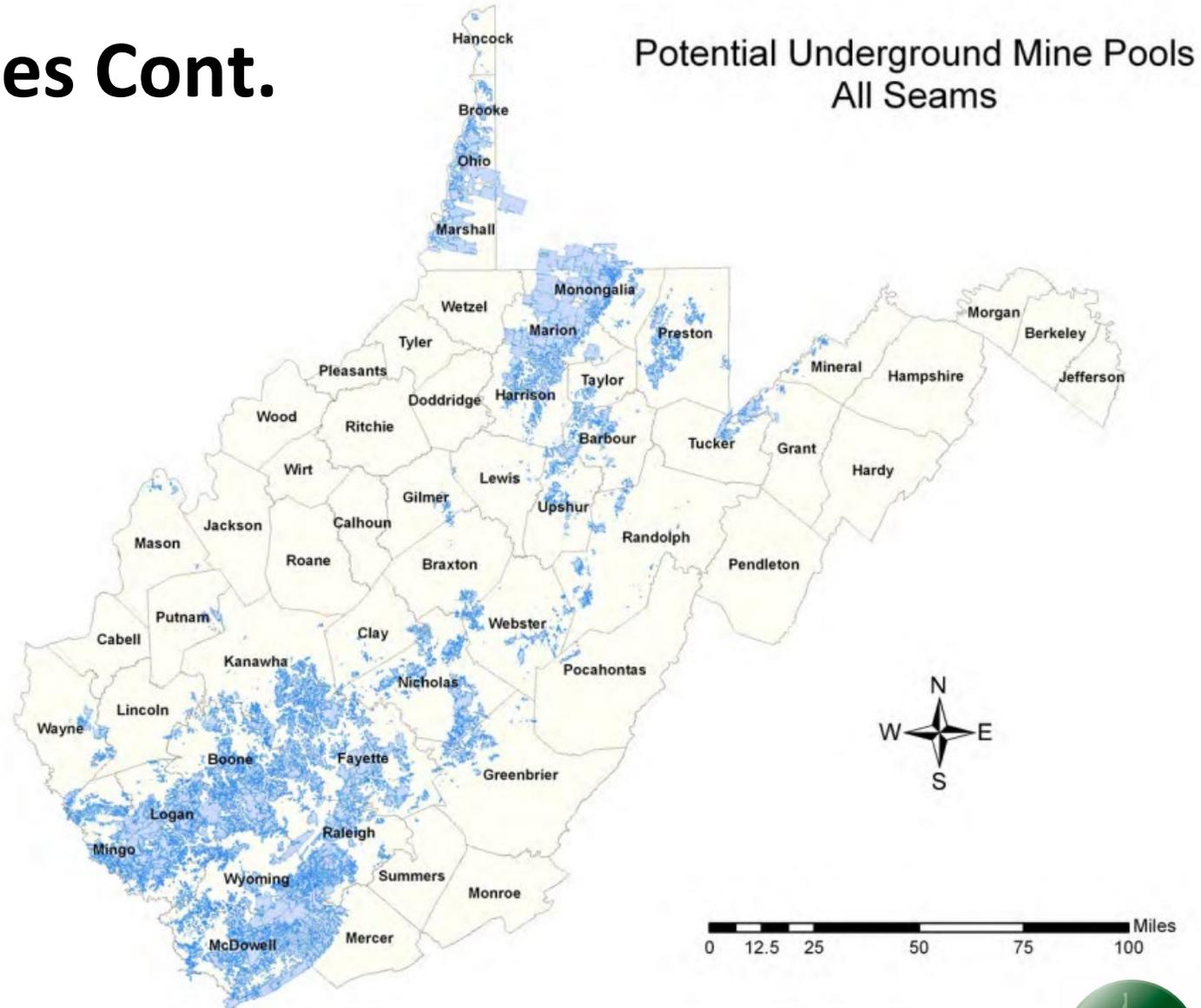
Early Research & References

- USGS SIR 2008-5105 developed regional equations & procedures for estimating stream flow statistics at ungaged locations.
- USGS SIR 2010-5185 provided estimation of selected seasonal streamflow statistics representative of 1930-2002 in WV.
- USGS SIR 2012-5186 summarized GW quality.
- USGS SIR 2012-5121 equated stream flow statistics to base flow to identify interconnection of surface & GW.



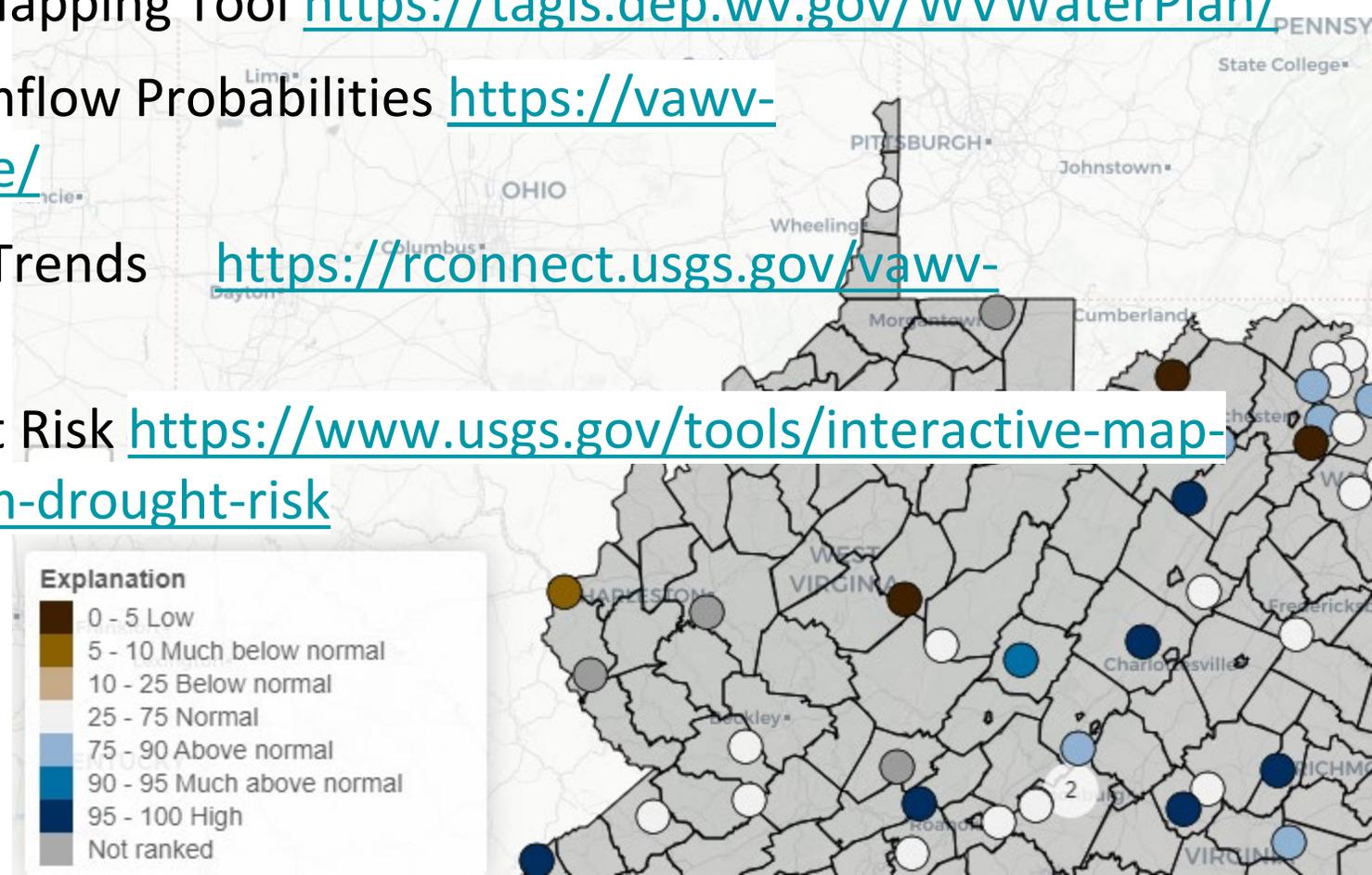
Early Research & References Cont.

- WVGES May 2012 WV Mine Pool Atlas evaluated abandoned coal mines as potential GW sources.
- WVDEP 2013 Water Laws, Water Regulations & Water Rights.
- USGS SIR 2022-5094 GW quality & geochemistry of the western wet gas part of the Marcellus shale oil & gas play produced since 1859 & analyzed 30 residential water wells in relation to PWS standards.



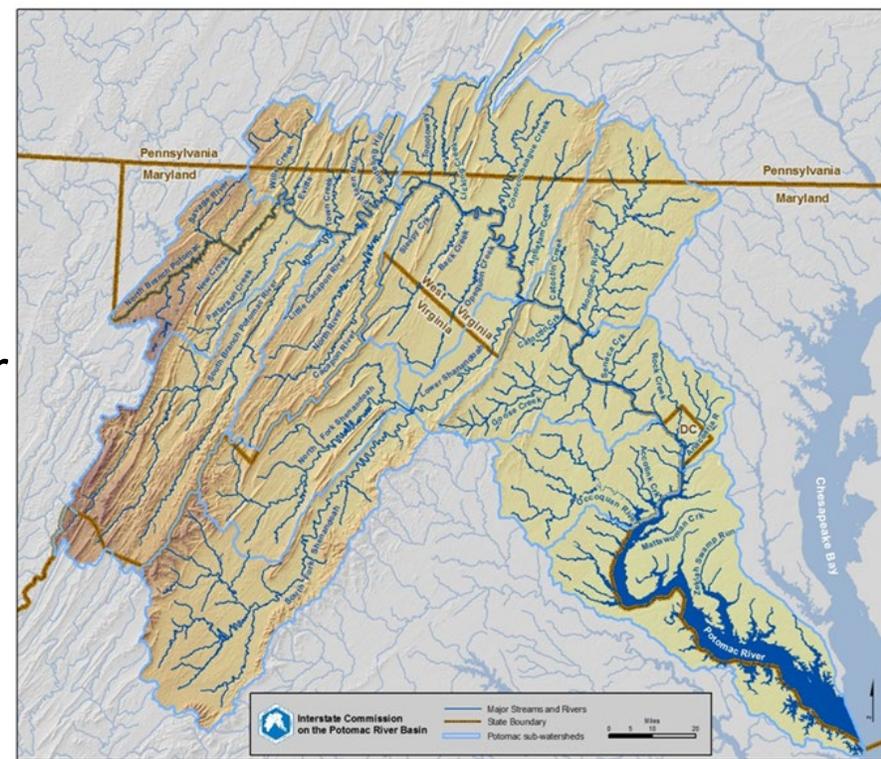
More Recent Resources

- Water Withdrawal Tool <https://tagis.dep.wv.gov/wwts/>
- Water Resources Management Mapping Tool <https://tagis.dep.wv.gov/WVWaterPlan/>
- Northeast Region Drought Streamflow Probabilities <https://vawv-gis.usgs.gov/webapps/drought-ne/>
- VA & WV Groundwater Levels & Trends <https://rconnect.usgs.gov/vawv-groundwater/>
- WV Public Water System Drought Risk <https://www.usgs.gov/tools/interactive-map-west-virginia-public-water-system-drought-risk>



2023 WVU Report

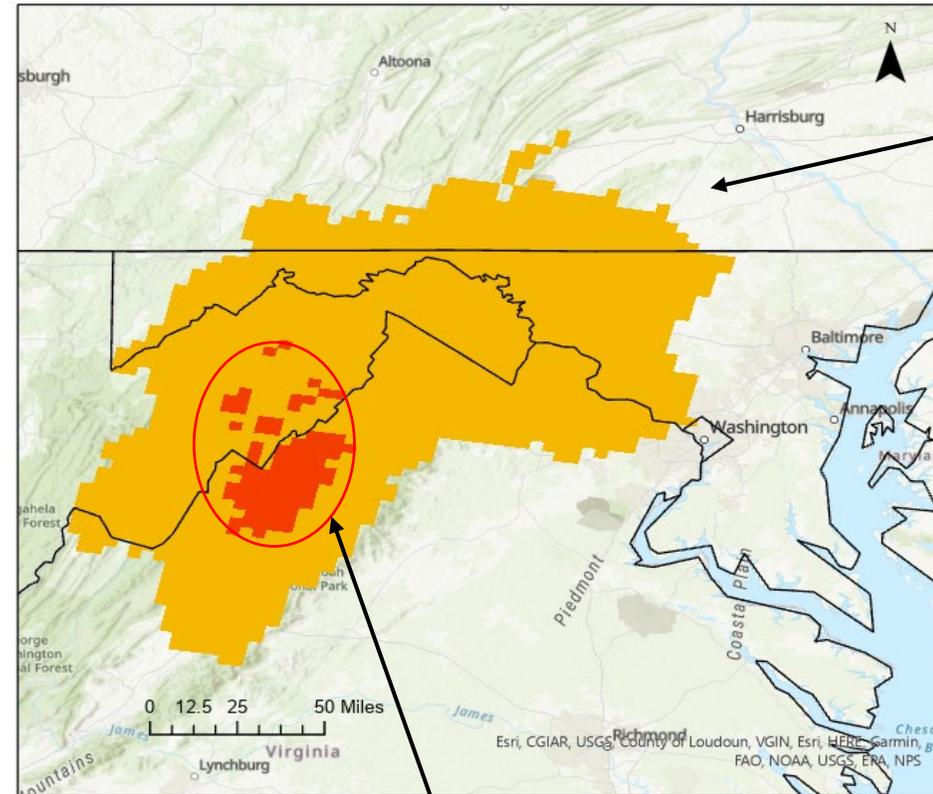
- *Quantifying Water Security in WV and the Potomac River Basin*
- Compared existing water use data sets accounting to identify strengths & potential improvements.
- Built a community-scale water tower model of the Potomac River basin to better quantify the Washington DC metropolitan areas hydrologic dependency.
- WV makes up 25.5% of the Potomac River Basin.
- High elevation & heavily forested areas in the hinterland produced the most disproportional runoff generation for the lowland area emphasizing WV as a vital headwater state.



2023 WVU Report Cont.

- LQU represents the majority of contemporary water use in WV.
- Legally mandate water reporting.
- Broaden water use sectors for reporting.
- Account for smaller users (e.g., agriculture sector, domestic supplies).
- Takeaways:
 - Spatial insight as to where land conservation & restoration may be considered
 - Future iterations of framework will incorporate GW, water quality & seasonality

Water Resource Contribution Index



0 < WRC < 1.0
Important to meet downstream seasonal demand

Shenandoah Valley Floor

USGS SIR 2023-5091

- *Groundwater Quality in Abandoned Underground Coal Mine Aquifers Across WV*
- Cover a large part of WV & could supply substantial quantities of water for a variety of uses.
- Applied existing secondary source data for understanding general water quality.
- Northern, younger, U. Pennsylvanian coal beds generally produce net acidic waters (poor quality).
- Southern, older, L. Pennsylvanian coal beds primarily produce net alkaline waters (good quality).
- Local effects such as mine age, depth of coal mine, degree of flooding & subsequent mine recovery may alter water quality in ways that deviate from this regional interpretation. More local characterization by water managers needed

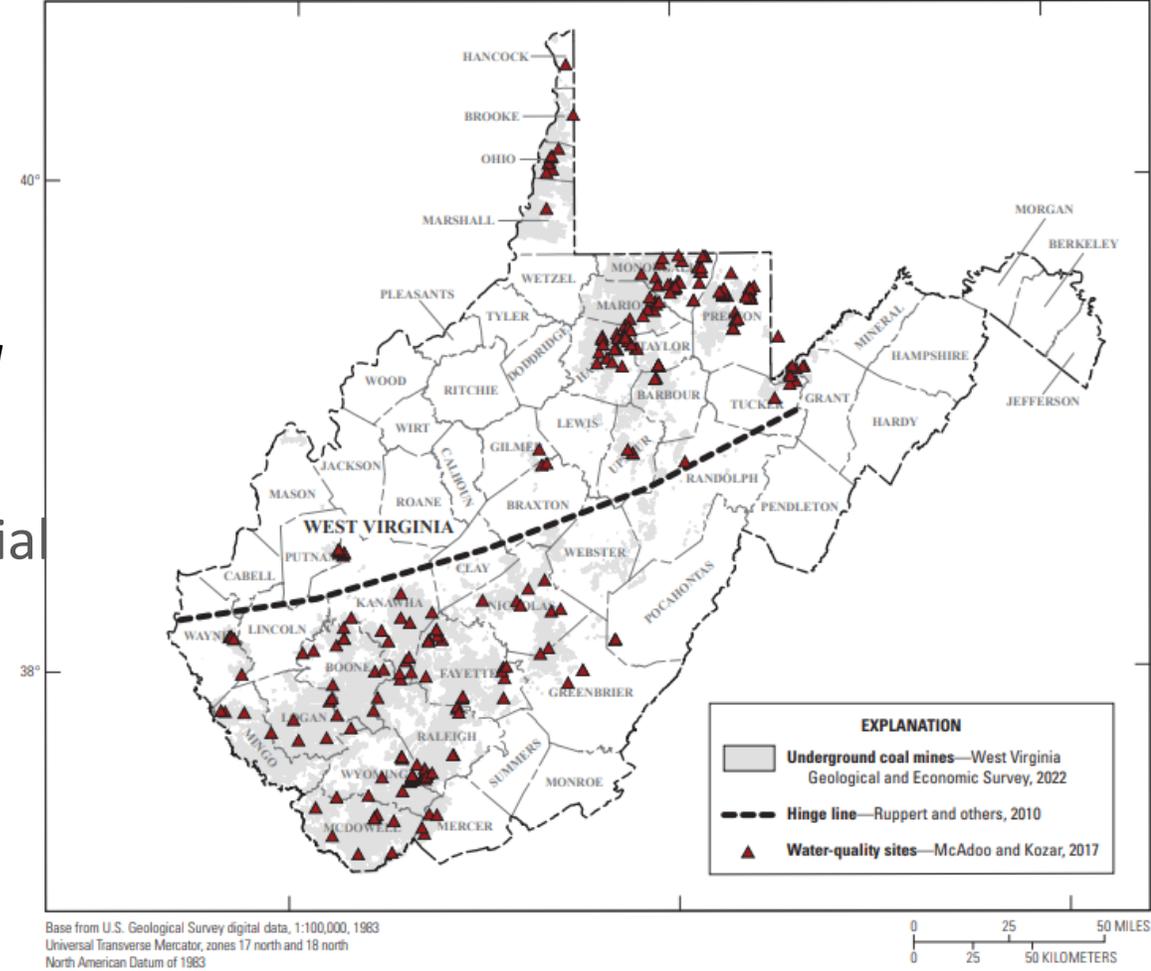
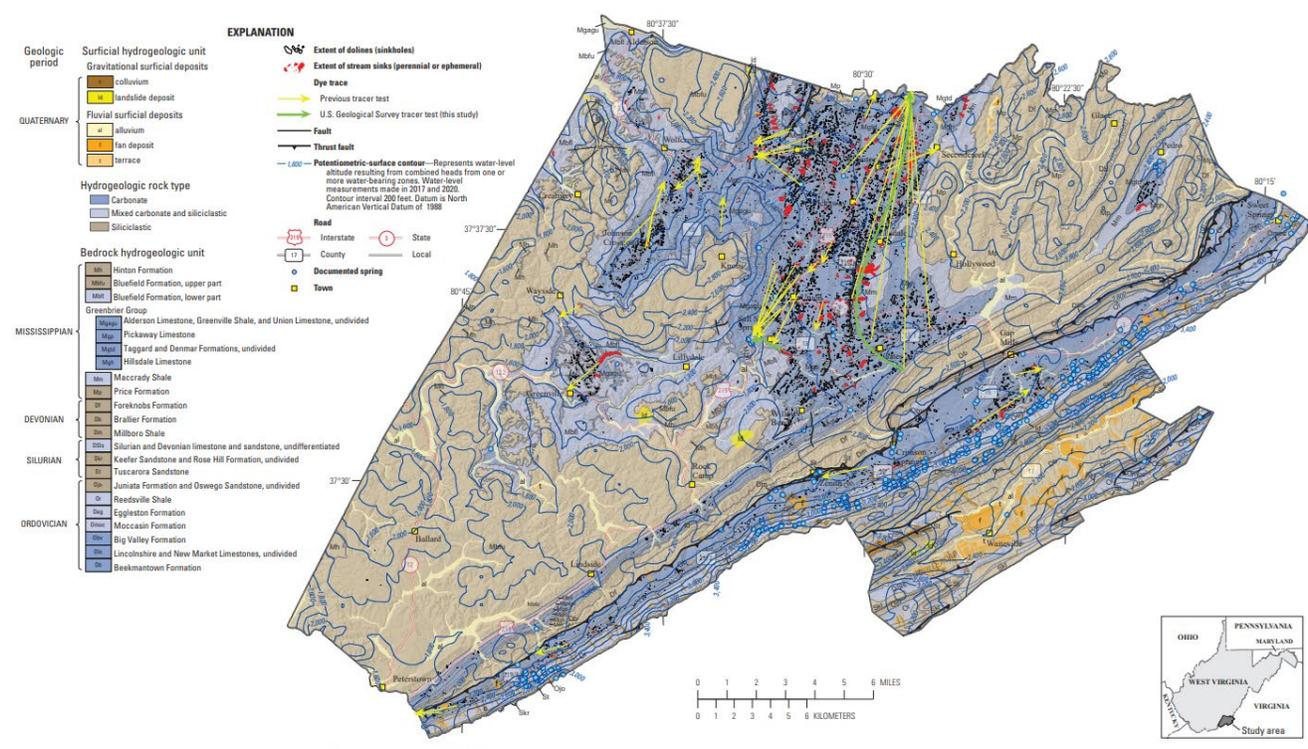


Figure 3. Map showing the sites in West Virginia where this study's water-quality data were collected.

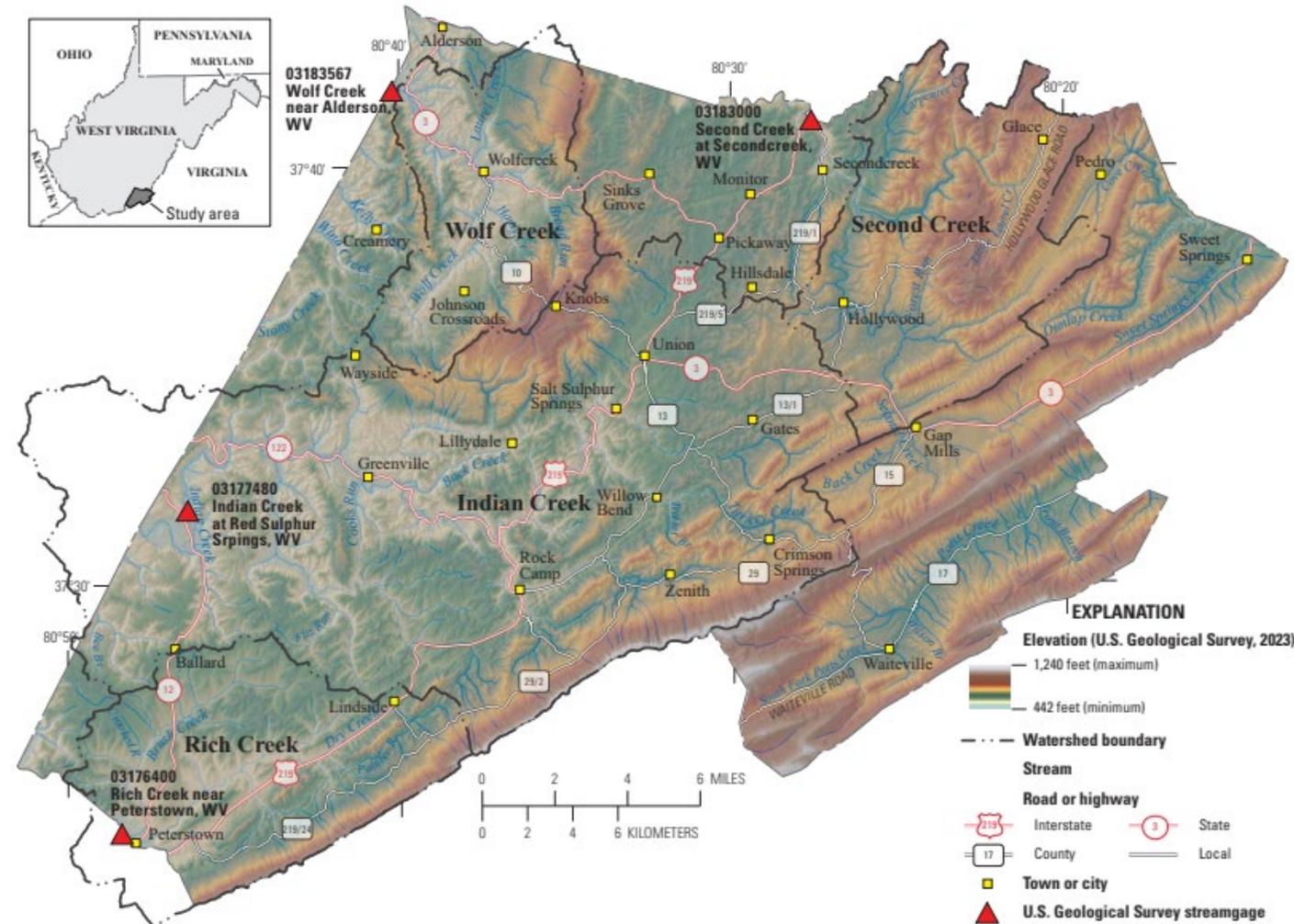
USGS SIR 2023-5121

- *Hydrogeology, karst, and groundwater availability of Monroe County, WV*
- SE part of state encompassing 474 mi²
- Consists of karst & siliciclastic aquifers of Ordovician, Silurian, Devonian & Mississippian age
- 2 physiographic provinces: the Valley and Ridge to the east of Peters Mountain & the Appalachian Plateau to the west
- **Extremely complex GW**
 - 5 aquifers with potentially multiple water-bearing zones within each



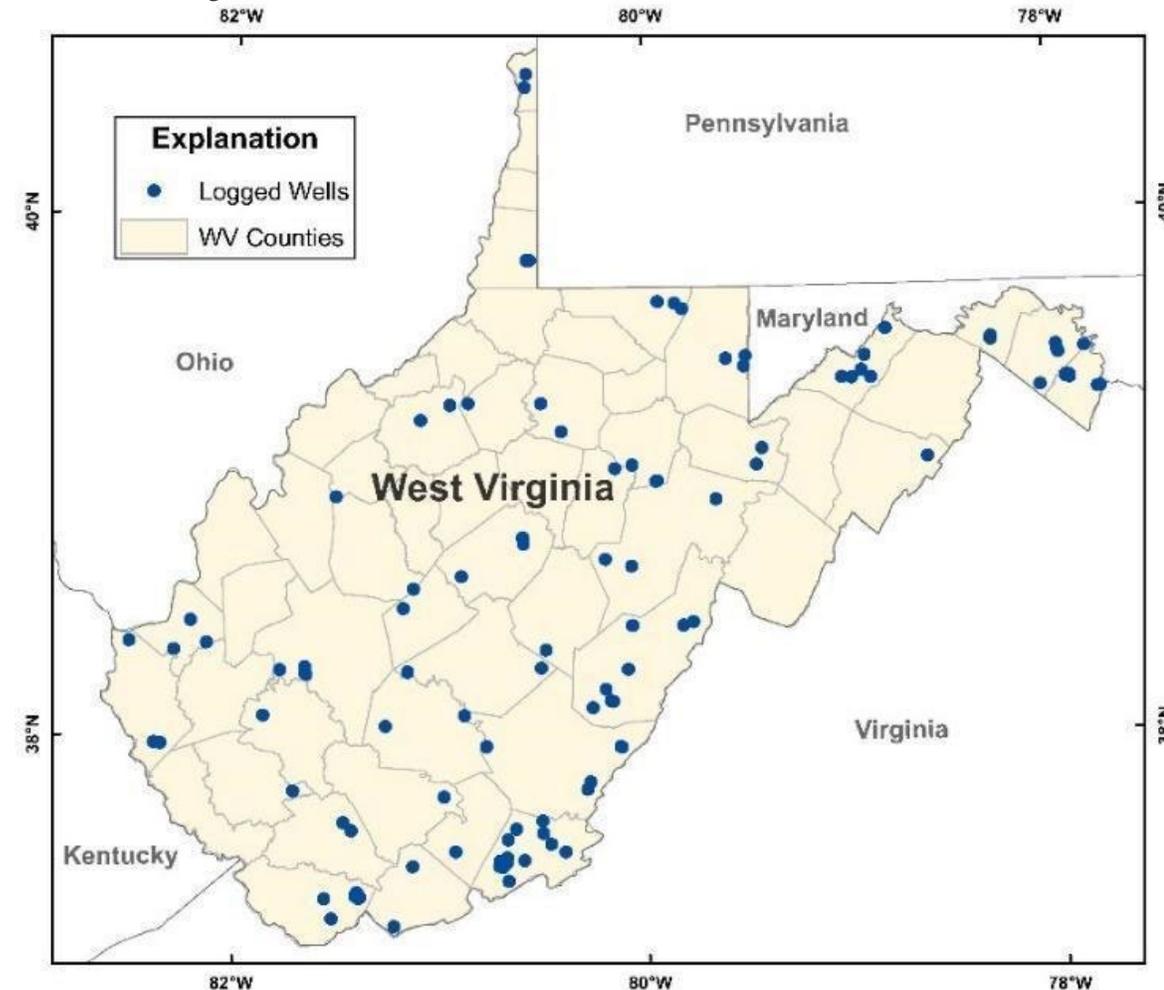
Why? Concerns over water availability, anticipated economic development & contamination susceptibility

- Land use
- Dye-tracer tests
- Geology
- Hydrology
- Borehole geophysics
- Models
- Water budgets
- Current & future availability better understood for water resource managers & emergency services



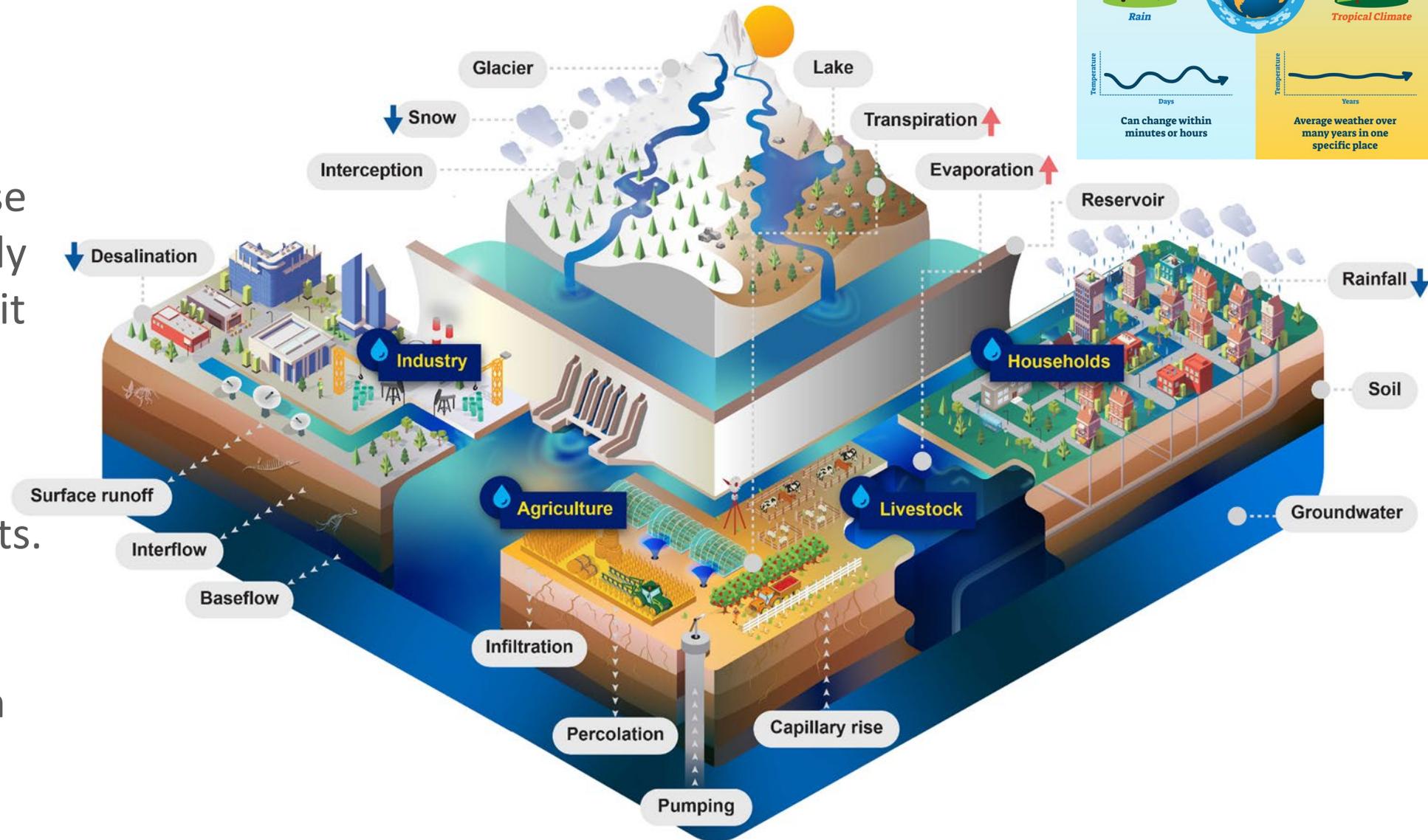
USGS Geophysical Groundwater Well Logging

- *Factors Controlling the Occurrence and Distribution of Fractures in Fractured-Rock Aquifers of WV*
- Final Report ETA Winter 2024/2025
- These aquifers cover 23,601 mi² & comprise the vast majority (97.4%) of surficial area within the state.
- Important water supplies for public drinking water, agriculture, industry & especially for residential homeowner/domestic well use.



Act Research Continues

- Use data to spatially inform where water use could potentially expand and/or it should be curtailed to minimize negative impacts.
- Modeling is the next key step in all of this.



New USGS Project October 2023

Estimation of Groundwater and Surface Water Withdrawals and Water Use in the Northern Shenandoah Valley

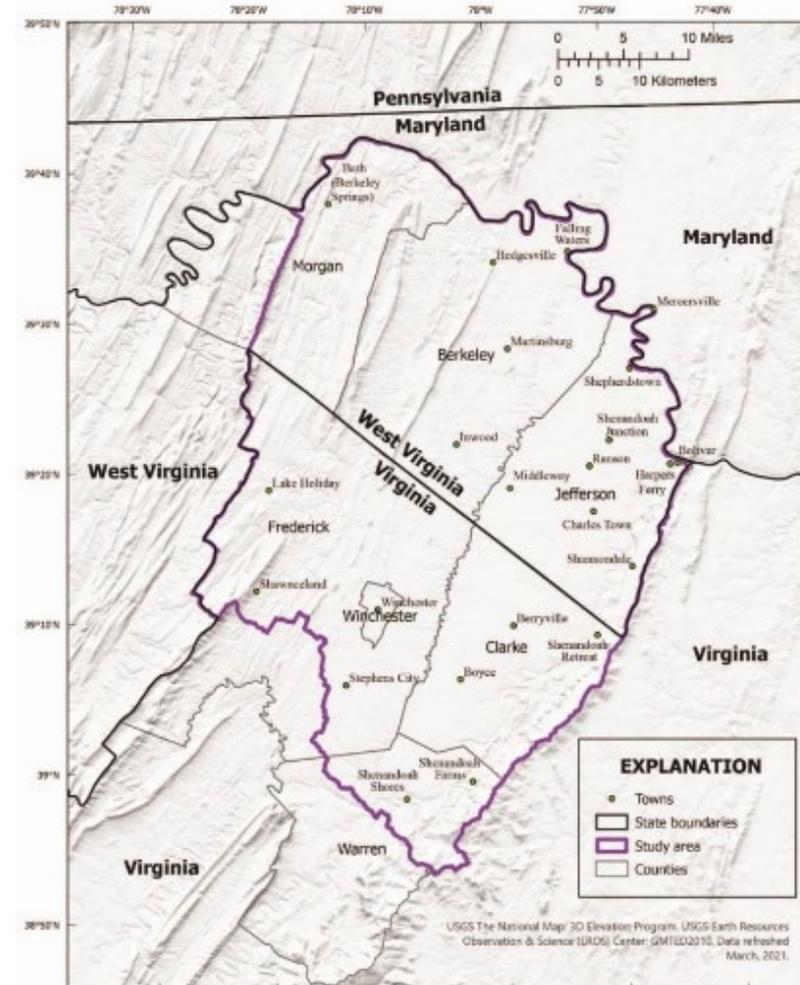
(Matt Kearns)

Objectives:

- Collect & compile existing, reported, and/or other known water use data
- Develop methods to estimate unreported water use, with emphasis on rural residential/domestic self-supply & agricultural

\$310,000 over 2.25 years (ETA December 2025)

- **\$205,000** WVDEP / **\$105,000** USGS match
- Preliminary step towards producing a water budget & predictive GW model



New USGS Proposal Fall 2024

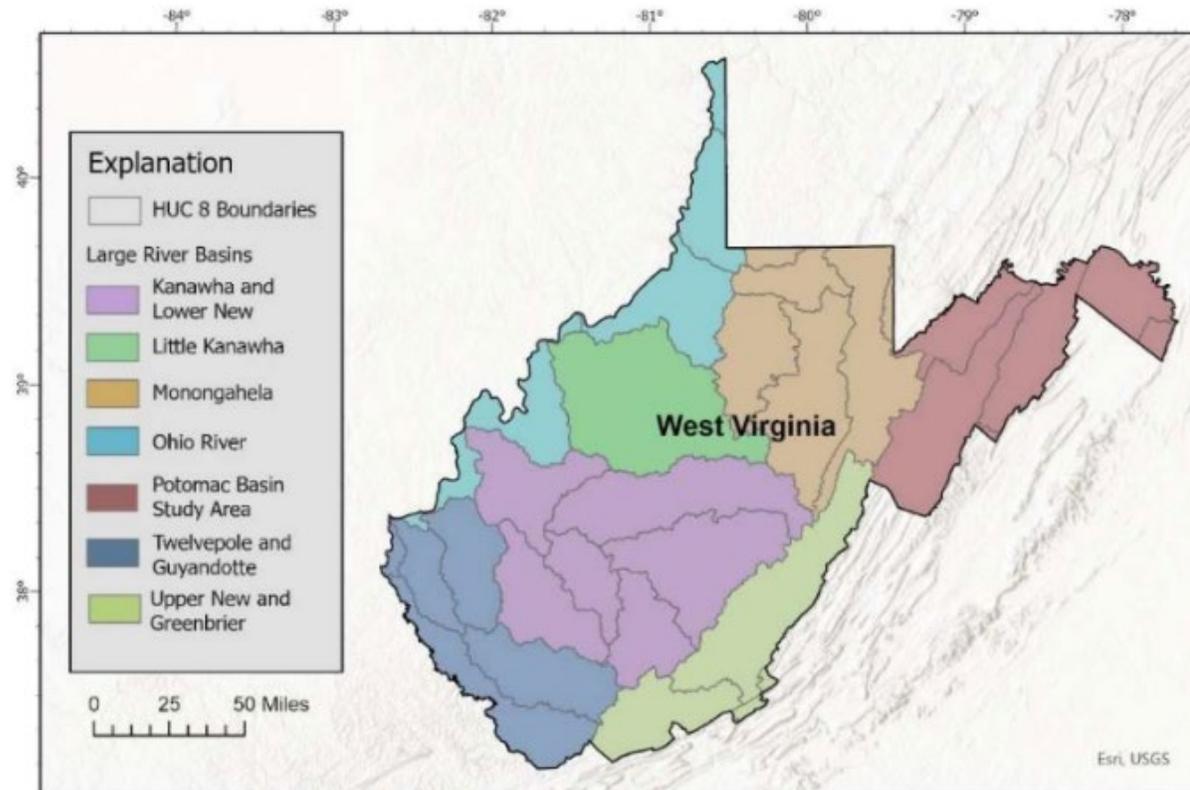
Water Budgets for River Basins in West Virginia (Mitch McAdoo)

Objectives:

- Estimate water budget components using the Soil Water Balance model
- Use hydrograph separation to estimate baseflow, runoff, & GW recharge from streamflow data
- Determine water availability through computation of water budgets
- Produce a professional publication documenting the results of the study.

\$400,000 over 2 years thru 2026

- **\$300,000** WVDEP / **\$100,000** USGS match



Moving Forward

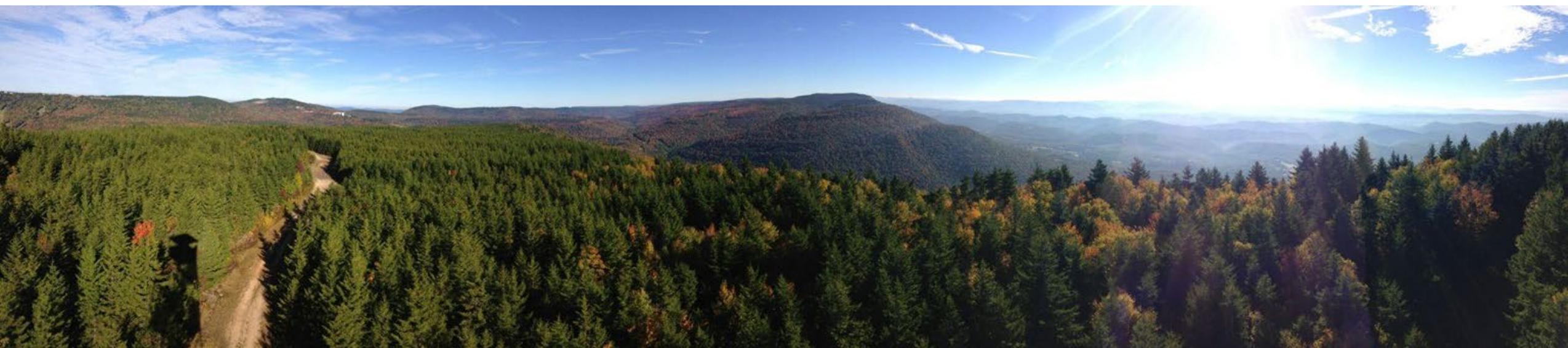
Key Funding

- Act line item
- WV Gaging Network line item

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

Our Focus

- Stay fully staffed
- Use all available resources
- Obtain data needed to determine water availability
- Propose management strategies to address any strain and minimize stress
- Protect water resources statewide



In Closing

- Continue to collaborate with agencies & stakeholders to share information & resources to support data & science-driven management decisions for our most precious resource.
- Thank you!
- Questions?
- *Whiskey is for drinking, water is for fighting*
- Mark Twain

