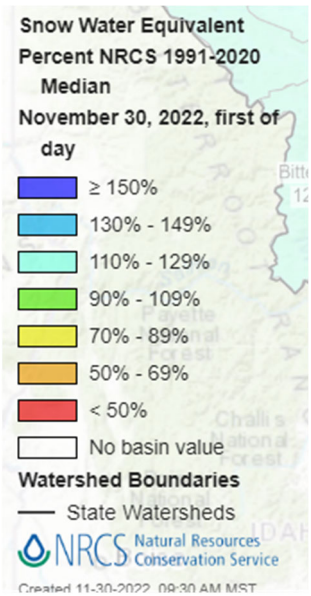
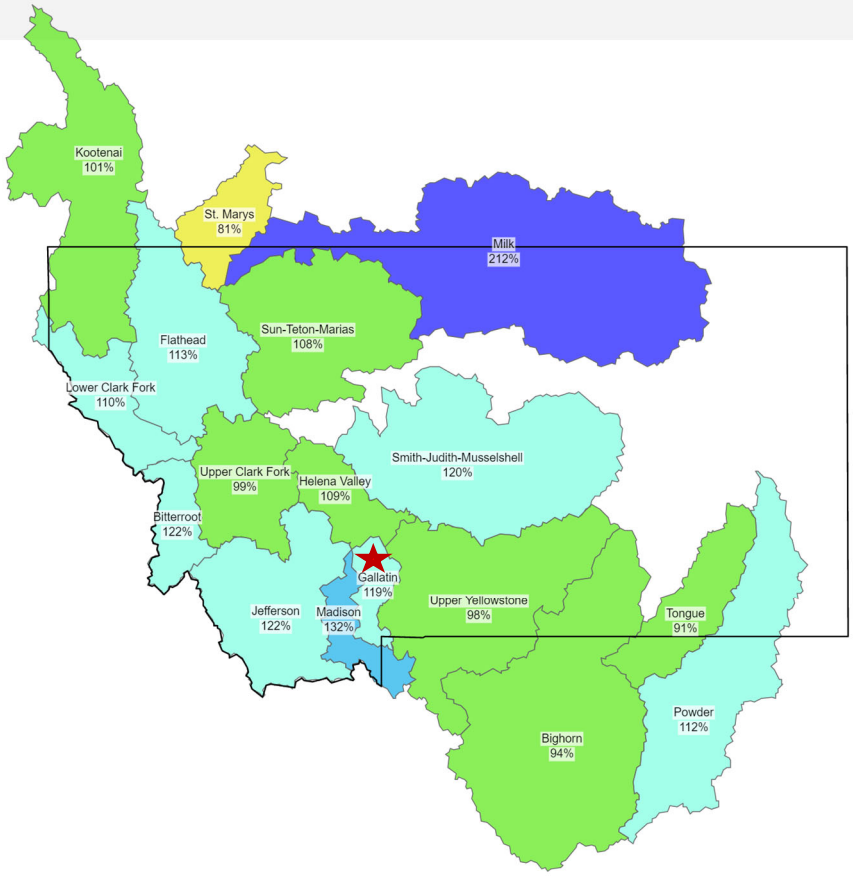
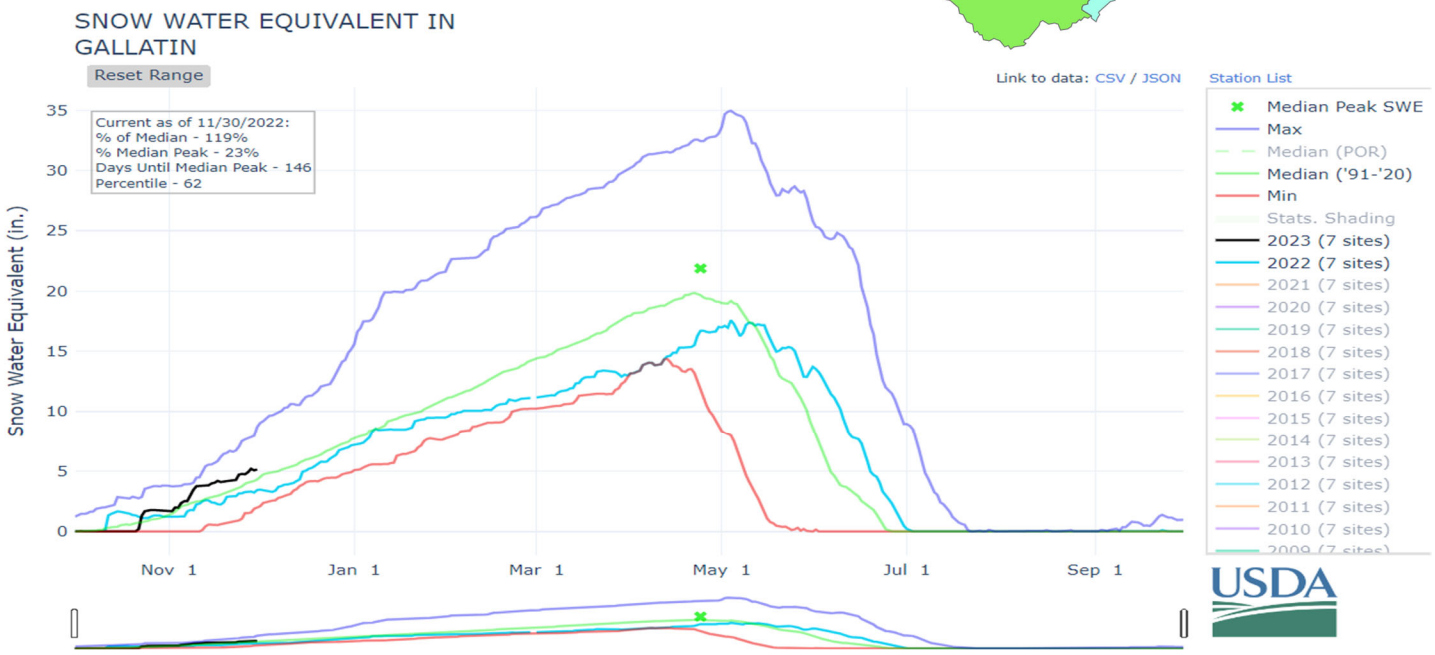
Gallatin County Water Supply
November 2022





★ = Gallatin River Basin



SNOWPACK SUMMARY (Water Year (WY) = October 1st—September 30)

*Data current as of November 30th

We are currently in Water Year 2023 (black line). The Snow Water Equivalent (SWE) was above normal (median) within the Gallatin River Basin on November 30th, 2022 at 5.1 inches (a 3.4 inch increase since last month). The SWE on November 30th, 2021 (central blue line) was 3.4 inches. Detailed end-of-month SNOTEL site information follows.

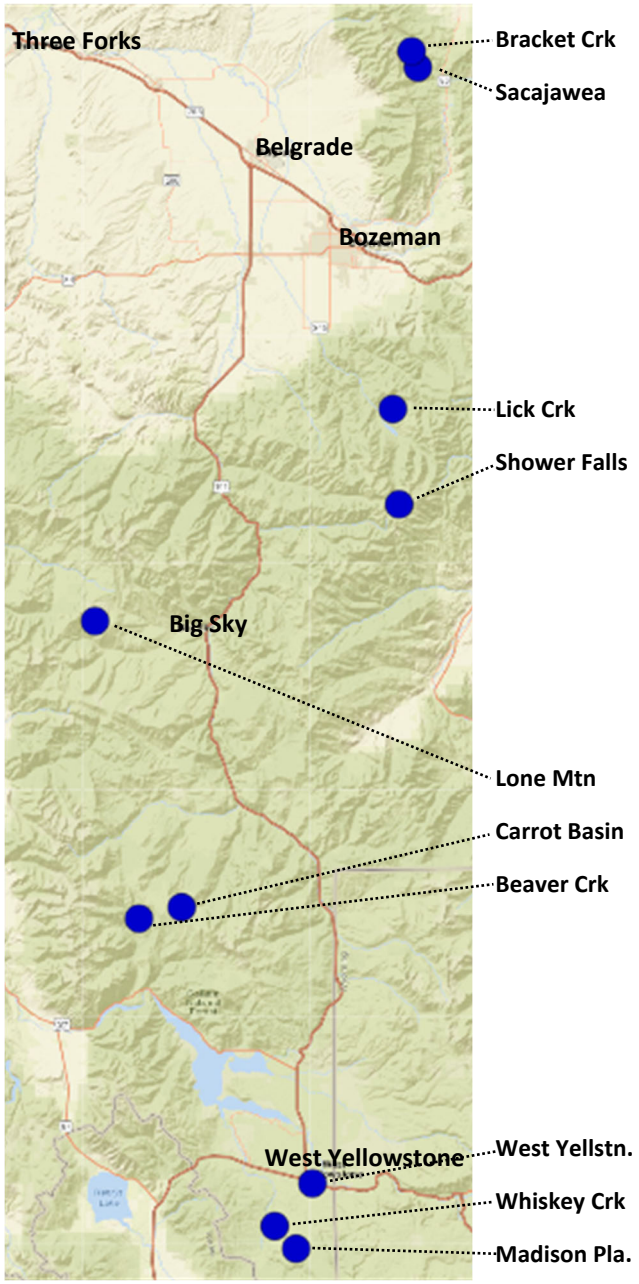
Snowpack Data
Gallatin River Basin—November 2022

Gallatin Valley Region (Bozeman-Belgrade-Four Corners)					
Station Name	*Date*	*Snow Depth (in)*	*SWE (in)*	*SWE % Normal*	*Normal SWE 1971-2000 (in)*
Brackett Creek	Nov. 2021	12	3.2	65	4.9
	Nov. 2022	17	3.7	76	
Sacajawea	Nov. 2021	1	0.4	21	1.9
	Nov. 2022	11	2.8	147	

Hyalite Region (Gallatin Gateway)					
Station Name	*Date*	*Snow Depth (in)*	*SWE (in)*	*SWE % Normal*	*Normal SWE 1971-2000 (in)*
Lick Creek	Nov. 2021	4	1.5	48	3.1
	Nov. 2022	18	3.7	119	
Shower Falls	Nov. 2021	22	5.4	86	6.3
	Nov. 2022	-	6.3	100	

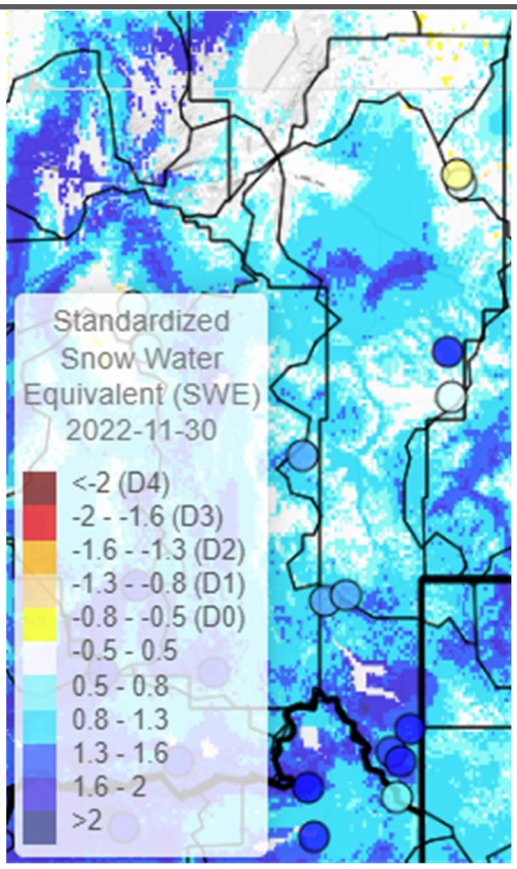
Lee Metcalf Wilderness Region (Big Sky)					
Station Name	*Date*	*Snow Depth (in)*	*SWE (in)*	*SWE % Normal*	*Normal SWE 1971-2000 (in)*
Beaver Creek	Nov. 2021	13	3.3	75	4.4
	Nov. 2022	-	5.5	125	
Carrot Basin	Nov. 2021	22	6.6	85	7.8
	Nov. 2022	-	9.1	117	
Lone Mountain	Nov. 2021	12	3.8	83	4.6
	Nov. 2022	31	6.4	139	

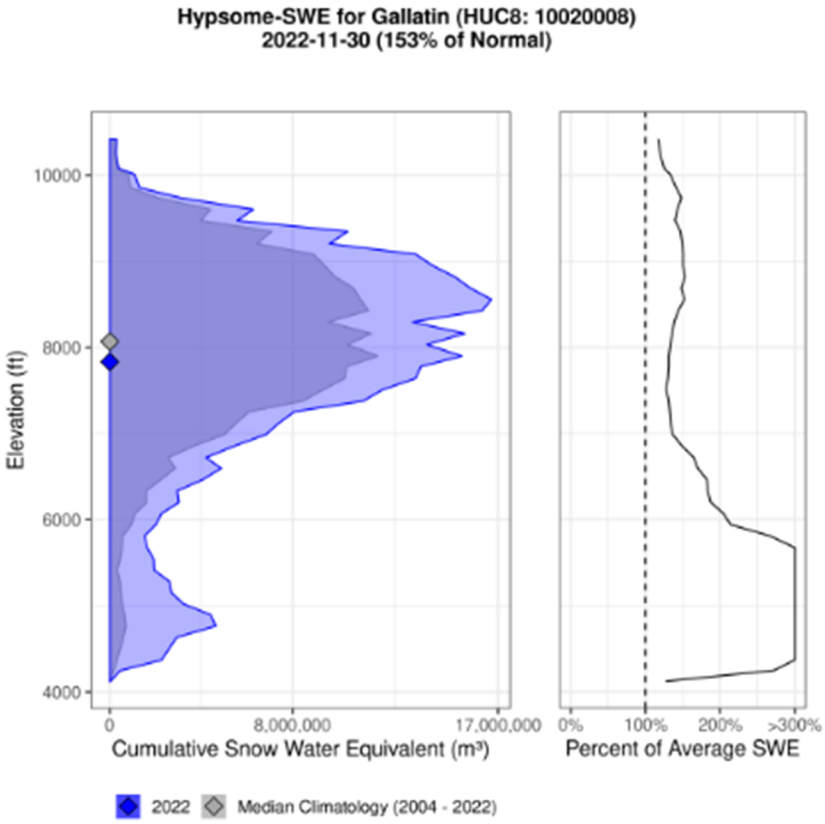
West Yellowstone Region					
Station Name	*Date*	*Snow Depth (in)*	*SWE (in)*	*SWE % Normal*	*Normal SWE 1971-2000 (in)*
Madison Plateau	Nov. 2021	11	2.7	44	6.1
	Nov. 2022	33	7.2	118	
West Yellowstone	Nov. 2021	2	1.2	44	2.7
	Nov. 2022	-	3.9	114	
Whiskey Creek	Nov. 2021	6	1.3	34	3.8
	Nov. 2022	-	4.6	121	



Standardized SWE from SNODAS & Hypsome-SWE

Gallatin River Watershed—November 2022





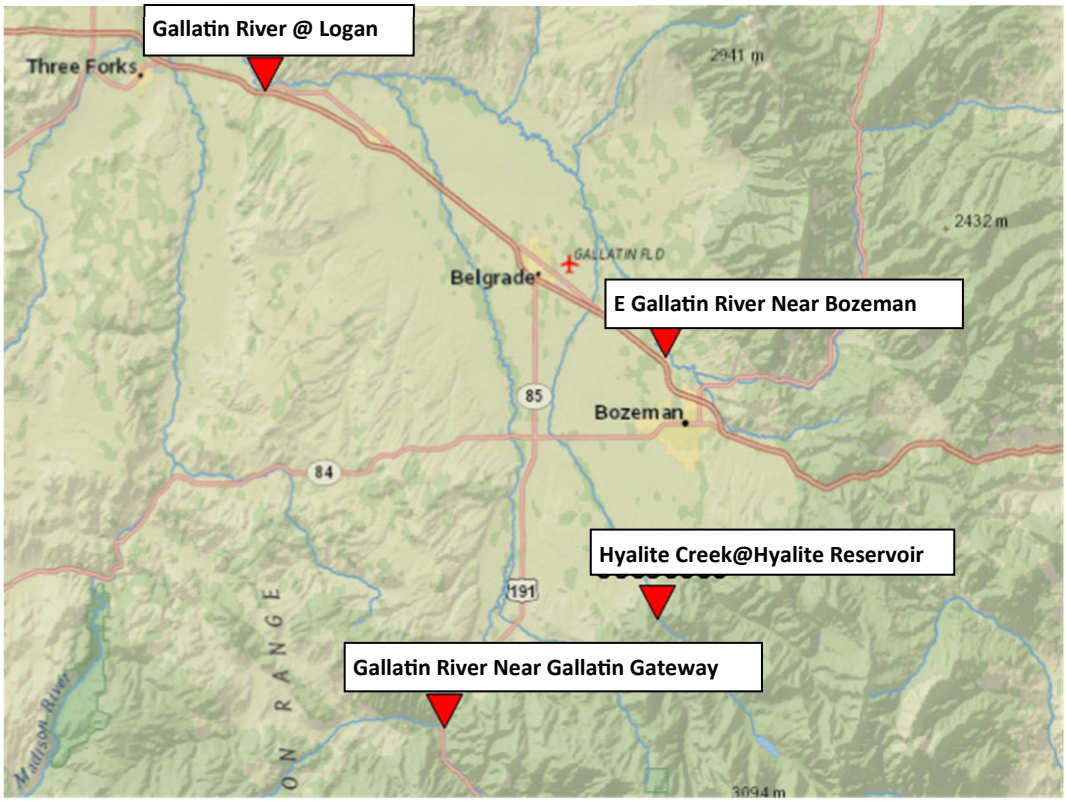
OVERVIEW *Data current as of November 30th

Left Map: This data set contains estimates of standardized snow pack anomalies based on the depth of snow water equivalent (SWE), from the NOAA National Weather Service's National Operational Hydrologic Remote Sensing Center SNOw Data Assimilation System (SNODAS). SNODAS is a modeling and data assimilation system created to provide the best possible estimates of snow cover and associated parameters to support hydrologic modeling and analysis. Negative (red) values represent lesser than average SWE while positive (blue) values represent greater than average SWE. Standardization is based on data from 2004-present and computed daily.

Right Graph: Hypsome-SWE represents a method to evaluate the distribution of SWE across watersheds. Hypsome-SWE is loosely based on the concept of hypsometry, the area-elevation relationship of a basin. Instead of evaluating the area-elevation relationship, here they evaluate the cumulative SWE (m3)-elevation relationship. More specifically, in this module, they compare the median hypsome-SWE curve for November 30th using the SNODAS period of record (2004-present) to the November 30th, 2022 SWE distribution. This allows for a rapid assessment of the distribution of SWE within a basin with respect to elevation and allows for easy comparison to the expected distribution given the SNODAS period of record.

Streamflow Data

Gallatin River Basin—November 2022



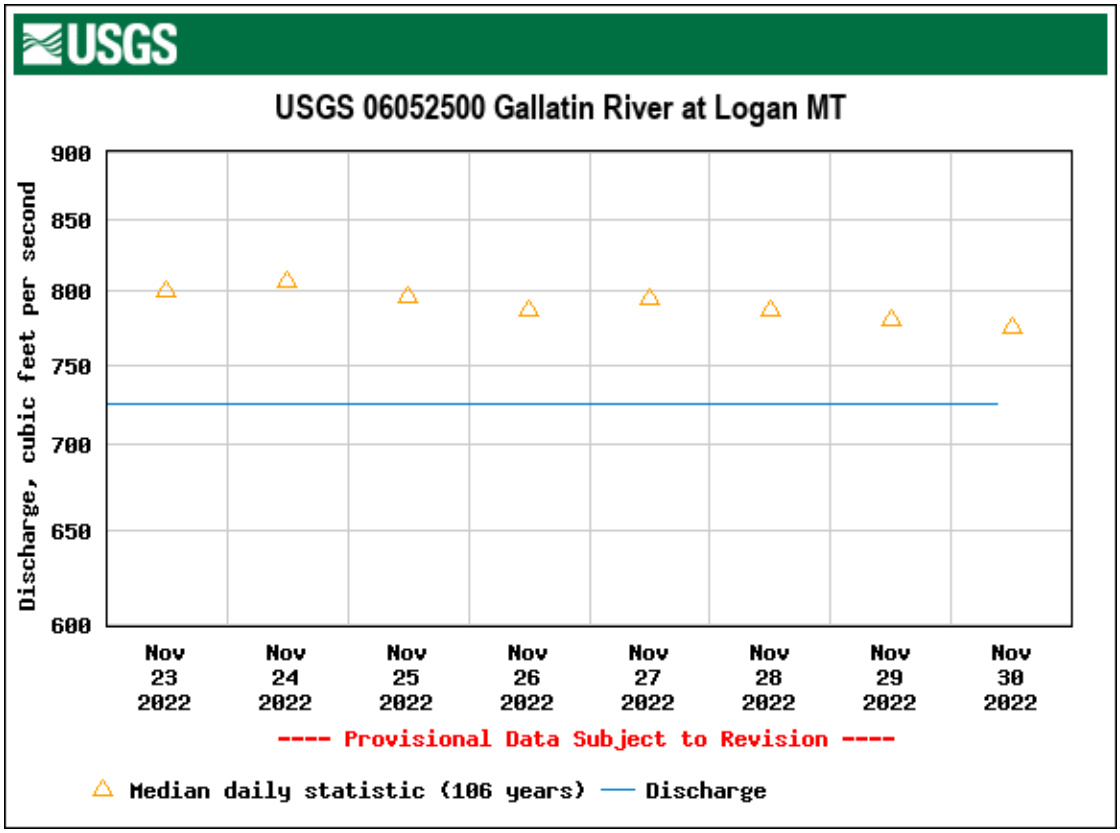
November 30th Gallatin Watershed Streamflow					
Station Name	2022 Discharge (cfs)	% Normal	Normal Dis-charge (cfs)	2021 Discharge (cfs)	Period Of Record (Yrs)
Gallatin at Logan	725	94	775	687	106
E Gallatin near Bozeman	Unavailable	Unavailable	50	45.9	8
Hyalite Creek at Hyalite Reservoir	Unavailable	Unavailable	23	26.8	68
Gallatin near Gallatin Gateway	236	72	330	347	92

STREAMFLOW SUMMARY *Data current as of November 30th

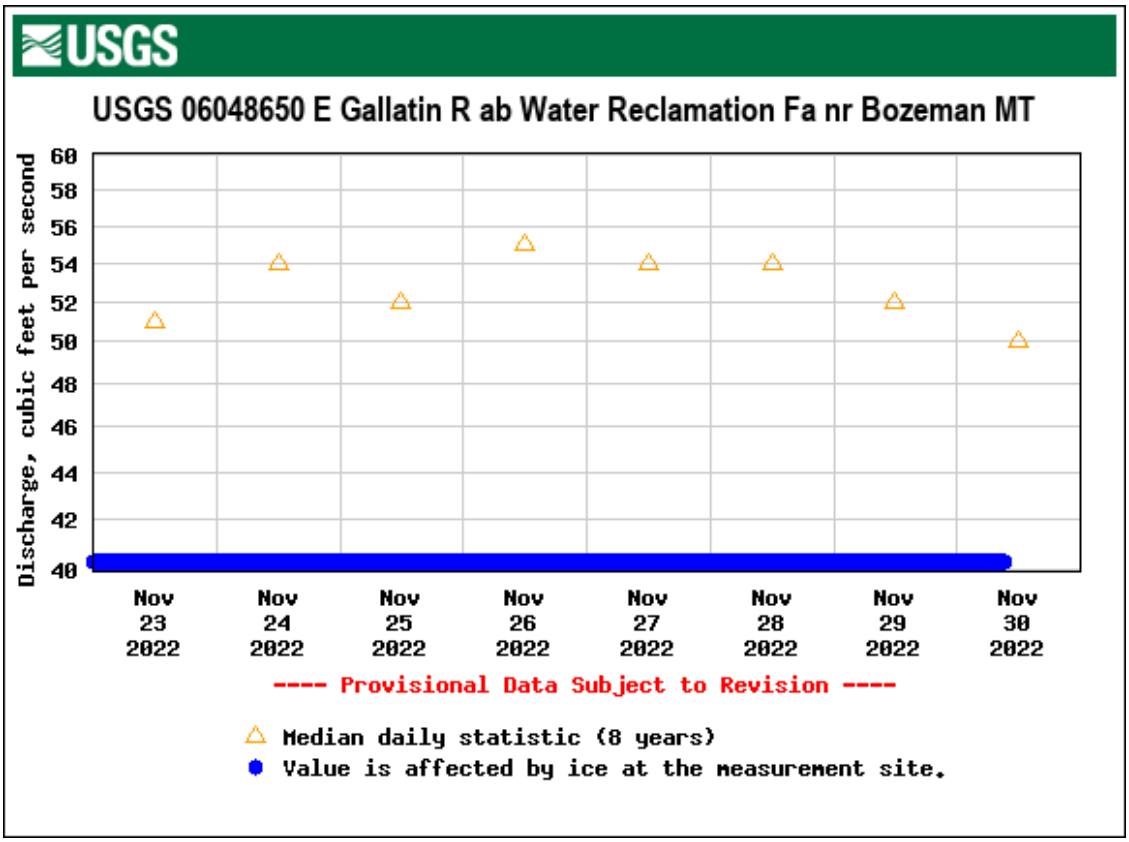
Discharge values at Gallatin at Logan are just below normal but above what they were last year at this time. Discharge values at Gallatin near Gallatin Gateway are also below normal and below what they were last year at this time. Unfortunately, data is not available at East Gallatin near Bozeman or Hyalite Creek sites.

Streamflow Data

Gallatin River Basin—November 2022



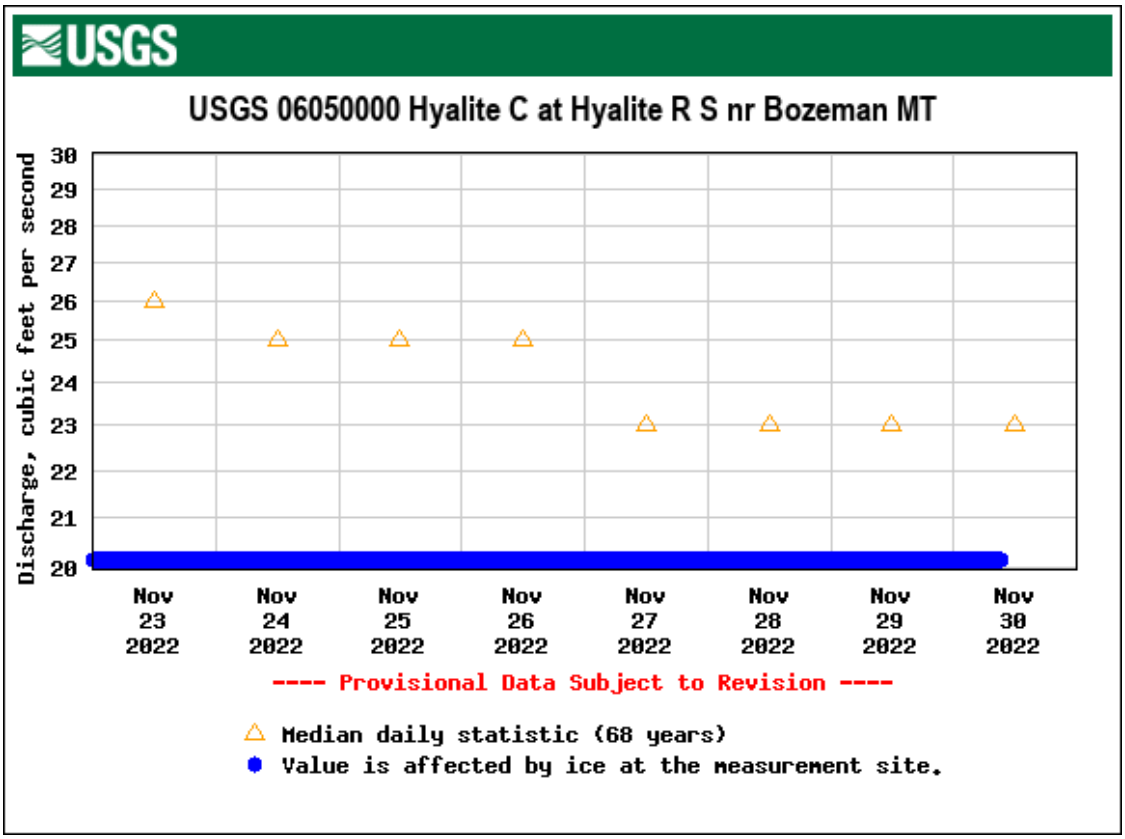
November 30th 9:00:00— Discharge is below normal.



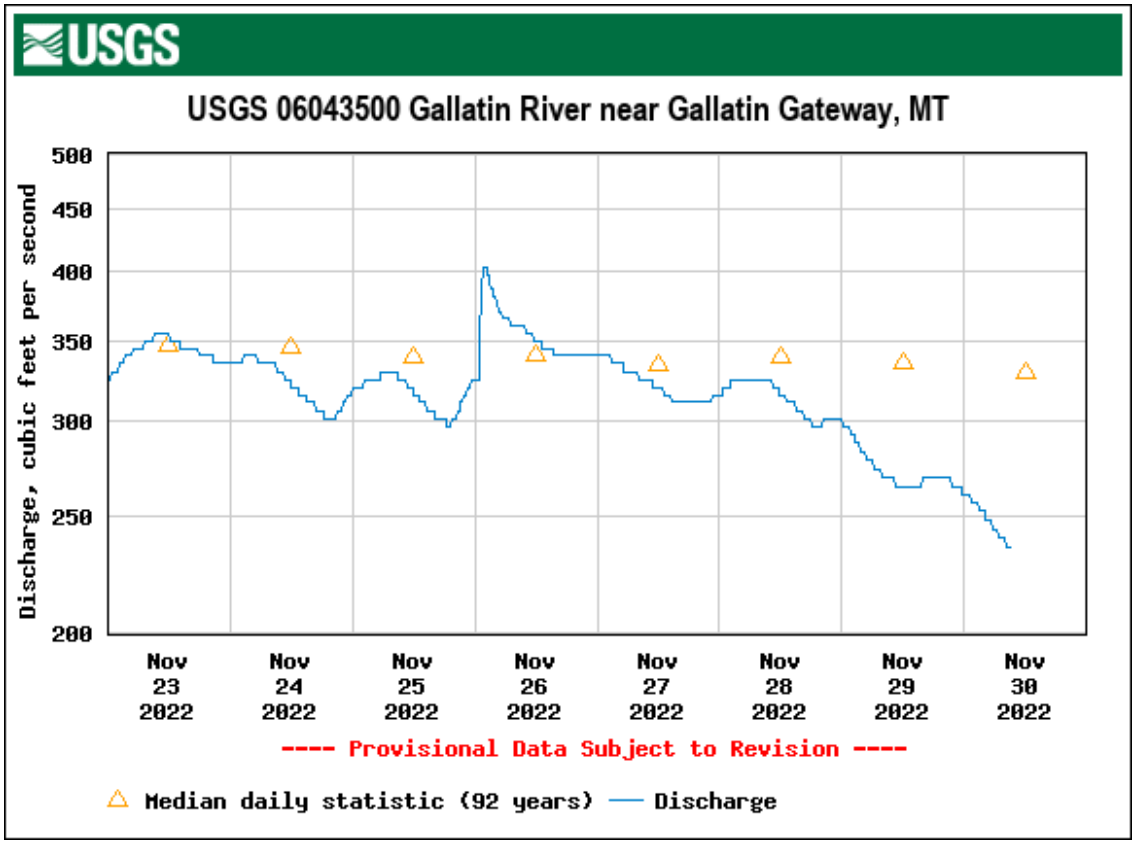
November 30th 9:30:00—Data is unavailable.

Streamflow Data

Gallatin River Basin—November 2022



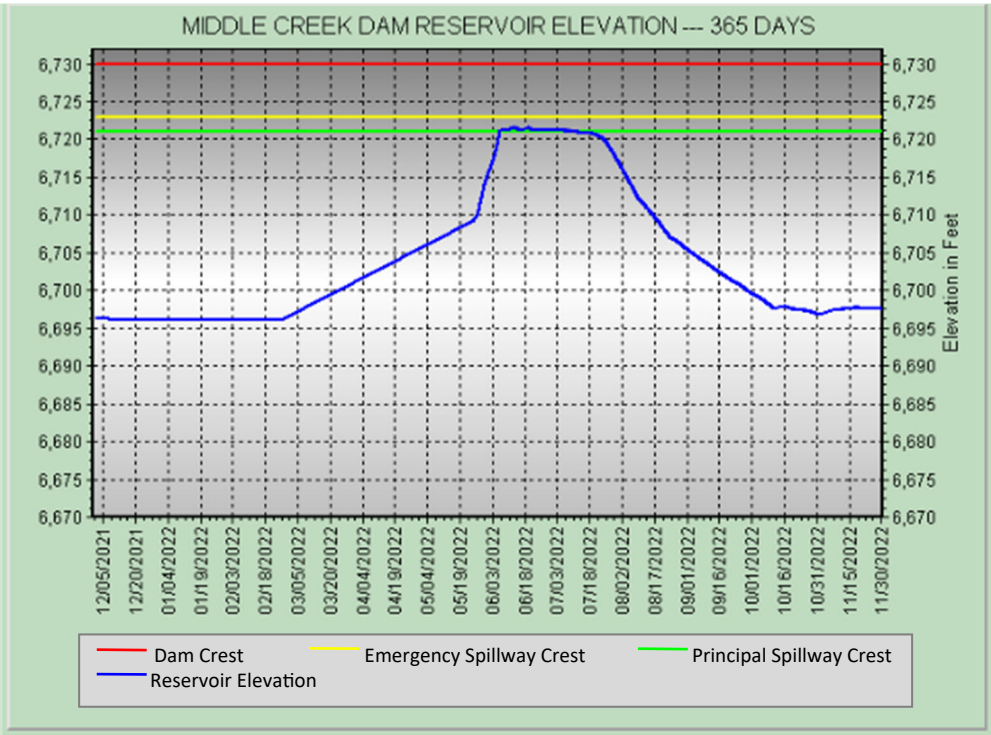
November 30th 9:30:00— Data is unavailable.



November 30th 9:00:00— Discharge is below normal.

Water Storage Data

Middle Creek Dam, Hyalite Reservoir—November 2022



TIME OF LAST READING	11/30/2022 :00 AM
RESERVOIR ELEVATION	6,697.5 FT
RESERVOIR VOLUME	5,534 AF

REFERENCE INFORMATION	FT (MSL)	AC-FT
DAM CREST	6730	12,790
EMERGENCY SPILLWAY CREST	6723	10,707
PRINCIPAL SPILLWAY CREST	6721	10,184
LOWEST USEABLE ELEVATION	6637	0

STATION LOCATION	TIME OF LAST READING	STAGE (FT)	DISCHARGE (CFS)
EAST FORK OF HYALITE ABOVE RESERVOIR	11/30/2022 9:15 AM	1.04 FT	No Data
WEST FORK OF HYALITE ABOVE RESERVOIR	11/30/2022 9:15 AM	.89 FT	8.64 CFS
MIDDLE CREEK BELOW RESERVOIR	11/30/2022 9:45 AM	.78 FT	17.41 CFS

PROVISIONAL DATA SUBJECT TO REVISION

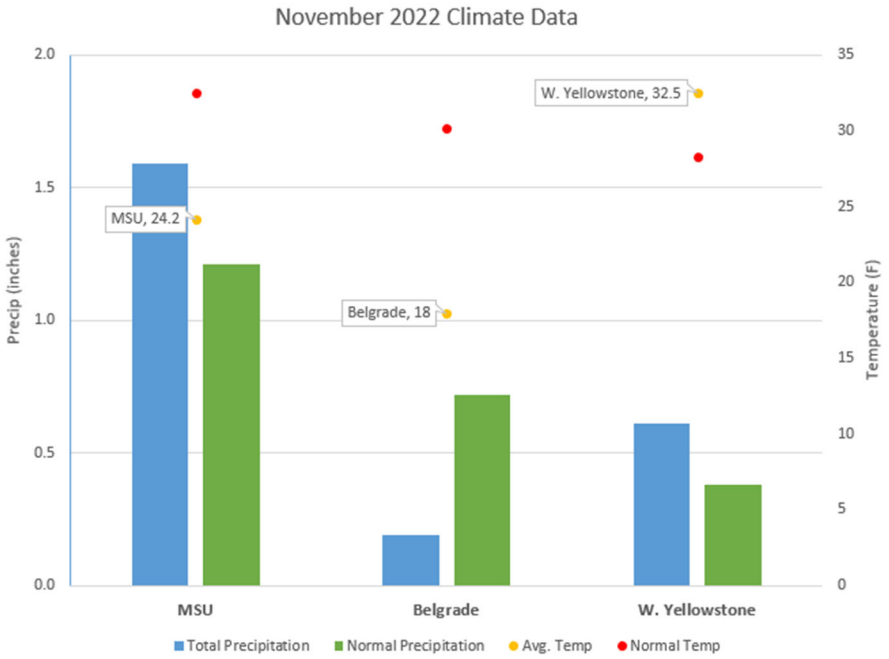
RESERVOIR SUMMARY *Data current as of November 30th

Middle Creek Dam Reservoir elevation is 6,697.5 ft which is below the principal spillway crest (6,721 ft). The reservoir elevation has increased .6 ft since November 1st, 2022 (date of last relevant WSO report). Reservoir volume 5,534 acre-ft; which is 95 acre-ft more than November 1st, 2022.

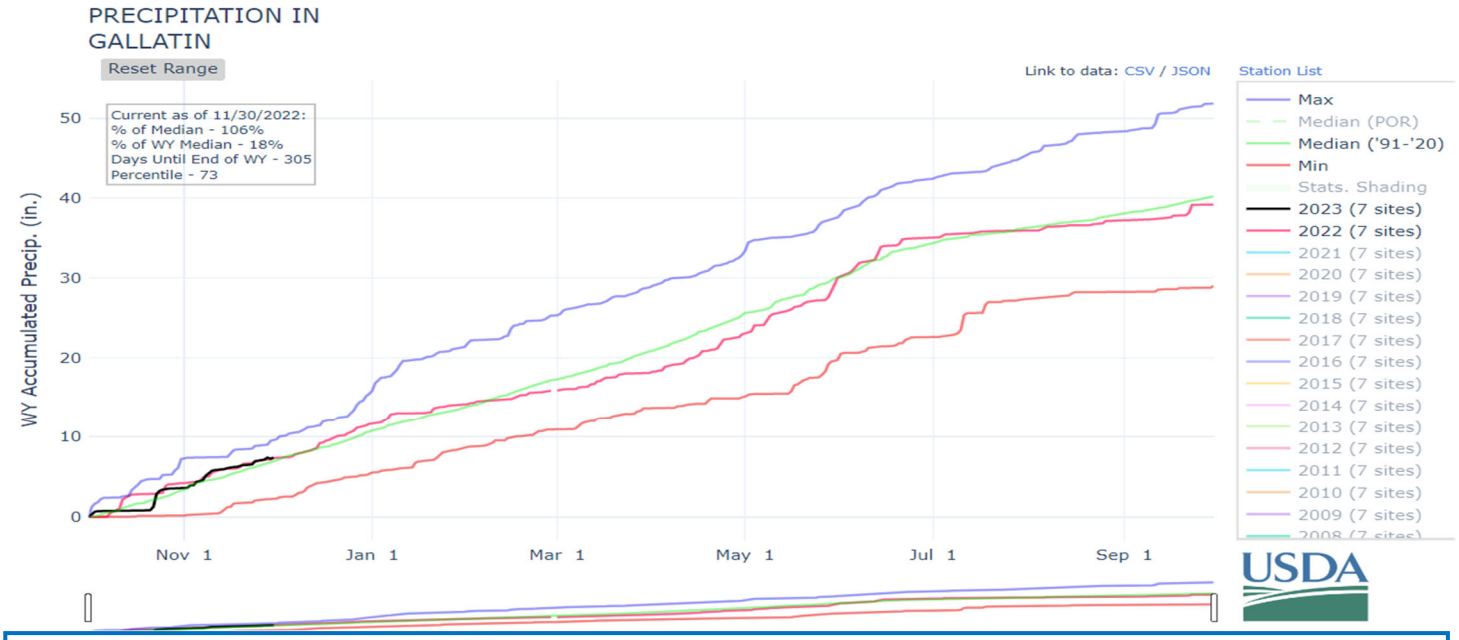
Discharge at West Fork and Middle Creek has decreased since November 1st, 2022.

Climate Data

Gallatin County—November 2022



Above graph depicting ACIS climate data representing the entire month of November.



TEMP & PRECIP SUMMARY (Water Year (WY) = October 1st—September 30)

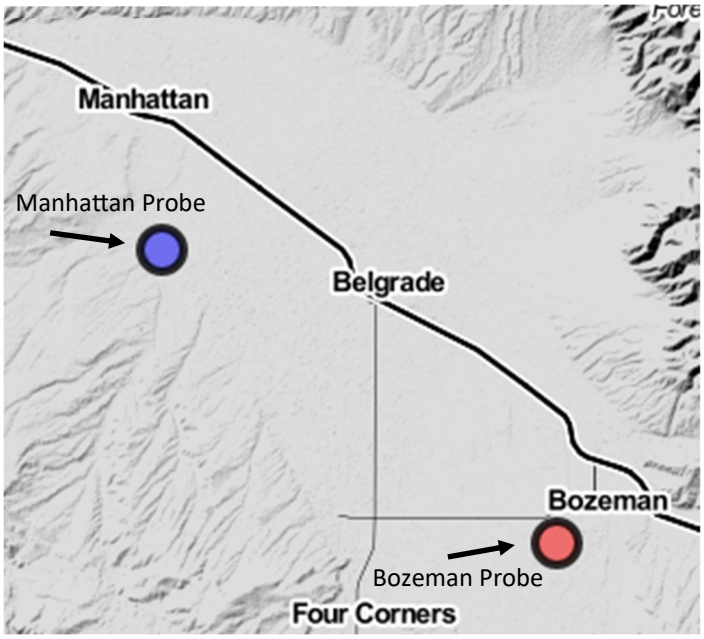
*Data is current as of November 30th

Average temperatures have decreased at the MSU, Belgrade, and West Yellowstone sites since October 2022 (ACIS graph). November has been cold in the valley. The MSU and Belgrade temperatures are below normal for this time of year. Precipitation totals for the month of November were above normal at the MSU and West Yellowstone sites but below normal at the Belgrade site.

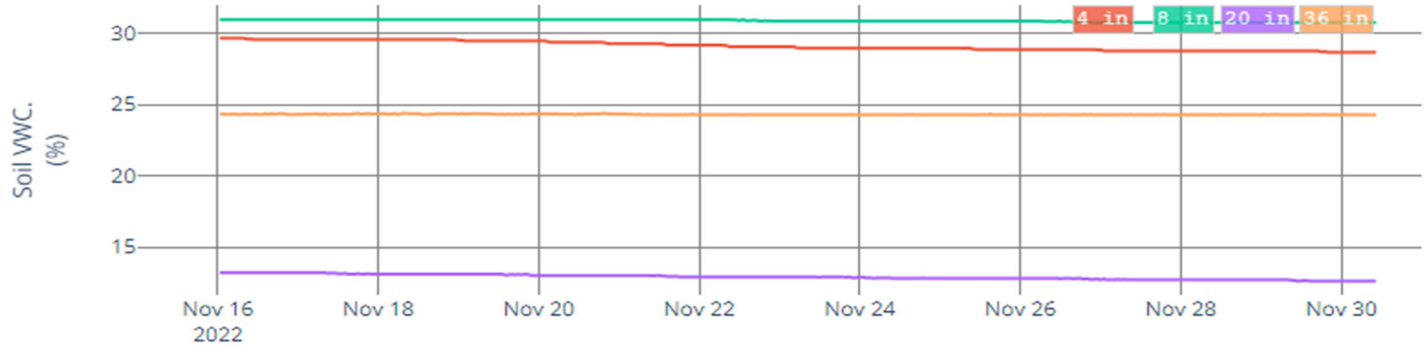
We are currently in Water Year 2023 (black line). The total accrued precipitation for the Gallatin River Basin as of November 30th, 2022 is above the average (median) at 7.4 inches (USDA graph). The total accrued precipitation for WY 2022 on November 30th, 2021 was 7.3 inches (central pink line).

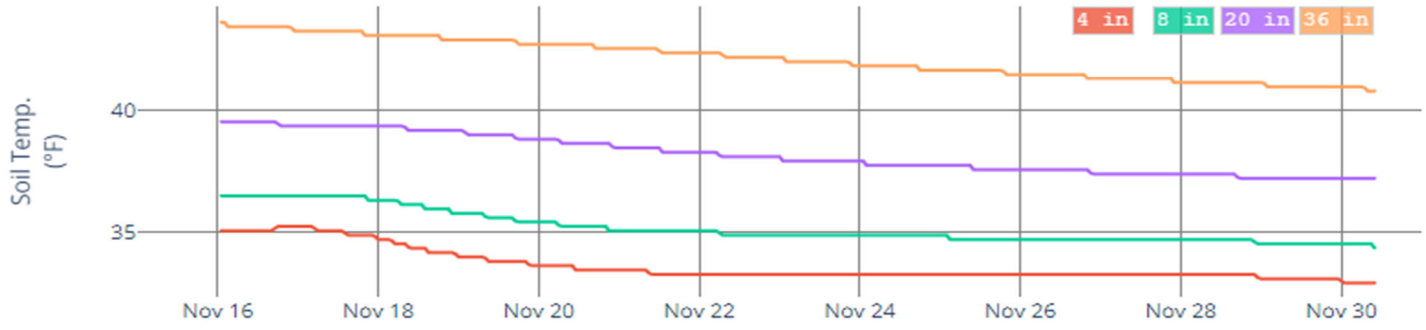
Soil Moisture Data

Mesonet Stations—November 2022



Manhattan Soil Probe Depth (in)	Soil Temp (°F)	Soil Water Content (%)
4" - Surface	32.90	28.70%
8" - Shallow rooting	34.34	30.80%
20" - Deep Rooting	37.22	12.60%

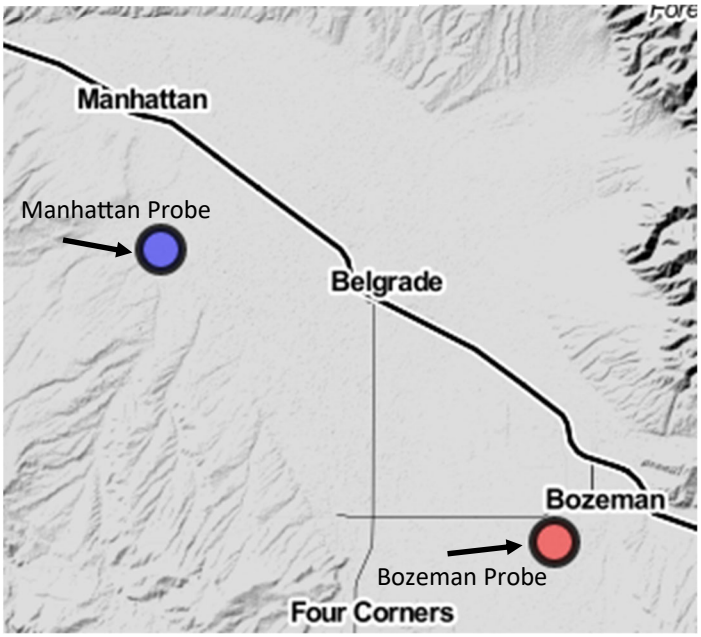




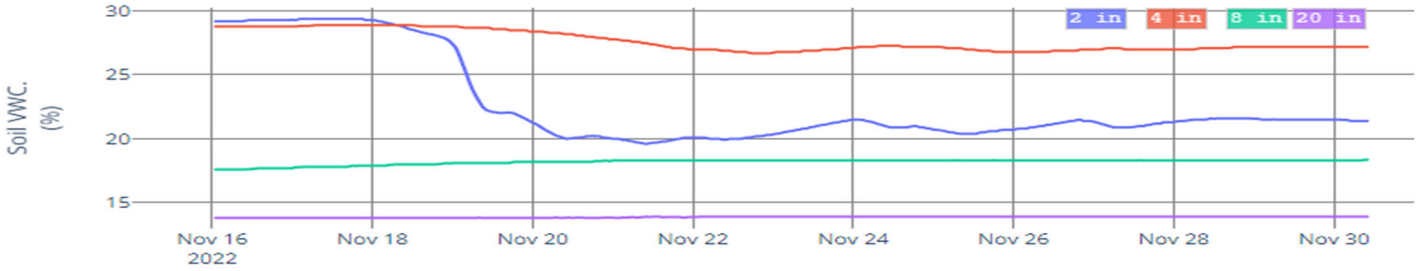
Soil moisture and temperature data for the Manhattan probe on November 30th 2022 is shown in the above table and graphs. See next page for the Bozeman probe information for November 30th 2022 and soil moisture summary data.

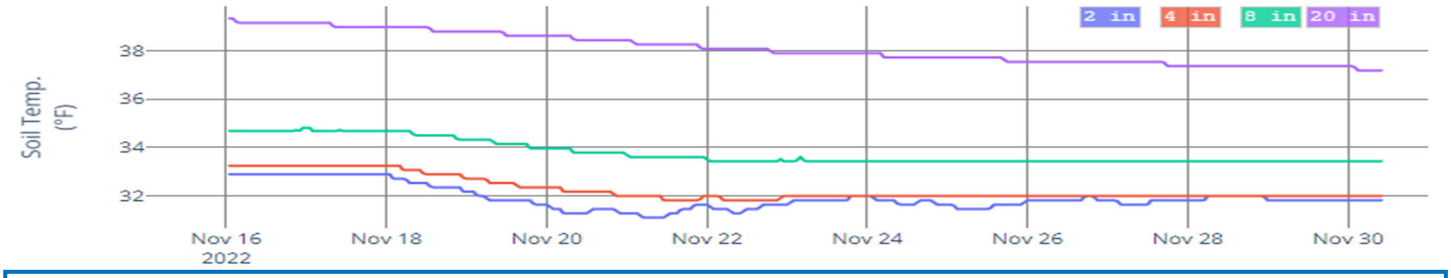
Soil Moisture Data

Mesonet Stations—November 2022



Bozeman Soil Probe Depth (in)	Soil Temp (°F)	Soil Water Content (%)
4" - Surface	32.00	27.20%
8" - Shallow rooting	33.44	18.40%
20" - Deep Rooting	37.22	13.90%



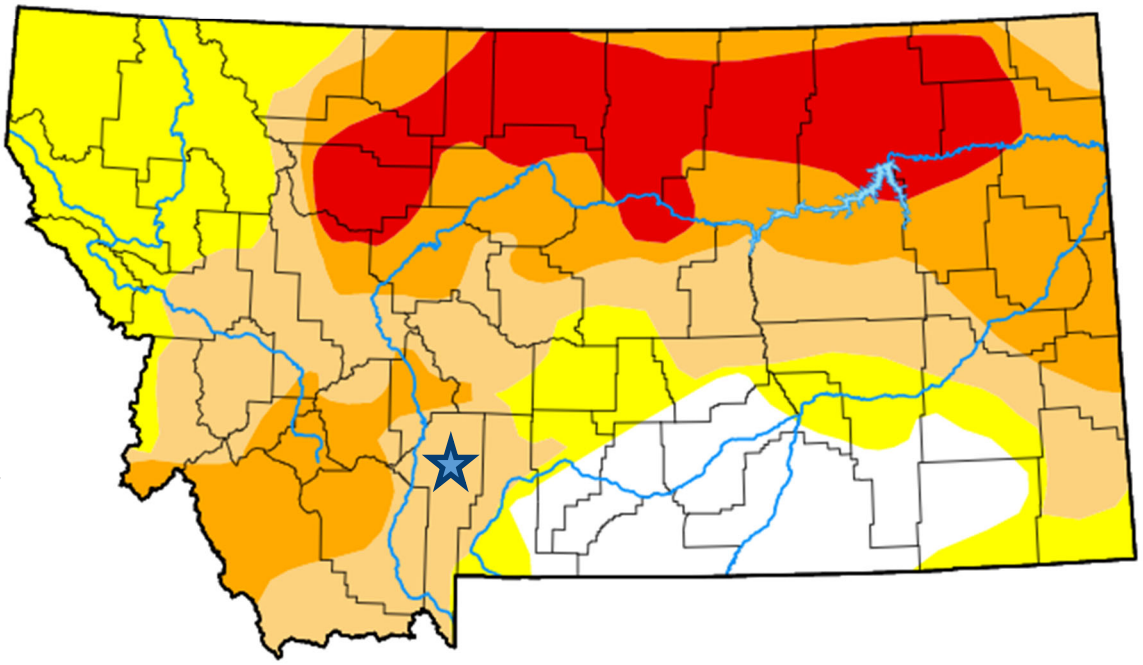


SOIL MOISTURE SUMMARY *Data current as of November 30th

At both stations, the soil temperatures have decreased at all depths. At the Manhattan station, soil water content has decreased at all depths since October 2022. The Bozeman station's soil water content has decreased at 4", increased at 8", and remained the same at 20" since October 2022.

Drought Index Data

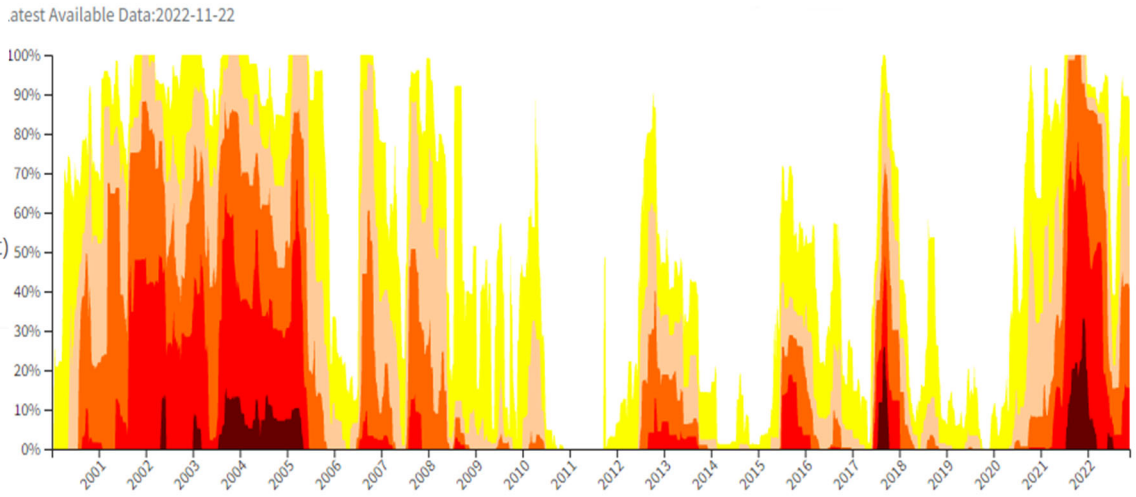
Gallatin County—November 2022



= Gallatin County

Intensity:

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)
- D3 (Extreme Drought)
- D4 (Exceptional Drought)
- No Data



DROUGHT INDEX SUMMARY *Data is current as of November 22nd

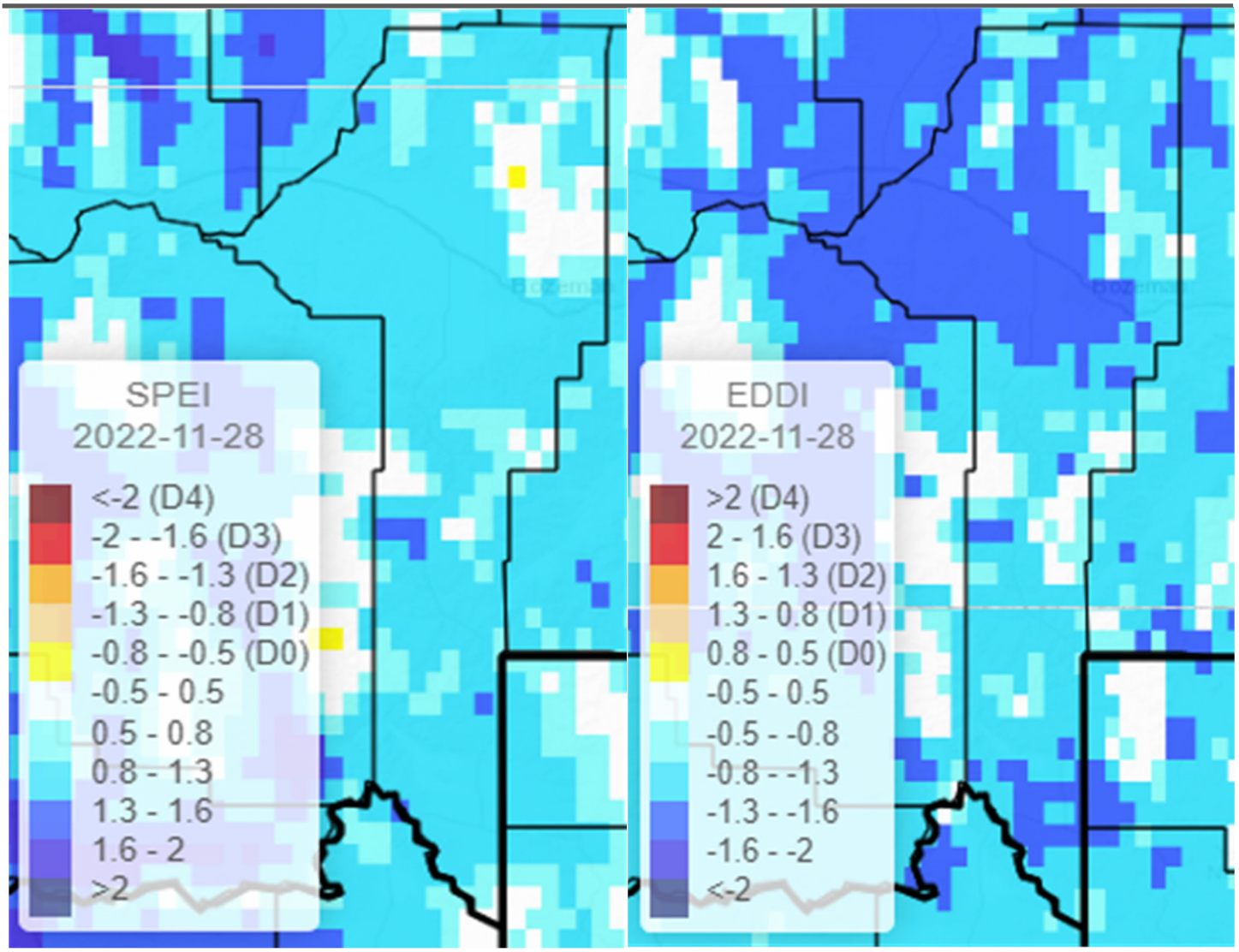
03.55% of Gallatin County is experiencing Abnormally Dry Drought conditions. Impacts include low soil moisture contributing to poor crop germination and dry pastures, increased fire danger, and low streamflow with impacts to recreational fishing.

96.42% of Gallatin County is experiencing Moderate Drought conditions. Impacts include feeding livestock supplemental hay, crops are stressed and growth is poor. Fire restrictions may be implemented.

0.03% of Gallatin County is experiencing Severe Drought conditions. Impacts include lower hay and crop yields, lower hay quality, non-existent subsoil moisture, high danger and fire count, poor air quality, low to dry livestock ponds, and stressed water wells.

Standardized Precipitation Evapotranspiration Index

Evaporative Demand Drought Index



SPEI & EDDI Overview *Data is current as of November 28th

The maps above show the current Standardized Precipitation Evapotranspiration Index (SPEI, Left) and Evaporative Demand Drought Index (EDDI, Right) for the month of November 2022.

SPEI takes into account both precipitation and potential evapotranspiration to describe the wetness (positive blue values) or dryness (negative red values) of a time period. SPEI has been calculated for the month of November 2022 to represent drought impacts on hydrological conditions for the past 30 days. SPEI incorporates the important effect of atmospheric demand on drought.

EDDI has examined how deviated from normal the atmospheric evaporative demand is for Gallatin County for the month of November 2022. EDDI is an experimental drought monitoring and early warning guidance tool. EDDI can offer early warning of agricultural drought, hydrologic drought, and fire-weather risk. Positive (red) values represent dryness categories while negative (blue) values represent wetness categories.

Gallatin County Water Supply Outlook

Source Information & Helpful Links

Gallatin Conservation District:

- Archive of Reports
- Understanding the Gallatin Water Supply Outlook Report Guide

Snowpack:

- USDA / NRCS Interactive Map
- Montana Snow Survey Homepage
- NRCS / NWCC National Water & Climate Center
- Standardized Snow Water Equivalent (SWE from SNODAS & Hypsome –SWE

Streamflow:

- USGS Real Time Streamflow
- State of Montana Gaging Stations
- DNRC Water Right Query System

Water Storage:

- DNRC Water Projects—Middle Creek Real Time Data
- Middle Creek Early Warning System
- BOR—Montana Lakes and Reservoirs
- DNRC State Water Projects—Reservoir Storage Data

Climate:

- ACIS Database
- NRCS Montana Basin-Wide Products
- Montana Snow Survey Homepage
- US Climate Data

Soil Moisture:

- Montana Mesonet
- DNRC Drought Status by County

Drought:

- US Drought Portal
- US Drought Monitor

SPEI & EDDI: Standardized Precipitation Evapotranspiration Index, Evaporative Demand Drought Index

Helpful Partner Websites:

- Department of Natural Resources & Conservation
- Gallatin County MSU Extension Office
- Gallatin Local Water Quality District
- Gallatin River Task Force
- Gallatin Watershed Council
- Montana Fish, Wildlife, & Parks
- Natural Resource Conservation Services
- One Montana
- Association of Gallatin Agricultural Irrigators