

Breaking Down Water Year Type

Presentation for CITT 5/9/24

Statistical Terms

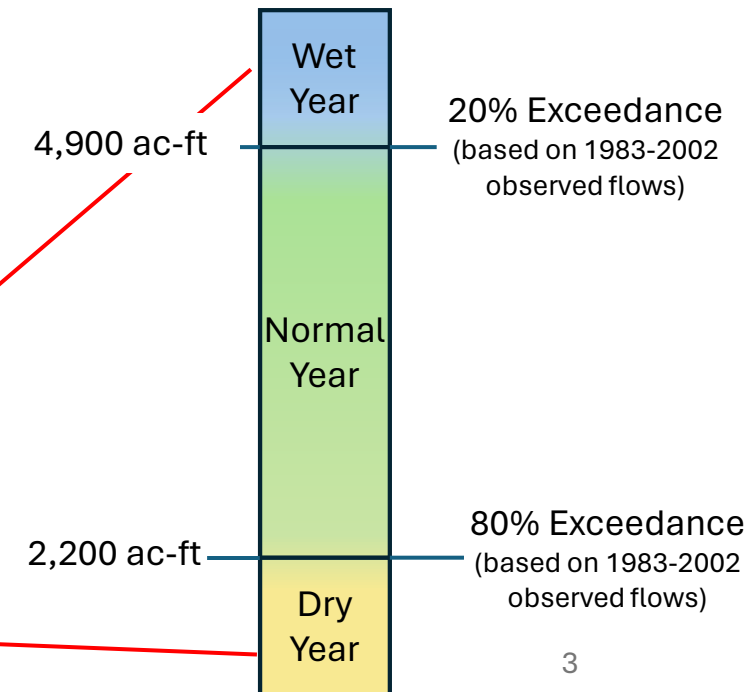
- **Percentile:**
 - A metric that expresses where a specific value falls within a dataset.
 - Example, if a child is in the 85th percentile of height for their age that means they are as tall or taller than 85% of children their age.
- **Percent Exceedance:**
 - A statistic that represents the probability that a given value will be equaled or exceeded.
 - Calculated by subtracting the percentile value from 100 percent.
 - Example, a flow rate at the 75th percentile would have a 25% exceedance probability (100-75=25).
 - Adapted from <https://help.waterdata.usgs.gov/faq/surface-water/what-is-a-percentile>
- **100th Percentile (0th percent exceedance level):** The highest observed value in a dataset
- **Median (50th percentile):** The middle number in a dataset
- **0th Percentile (100th percent exceedance level):** The lowest observed value in a dataset
- *note that percent exceedance refers to the probability of something happening in the future (based on previous data) and percentile refers to where a given value falls within a dataset

Water Year Thresholds (Appx 3.7)

- Determined based on the 1983-2002 study period
- Three geographic areas: Jocko, Mission, and Little Bitterroot
- Hydrological conditions determined from modeled natural flows (using the HYDROSS model) at the mouth of major streams
- Wet Year: < 20% Exceedance, Normal Year: 20%- 80% Exceedance, Dry Year: > 80% Exceedance
- Observed natural flow at upstream indicator gages used as a surrogate for the purposes of establishing a water year type
- Example: Little Bitterroot Area

Table 1: April 2024 Water Year and NRCS Streamflow Forecast¹

Area	Gage Site	April NRCS Streamflow Forecast, April- July 2024				Site-Specific Water Year Thresholds		
		70% Exceedance	50% Exceedance	30% Exceedance	% of 30 yr Median	Dry Year	Normal Year	Wet Year
Jocko	South Fork Jocko near Arlee	22,000	25,000	29,000	71%	<24,000	24,000 - 36,000	>36,000
Mission	Mission Creek near St. Ignatius	23,000	25,000	27,000	96%	<21,100	21,100 - 29,000	>29,000
	South Crow Creek near Ronan	8,600	9,300	10,500	91%	<7,700	7,700 - 11,800	>11,800
	Hellroaring Creek	3,200	3,500	4,000	85%	<3,350	3,350-4,750	>4,750
Little Bitterroot	Mill Creek above Bassoo Creek near Niarada	2,100	2,600	3,100	55%	<2,200	2,200 - 4,900	>4,900



Exceedance Probability

- Exceedance probability listed in the streamflow forecast section is based on the NRCS’s M4 forecasting model.
- This model was updated in 2024 with increased modeling improvement and to add two new gaging sites
- The model uses machine learning and a variety of statistical approaches, takes into account snowpack, antecedent conditions
- Example: For the Jocko Area
 - 30% chance that actual streamflow for April-July will be greater than 29,000 ac-ft,
 - 50% chance that flow will be greater than 25,000 ac-ft,
 - 70% chance that flow will be greater than 22,000 ac-ft

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% of 30 Year Median

- Median based on the 1991-2020 dataset
- Example: Mission Creek
 - NRCS forecast 50% exceedance probability is 25,000 acre-feet
 - 50% chance that streamflow for Mission Creek for April-July will be greater than 25,000 ac-ft
 - The 30-year median is 26,000 acre-feet
 - The 50% exceedance level is 96% of the 30 year median

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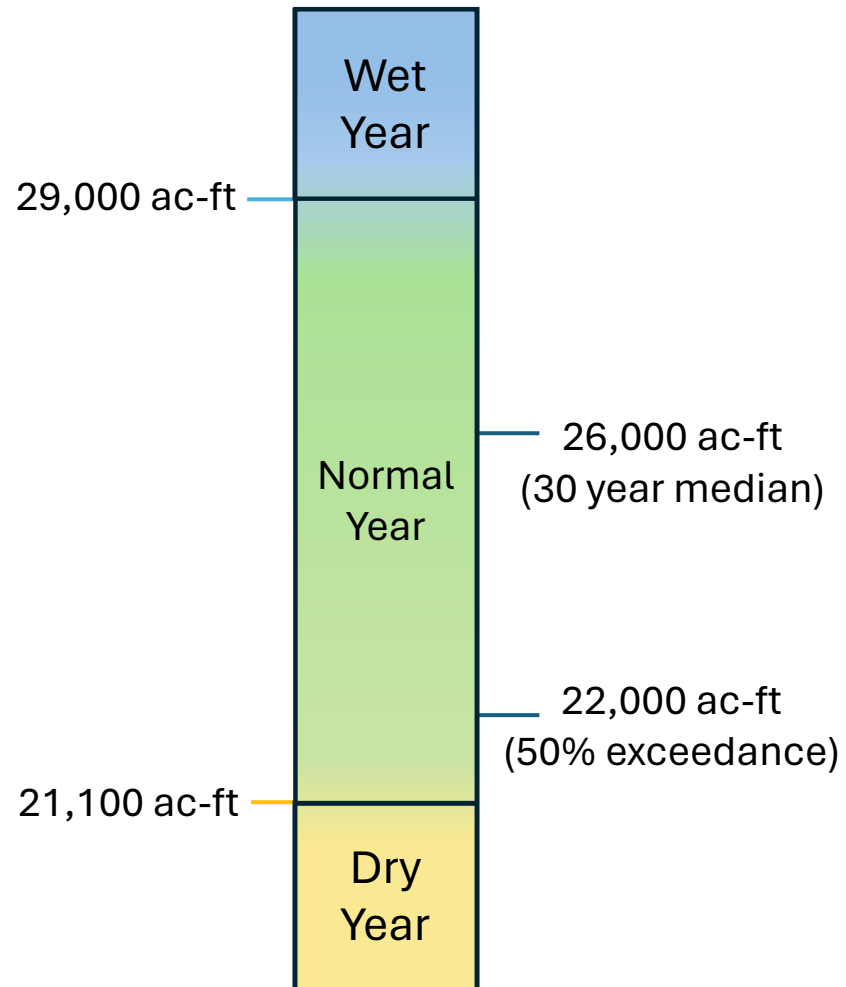
Streamflow Forecast Summary: April 1, 2024
(Medians based On 1991-2020 reference period)

Flathead	Forecast Period	Forecast Exceedance Probabilities For Risk Assessment Chance that actual volume will exceed forecast						30yr Median (KAF)
		90% (KAF)	70% (KAF)	50% (KAF)	% Median	30% (KAF)	10% (KAF)	
Mission Ck nr St. Ignatius	APR-JUL	21	23	25	96%	27	30	26
	APR-SEP	24	27	29	94%	32	36	31

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Normal Years Can Feel Dry



- Example Mission Creek
- If the April forecast the 50% exceedance probability was 22,000 ac-ft
- 85% of the 30 year median
- Drier than “normal” but still in the normal category
- *Note: the 50% exceedance level in this example is hypothetical; all other numbers are factua;

From Geographic Areas to Gages

- Appendix 3.7 lists Wet, Normal, and Dry Year thresholds for each geographic area
- Values established for combined April-July flow
- Hydrological conditions determined from natural flows at major streams
- Observed natural flows at indicator gages in each area were used to determine water year thresholds for each geographic area

Table 5.1: Hydrologic Condition Based on April-July Flow at Indicator Gages

<i>Hydrologic Condition</i>	<i>Jocko Area</i>	<i>Mission Area</i>	<i>Little Bitterroot Area</i>
	Combined April through July flow at: <ul style="list-style-type: none"> • South Fork Jocko River (USGS Gage 12381400) • Agency Creek above Jocko S Canal (CSKT Gage 5167.00) 	Combined April through July flow at: <ul style="list-style-type: none"> • South Crow Creek (USGS Gage 12375900) • Mission Creek above Reservoir (USGS Gage 12377150) • Hellroaring Creek above Reservoir (CSKT Gage 0060.00) • North Crow Creek at Campground (CSKT Gage 3512.00) 	April through July Flow at: <ul style="list-style-type: none"> • Mill Creek above Bassoo Creek (USGS Gage 12374250)
<i>Wet Year</i>	> 41,500 AF	> 66,500 AF	> 4,900 AF
<i>Normal Year</i>	29,000 AF – 41,500 AF	46,500 AF – 66,500 AF	2,200 AF – 4,900 AF
<i>Dry Year</i>	< 29,000 AF	< 46,500 AF	< 2,200 AF

From Geographic Areas to Gages

- Some 20% and 80% values are interpolated to determine the precise Wet, Normal, and Dry Year thresholds for each gage
- Combined gage results for each area to determine water year thresholds
- Example: Hellroaring Creek

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Table 3.4: Mission Area

Hellroaring Cr (60.00)

Rank	Exceedance Probability	Apr-Jul Flow (AF)	Year
1	5%	7,310	1997
2	10%	5,785	1996
3	14%	4,892	1990
4	19%	4,786	1983
5	24%	4,636	1991
6	29%	4,629	1984
7	33%	4,342	1985
8	38%	4,251	1993
9	43%	4,136	1998
10	48%	4,033	1989
11	52%	3,832	1986
12	57%	3,771	1995
13	62%	3,641	1994
14	67%	3,626	2000
15	71%	3,612	2002
16	76%	3,390	2001
17	81%	3,334	1999
18	86%	3,255	1987
19	90%	3,156	1992
20	95%	2,998	1988

20% Threshold	
19	4,786
20	4,756
21	4,726
22	4,696
23	4,666
24	4,636

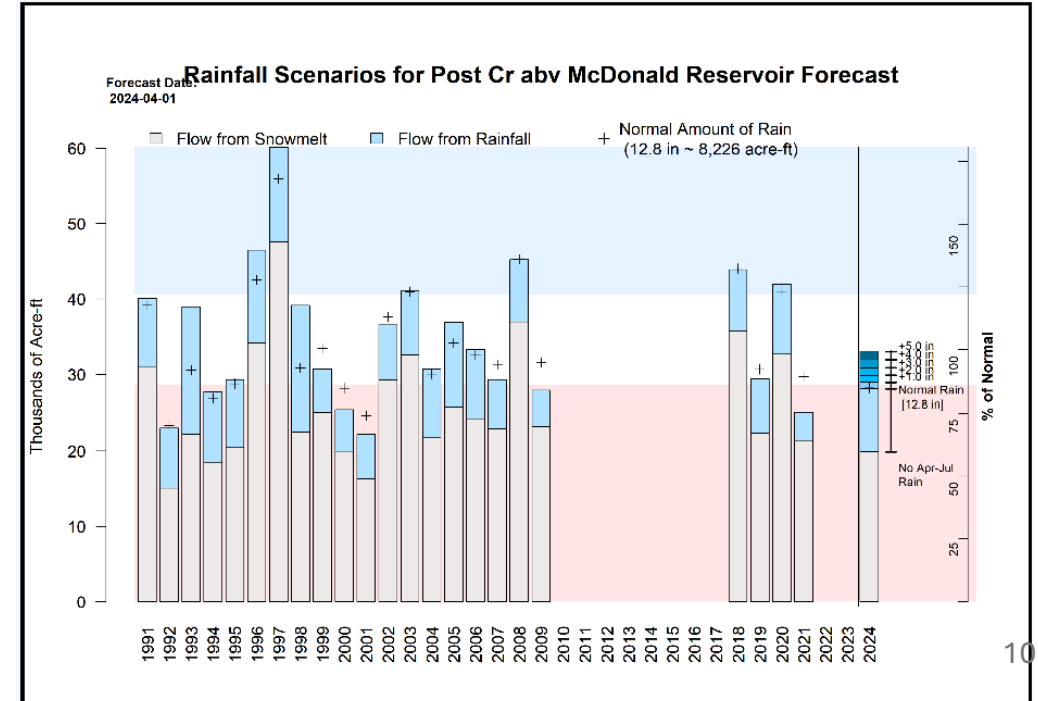
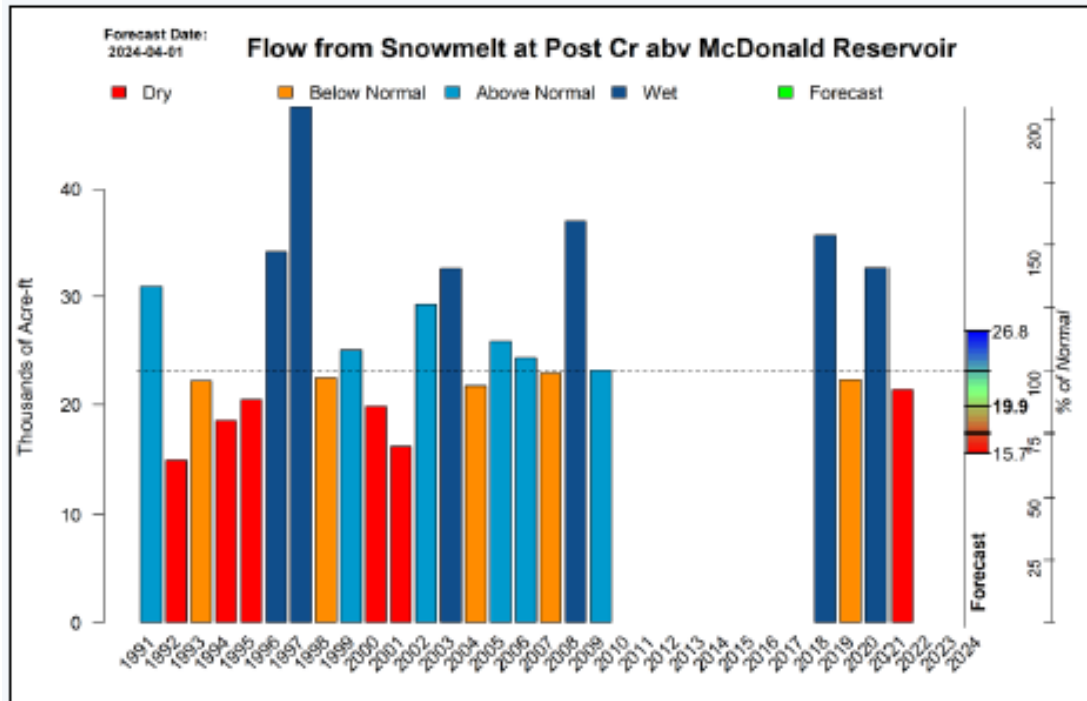
80% Threshold	
76	3,390
77	3,379
78	3,368
79	3,356
80	3,345
81	3,334

Post Creek Water Supply Forecast

- Generated by Todd Blythe in DNRC's Water Sciences Bureau
- Forecasts in March, April, and May
- Similar methodology to NRCS forecasting
- Used for informational purposes/ FIIP planning
- Not part of water year categorization
- Predicts water supply based on snow melt with different precip scenarios

Post Creek Water Supply Forecast

- Example: April 2024
 - The April 1 water supply forecast predicts a below normal volume of 19,344 acre-feet (Figure 3) of water from snowmelt, or 83% of 1991-2021 median
 - With a normal amount (12.8 inches) of rain from April 1 – July 31, the total runoff is predicted to be 27,569 acre-feet (5,723 acre-feet less than normal)



Data Sources

- % of 30 Year Median and Exceedance Probabilities
 - <https://www.nrcs.usda.gov/wps/portal/wcc/home/snowClimateMonitoring/snowpack/basinDataReports/>
- Water Year Type Thresholds
 - https://dnrc.mt.gov/_docs/water/Appendix_3.7_Wet_Norm_Dry_2015-01-08.pdf
- Post Creek Water Supply Forecasts
 - https://dnrc.mt.gov/Water-Resources/Water-Planning-Implementation-and-Communications/Resources-Project-Guidance-and-Planning/Water_Commissioner/Forecasting
- Water Supply Outlook Reports
 - <https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/montana/montana-snow-survey/water-supply-outlook-reports-montana>
- SWE Plots
 - <https://nwcc-apps.sc.egov.usda.gov/basin-plots/#MT>