

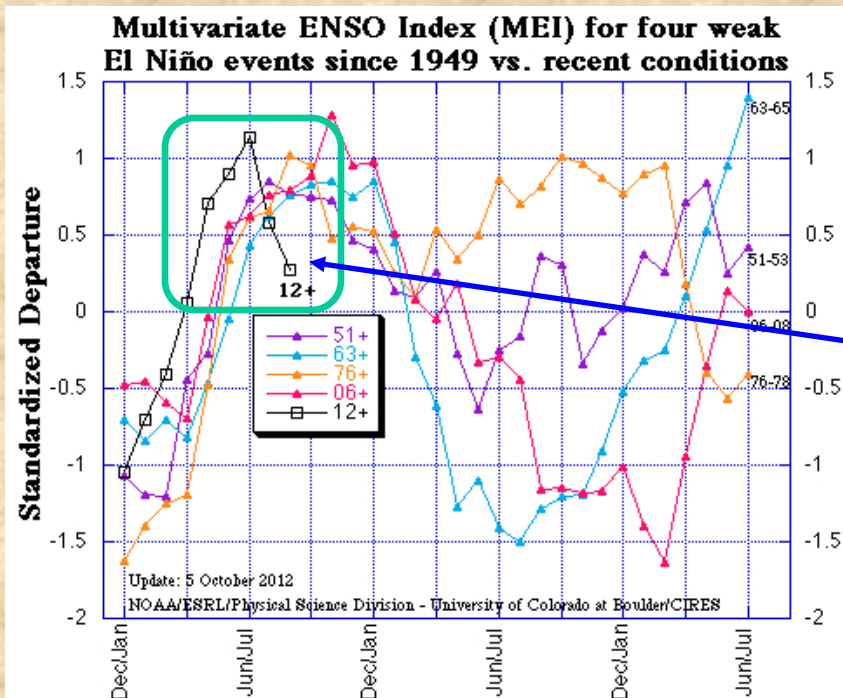
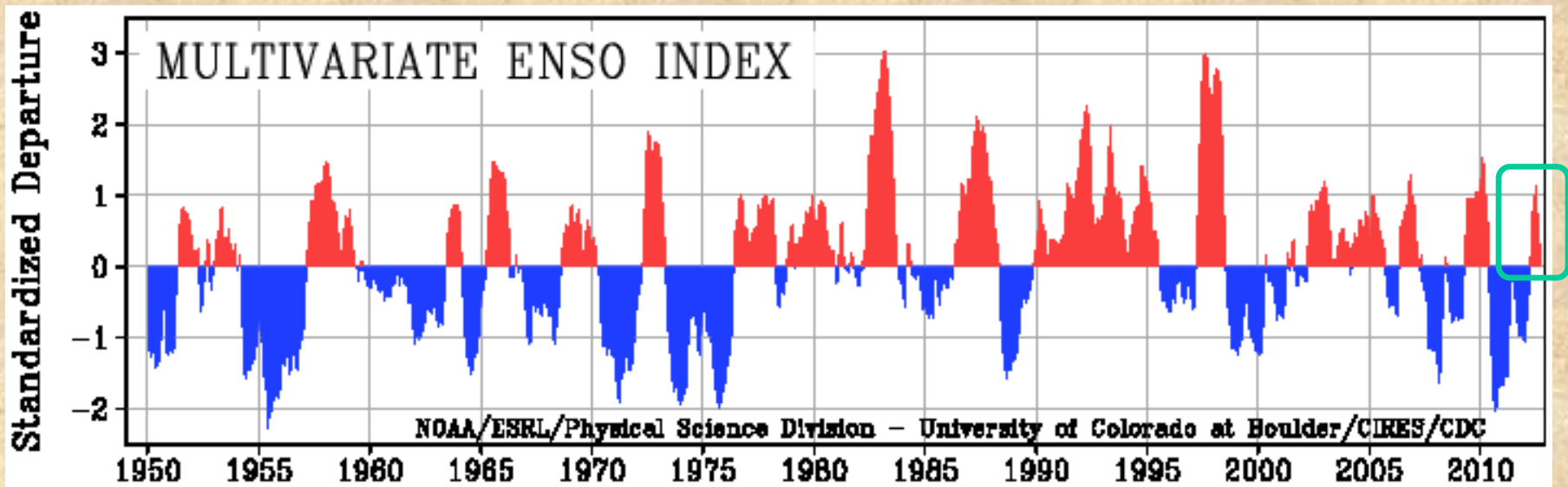
**Autumn
2012**



October 16th, 2012

UPPER COLORADO RIVER BASIN DROUGHT EARLY WARNING SYSTEM

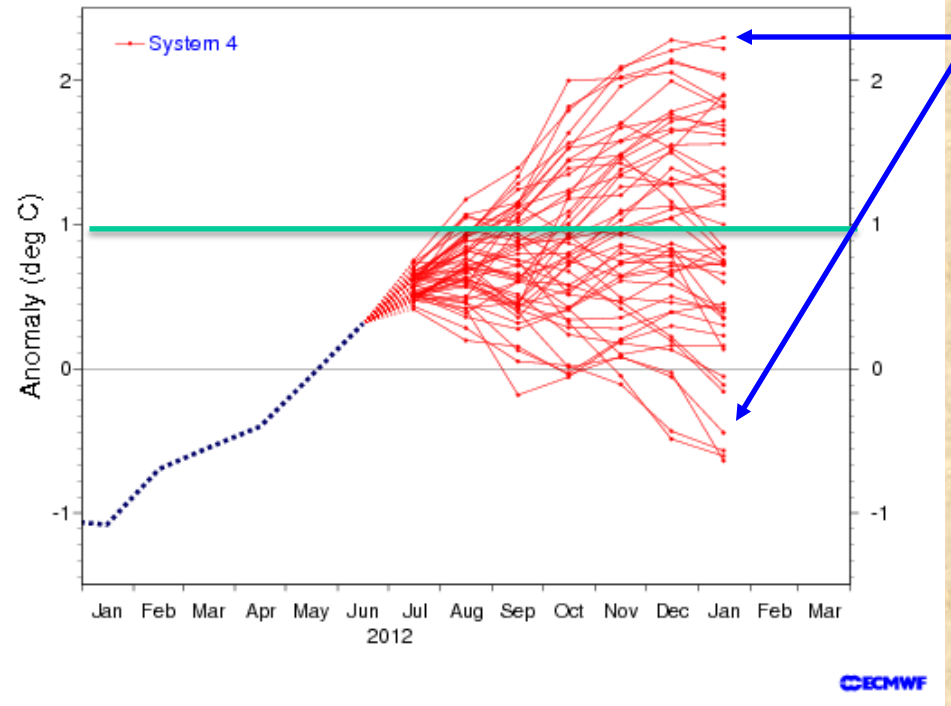
Weekly Climate, Water & Drought Assessment



2010-12 La Niña event reached its biggest peak since the mid-70s in late 2010, followed by a brief excursion to ENSO-neutral conditions during mid-2011; it reached a second peak last winter, and has been followed by a weak El Niño event that may already have come and gone.

<http://www.esrl.noaa.gov/psd/enso/mei>

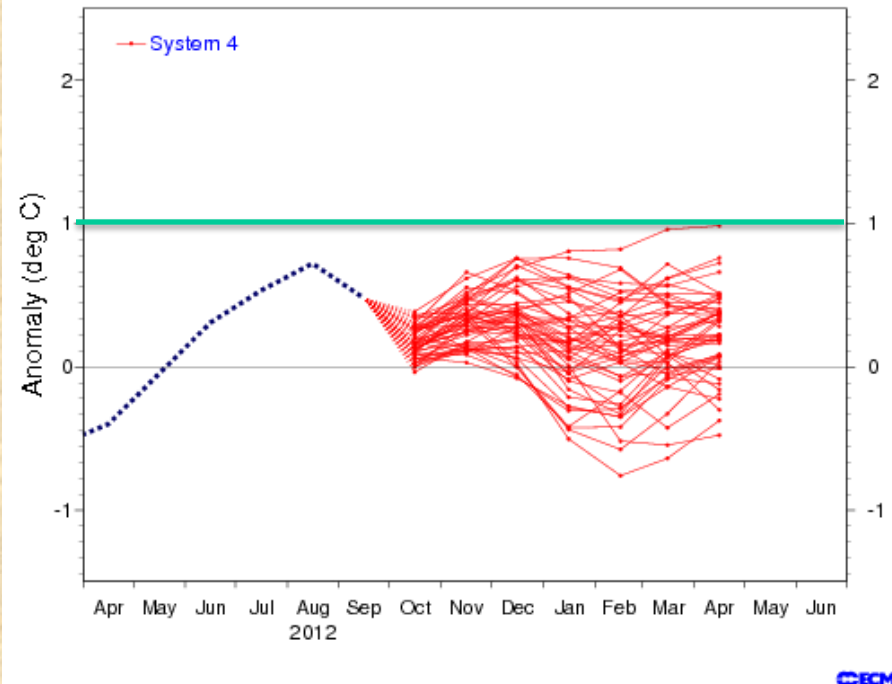
NINO3.4 SST anomaly plume
ECMWF forecast from 1 Jul 2012
Monthly mean anomalies relative to NCEP OIv2 1981-2010 climatology



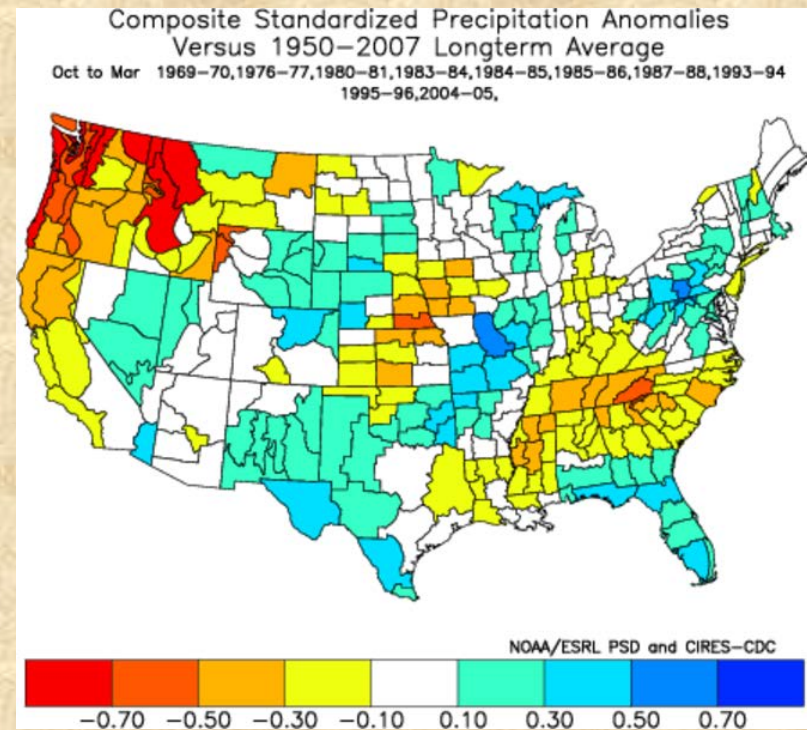
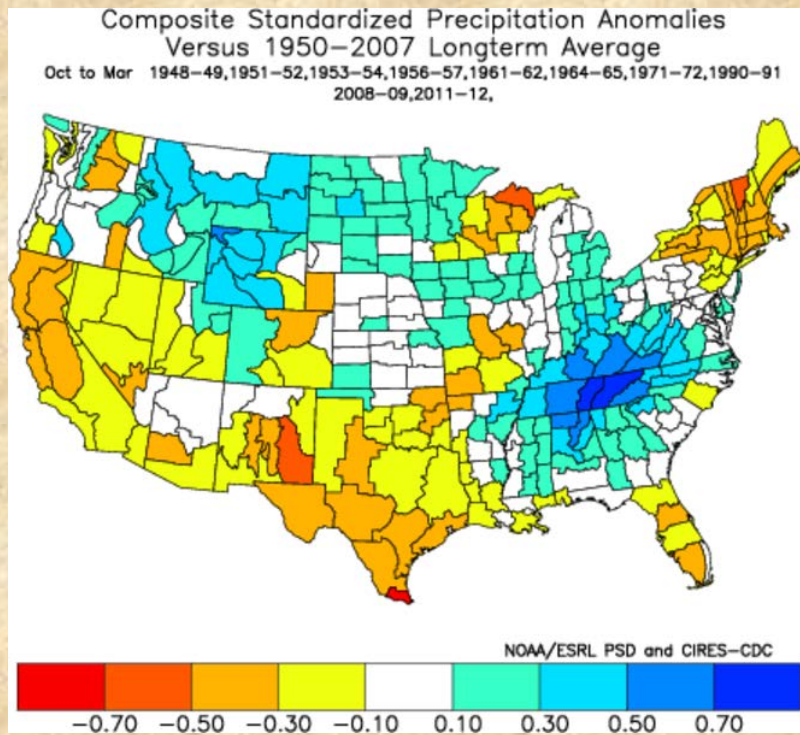
The ECMWF July 2012 forecast (left) showed a **substantial range** – with seven members below 0° C and five members reaching ‘*Super-El Niño-size*’ of $+2^{\circ}$ C or by early 2013. The mean outcome (just under $+1^{\circ}$ C) was a weak El Niño through the remainder of 2012.

The ECMWF **October 2012** forecast (right) maintains weak El Niño-like conditions, mostly remaining below $+0.5^{\circ}$ C, with more ensemble members slipping back into negative territory than remaining above 0.5° C by early 2013. *Looks like we will see a rare ENSO-neutral winter in the wake of double-dip La Niña.*

NINO3.4 SST anomaly plume
ECMWF forecast from 1 Oct 2012
Monthly mean anomalies relative to NCEP OIv2 1981-2010 climatology

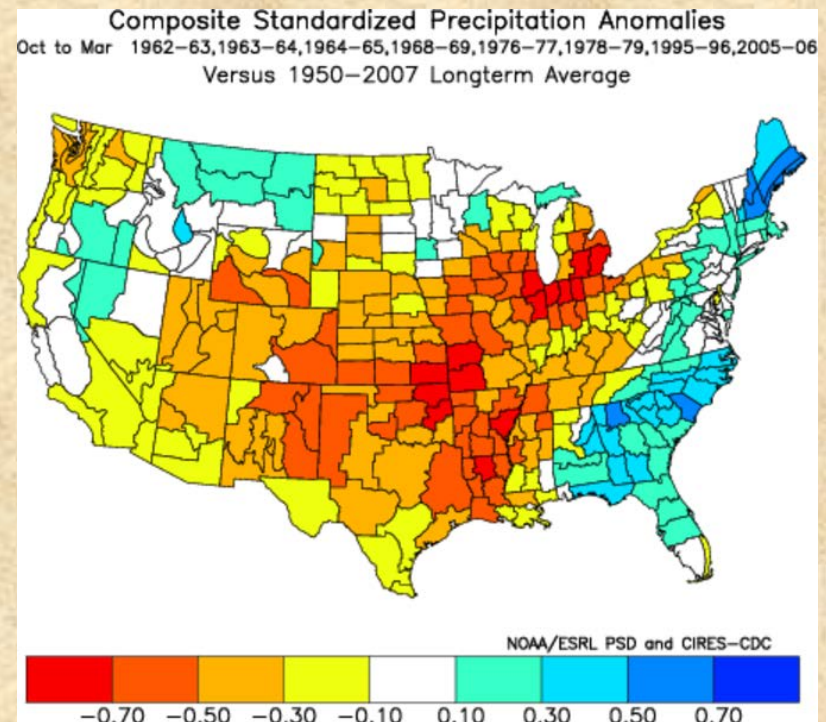
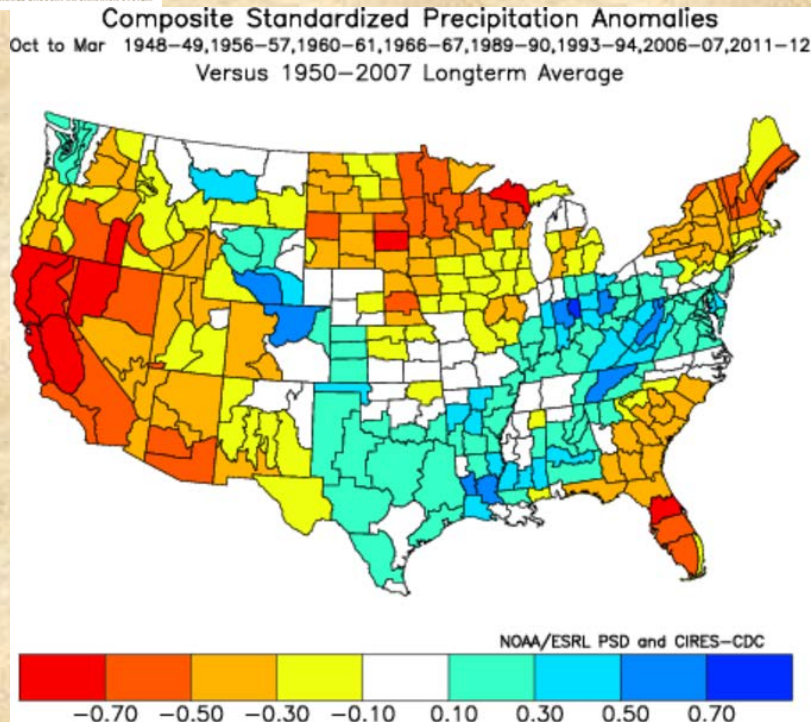


Neutral ENSO vs. PDO- (left) or PDO+



During negative PDO and no moderate to strong ENSO event of either phase, the winter half-year (Oct-Mar) tends to be drier than average over eastern CO (left), while the West slope is slightly favored with moisture. In the positive PDO case (right), northeastern CO is most favored, while the rest of the state shows no preference for wet or dry. *If we were to see a renewed El Niño while keeping negative PDO conditions, the outlook would be more favorable for all of Colorado. Meanwhile, the odds for negative PDO are extremely high, based on last winter and this summer's values.*

Neutral ENSO vs. NAO+ (left), or NAO-

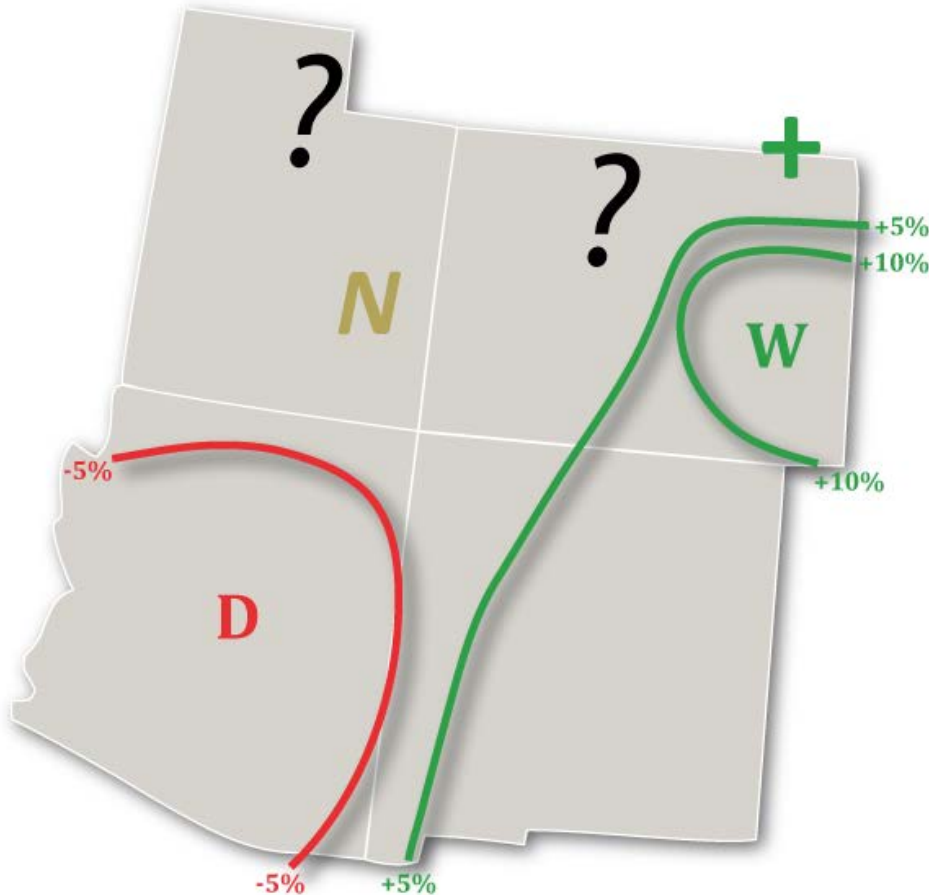


During positive NAO and no moderate to strong ENSO event, the winter half-year (Oct-Mar) tends to be wetter than average over eastern CO (left), while the West slope is less favored with moisture. In the negative NAO case (right), all of Colorado tends to be dry, especially over eastern plains. *If we were to see a renewed El Niño with positive NAO conditions, the outlook would be more favorable for most of Colorado.*

At least one precursor of the NAO indicates positive conditions for this winter!

Experimental PSD Precipitation Forecast Guidance

OCT – DEC 2012 (Issued September 18, 2012)



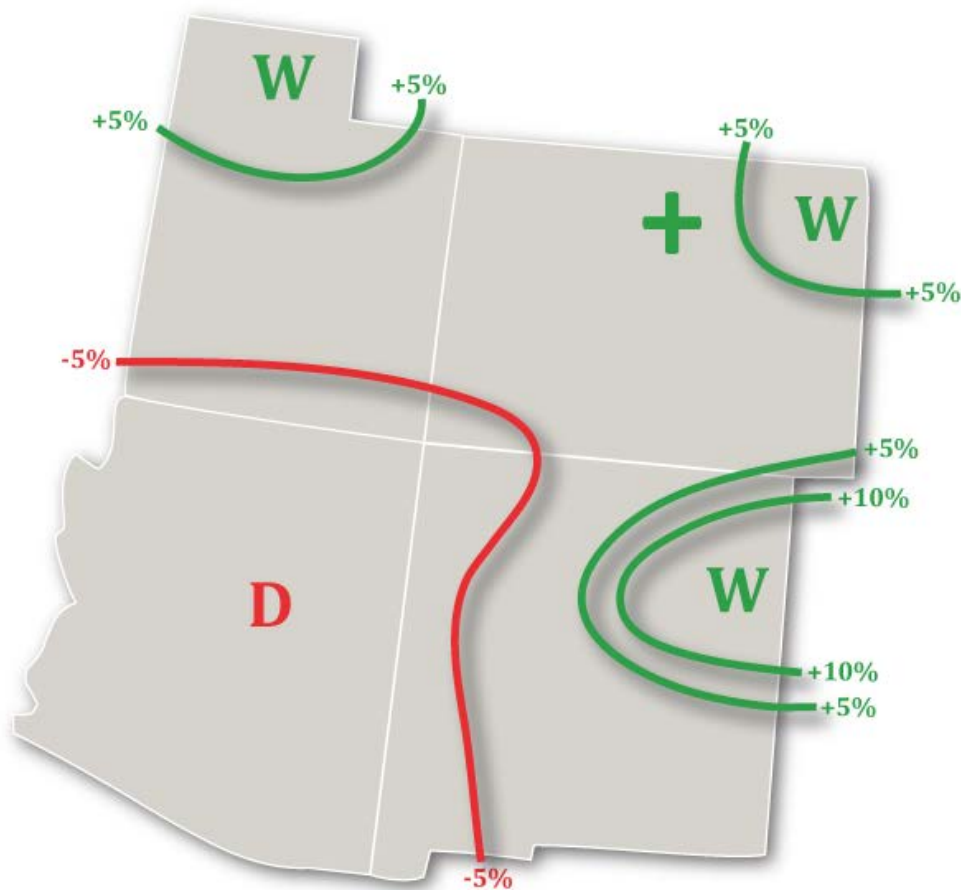
Fall (left) remains the hardest season to predict for this region. **In particular, “??” over the mountains of northern UT and CO denote an uncertain outcome.** Unfortunately, a closer look at the performance of similar forecasts in the past shows a preference for dry outcomes over north-central CO, which does not bode well for the first half of our snowpack season.

Eastern CO has a tilt towards wetness where operational forecasts have been most reliable since 1999.

There is a great need to improve seasonal forecasts for Upper Basin!

Experimental PSD Precipitation Forecast Guidance

JAN – MAR 2013 (Issued September 24, 2012)

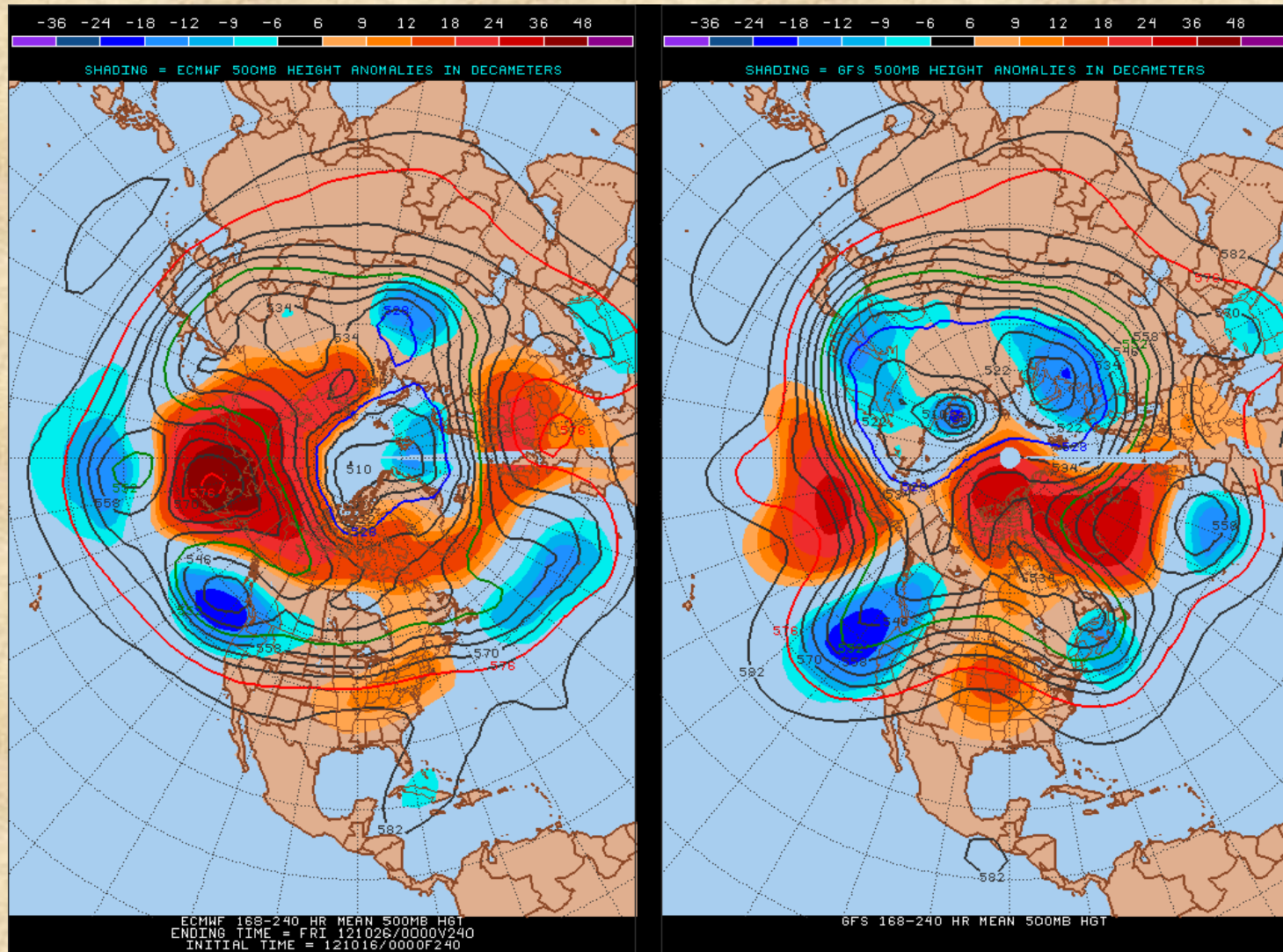


In September, winter precipitation (left) is fairly predictable in much of this region, except for the eastern half of CO and SE NM.

While slightly tilting towards above-average moisture, our northern mountains show a wide spread of outcomes in similar situations in the past.

IF El Niño were to rally soon, the combination of El Niño with negative PDO would improve snowpack prospects, as last seen in 1994-95.

Next 7-10 days



ECWMF vs GFS from last night shows trough along West Coast, and ridging east of us – more pronounced in GFS which would be detrimental to our precipitation chances.

Executive Summary (16 oct2012) klaus.wolter@noaa.gov

- 1. El Niño did not fully mature this summer, and will probably remain anemic into the winter.**
- 1. No big storm in sight for the next two weeks– in contrast to typical El Niño situations, this October will probably not deliver above-average moisture – looks like we are not off to a good start.**
- 1. My forecast for late fall (October-December) shows a tilt towards wet conditions covering most of eastern CO, with little information away from climatology further west. If El Niño had been in place, October and December would have been the months to watch to give us above-normal moisture. A first peek at late winter (January-March) shows above-normal odds for moisture in north-central and northeast CO where operational skill has been minimal at this lead-time, with a hint of expected drier-than-average conditions towards the Four Corners.**
- 2. Bottomline: El Niño may already have come and gone, so we may end up with a rare ENSO-neutral winter after a double-dip La Niña. While El Niño would boost our chances for moisture overall in next six months, negative PDO conditions will favor the mountains over the eastern plains during the winter. A positive NAO would increase our chances for moisture east of the divide. *Both of these conditions are more likely than not for now – stay tuned!***

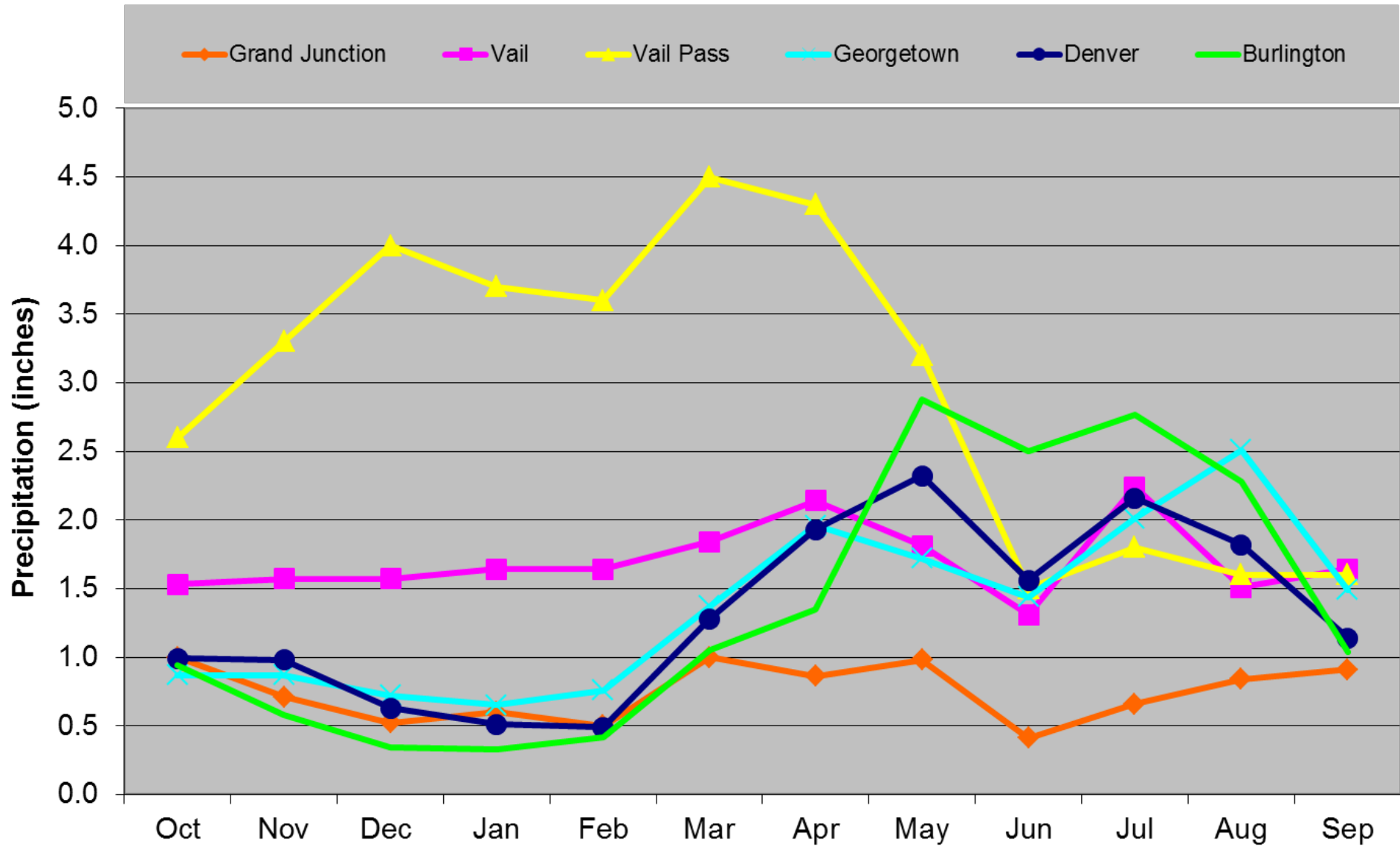
Today's Agenda

- Assessment of current water conditions
- Precipitation Forecast
- Recommendations for Drought Monitor

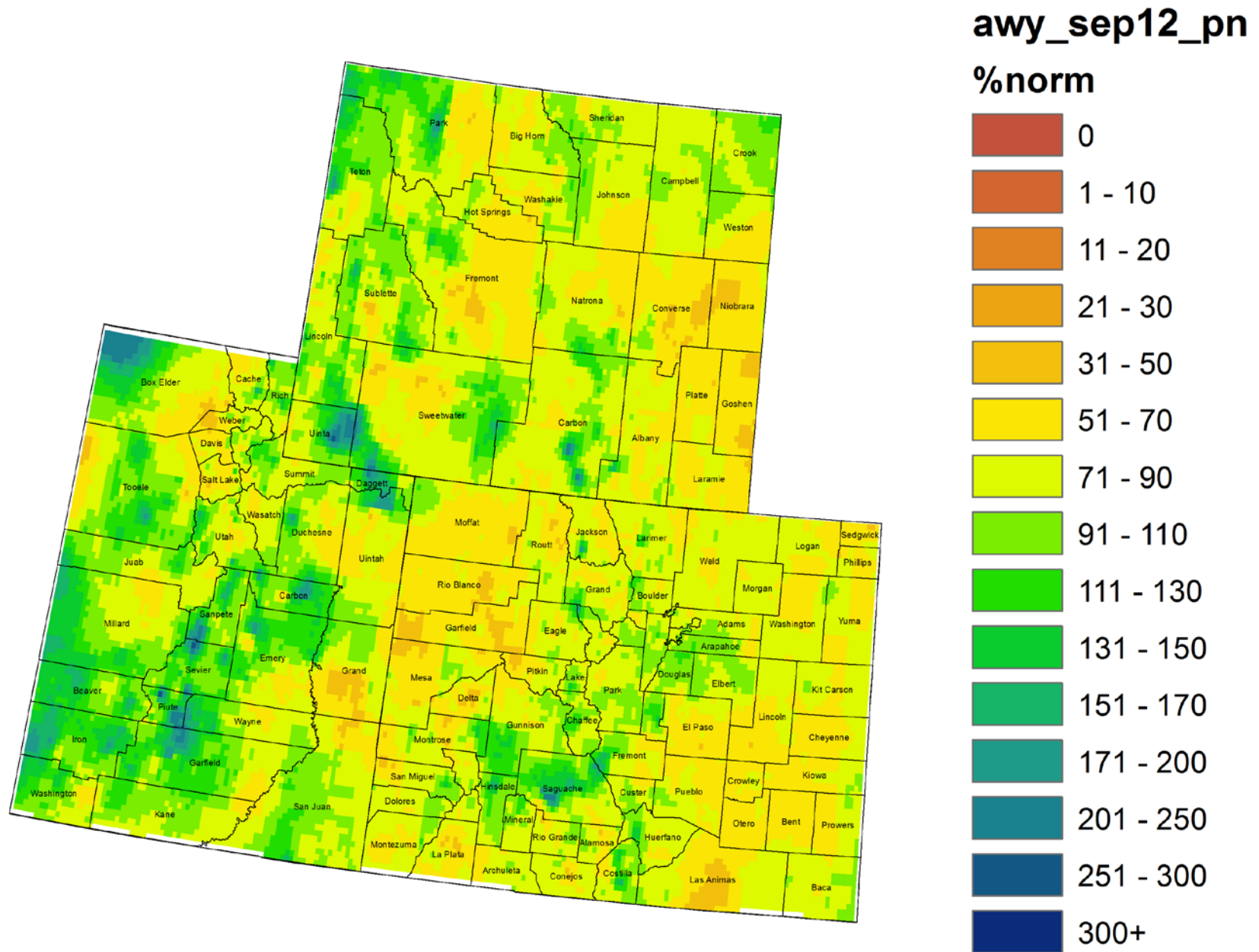
Precipitation/Snowpack Update



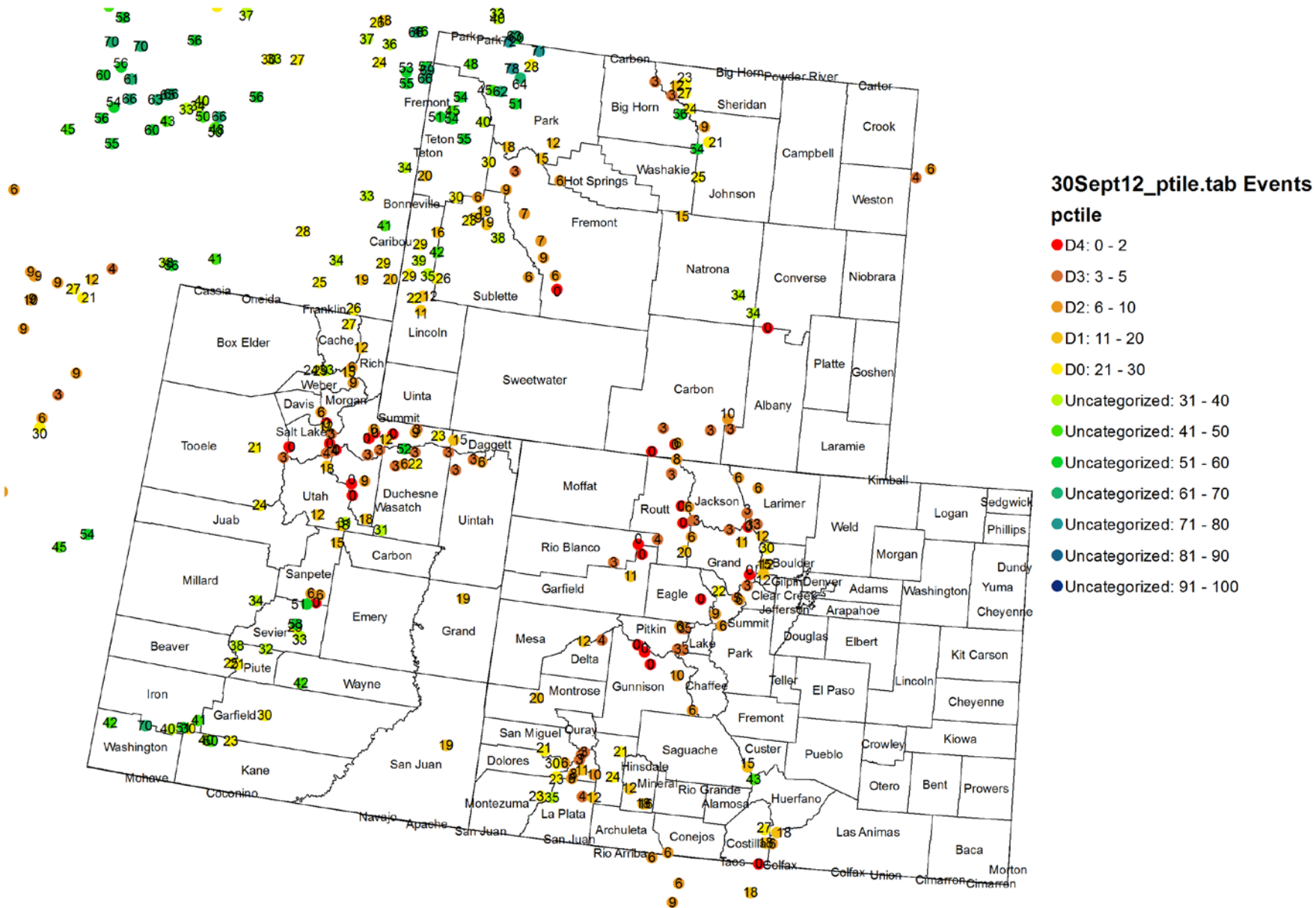
Water Year Average Precipitation for Selected Stations



Colorado, Utah and Wyoming Water Year 2012 Precipitation as Percentage of Normal (Oct 2011 - Sept 2012)

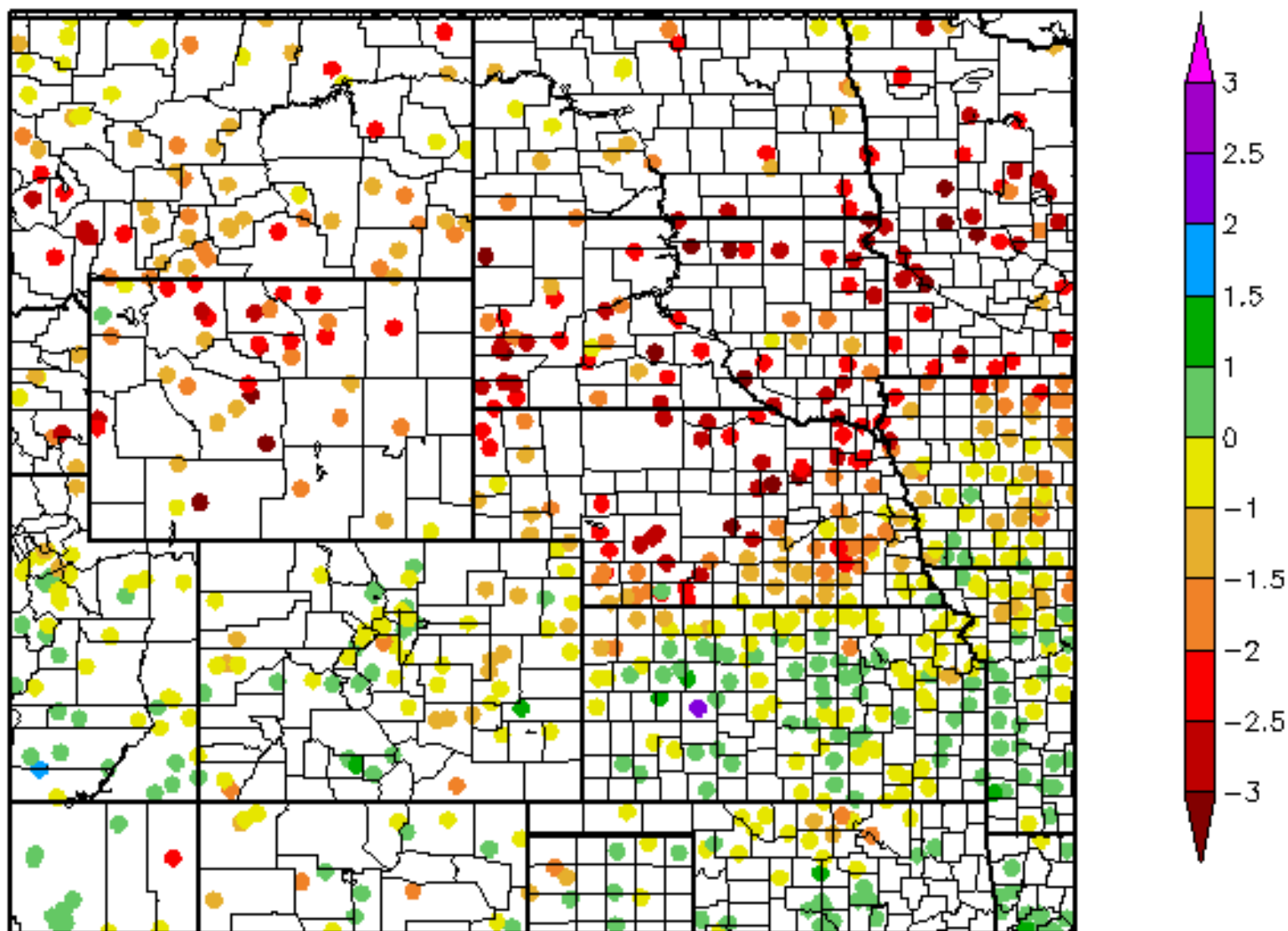


Snotel Water Year Precipitation Percentile Ranking for 30 September 2012 (Stations with 15+ years of data only)



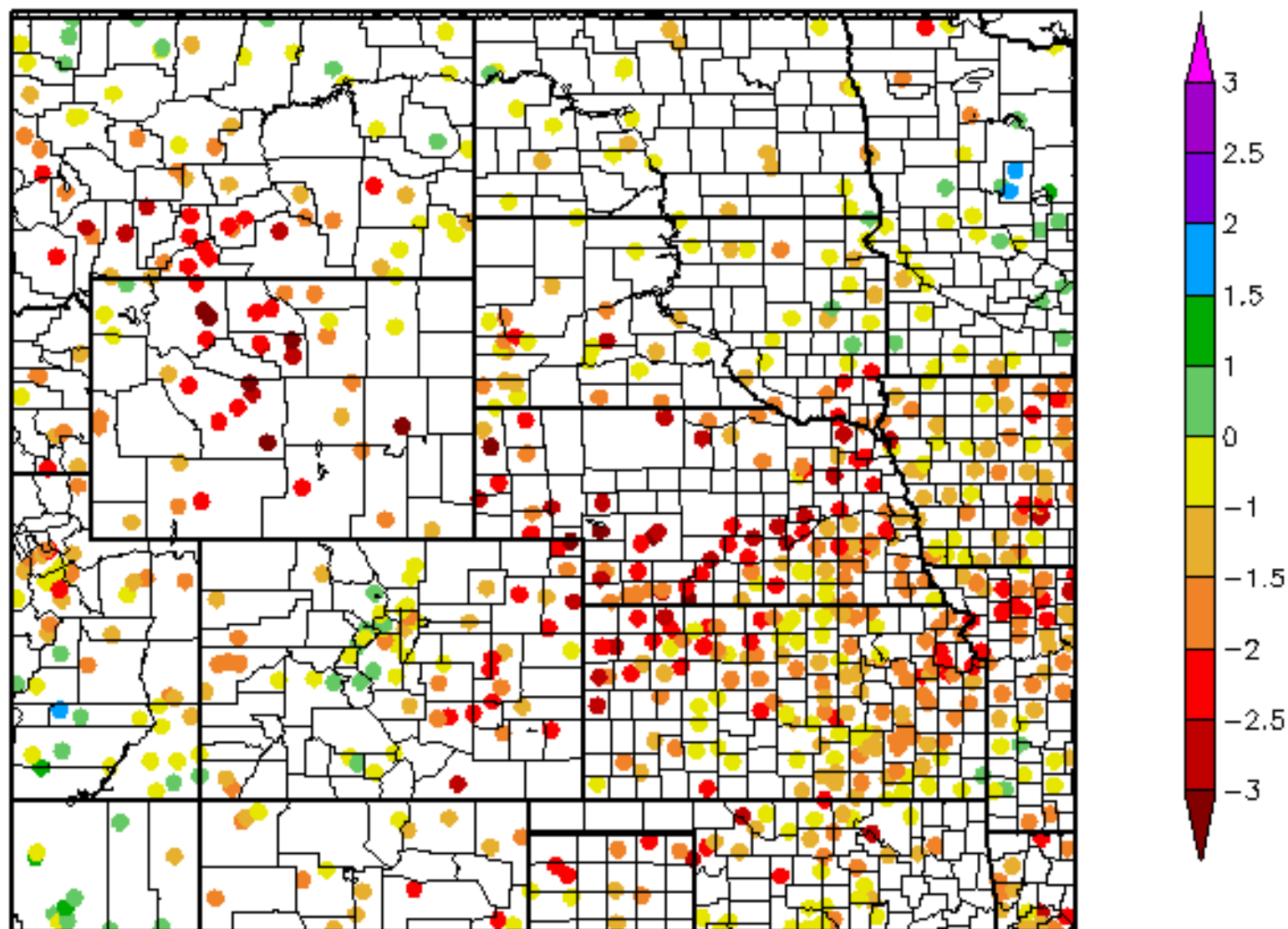
60 Day SPI

8/16/2012 - 10/14/2012



6 Month SPI

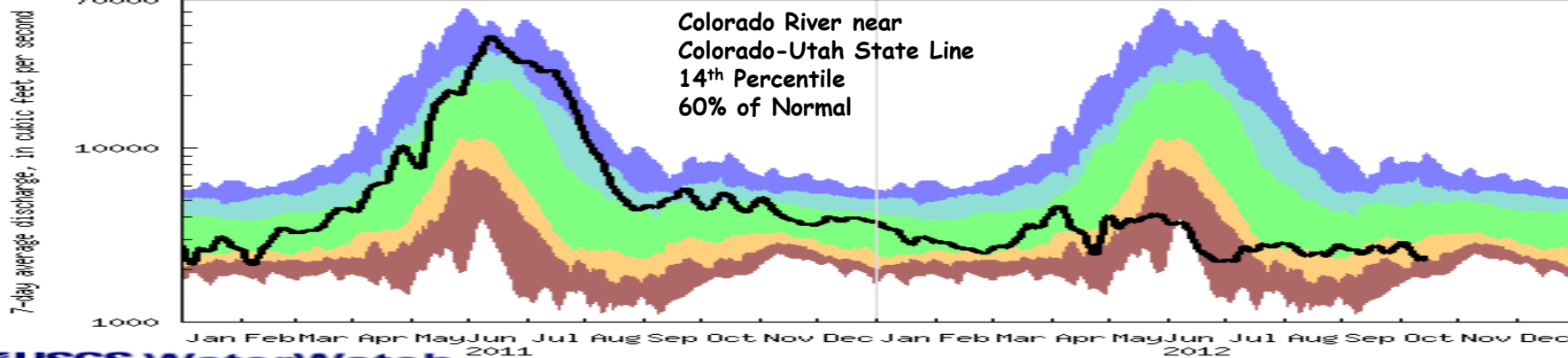
4/15/2012 - 10/14/2012



Streamflow Update



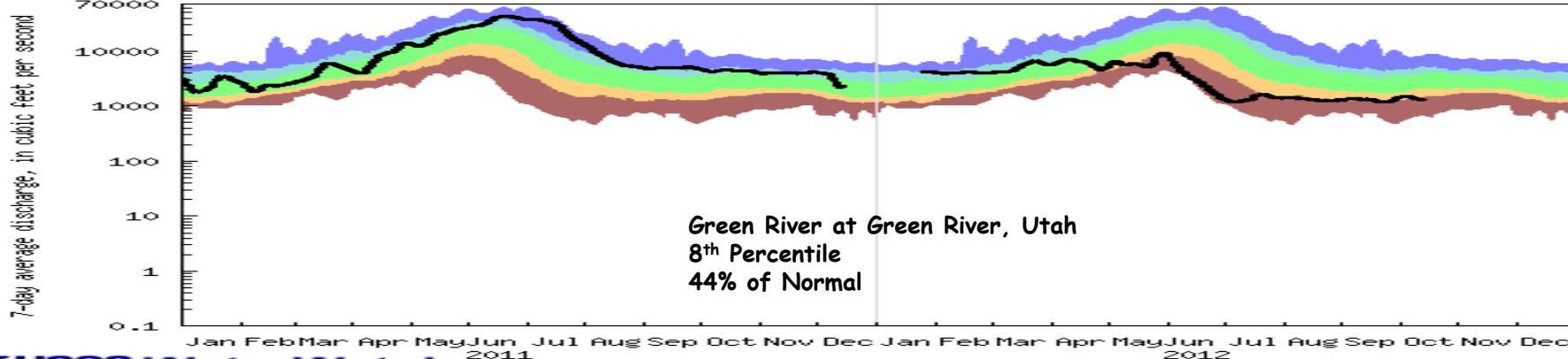
Duration hydrograph of 7-day average streamflow for USGS 09163500
 (Drainage Area: 17843 square miles, Length of Record: 61 years)



USGS WaterWatch

Last updated: 2012-10-15

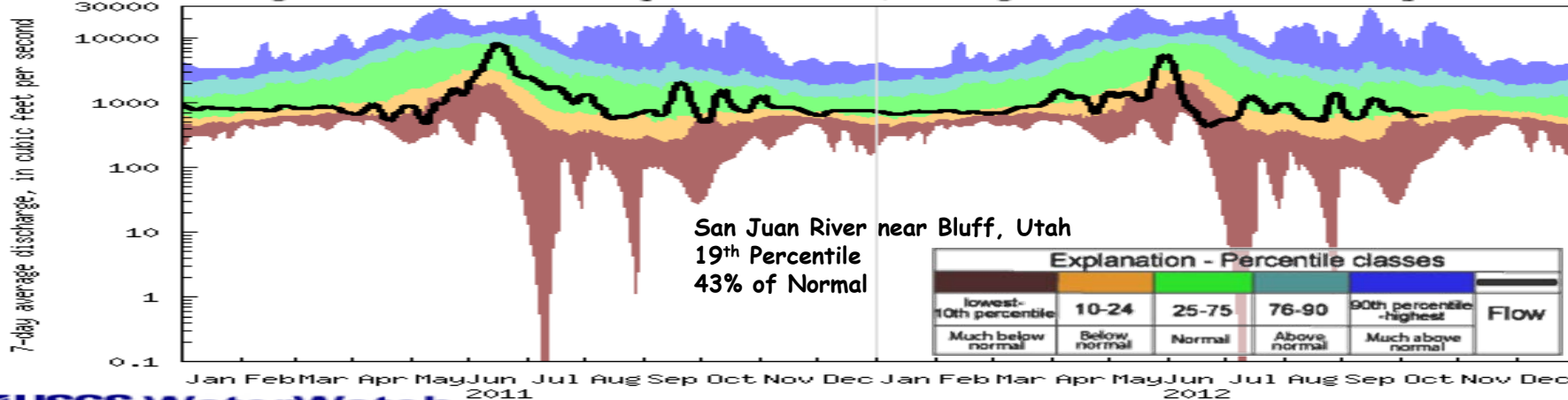
Duration hydrograph of 7-day average streamflow for USGS 09315000
 (Drainage Area: 44850 square miles, Length of Record: 117 years)



USGS WaterWatch

Last updated: 2012-10-15

Duration hydrograph of 7-day average streamflow for USGS 09379500
 (Drainage Area: 23000 square miles, Length of Record: 97 years)



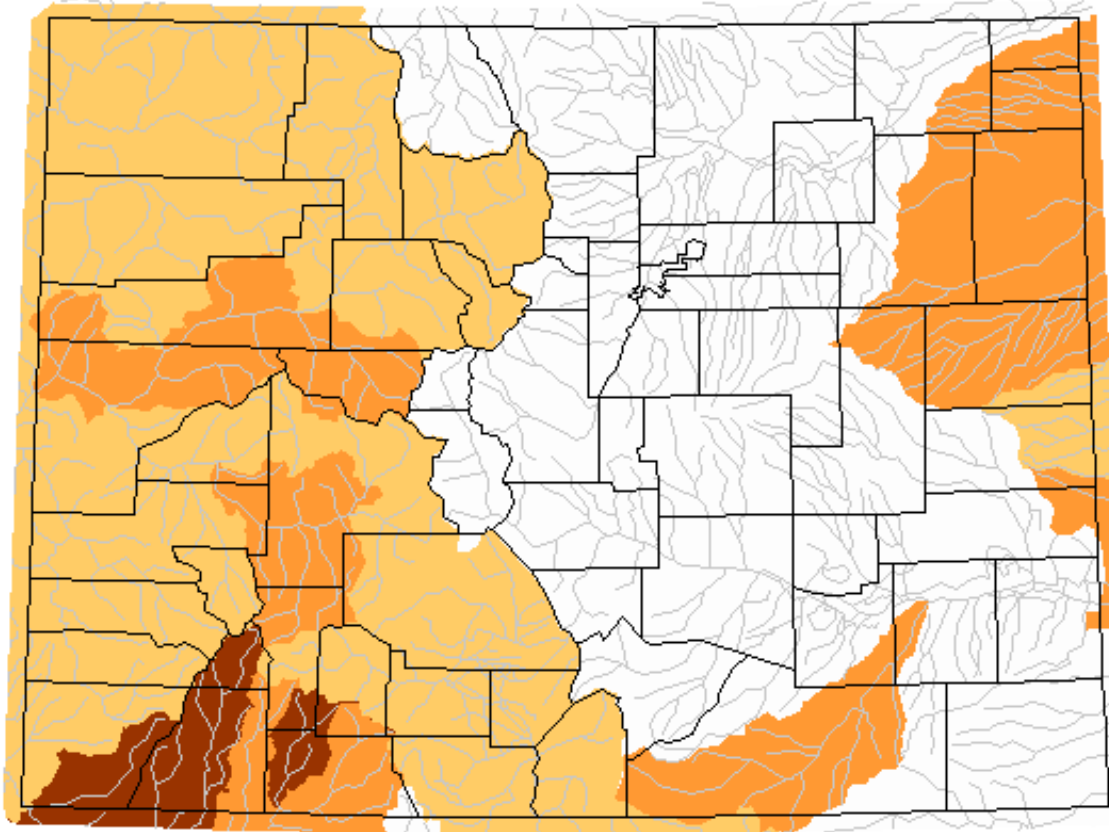
USGS WaterWatch





Last updated: 2012-10-15

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

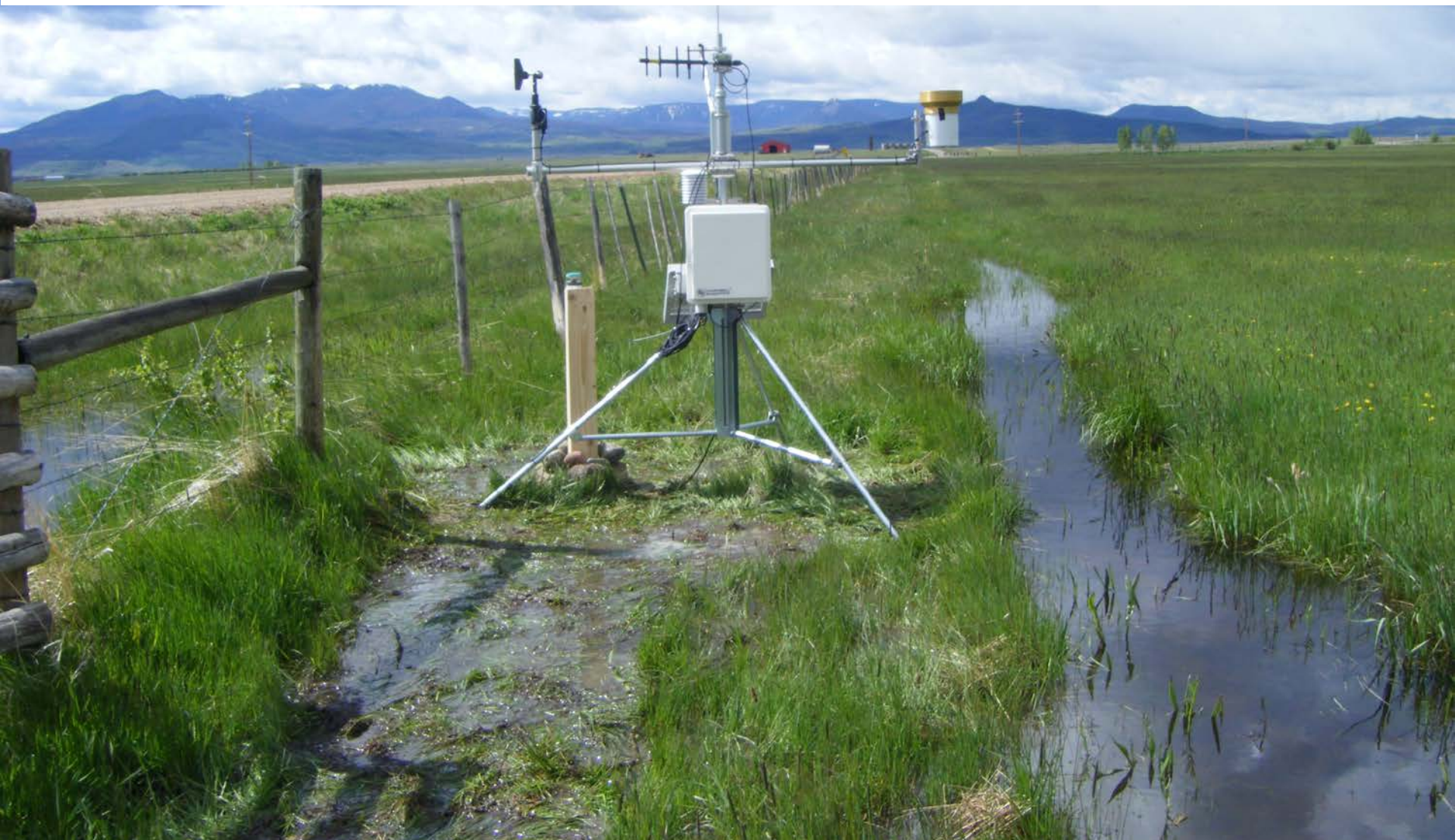
7-day average streamflow compared to historical streamflow

Sunday, October 14, 2012

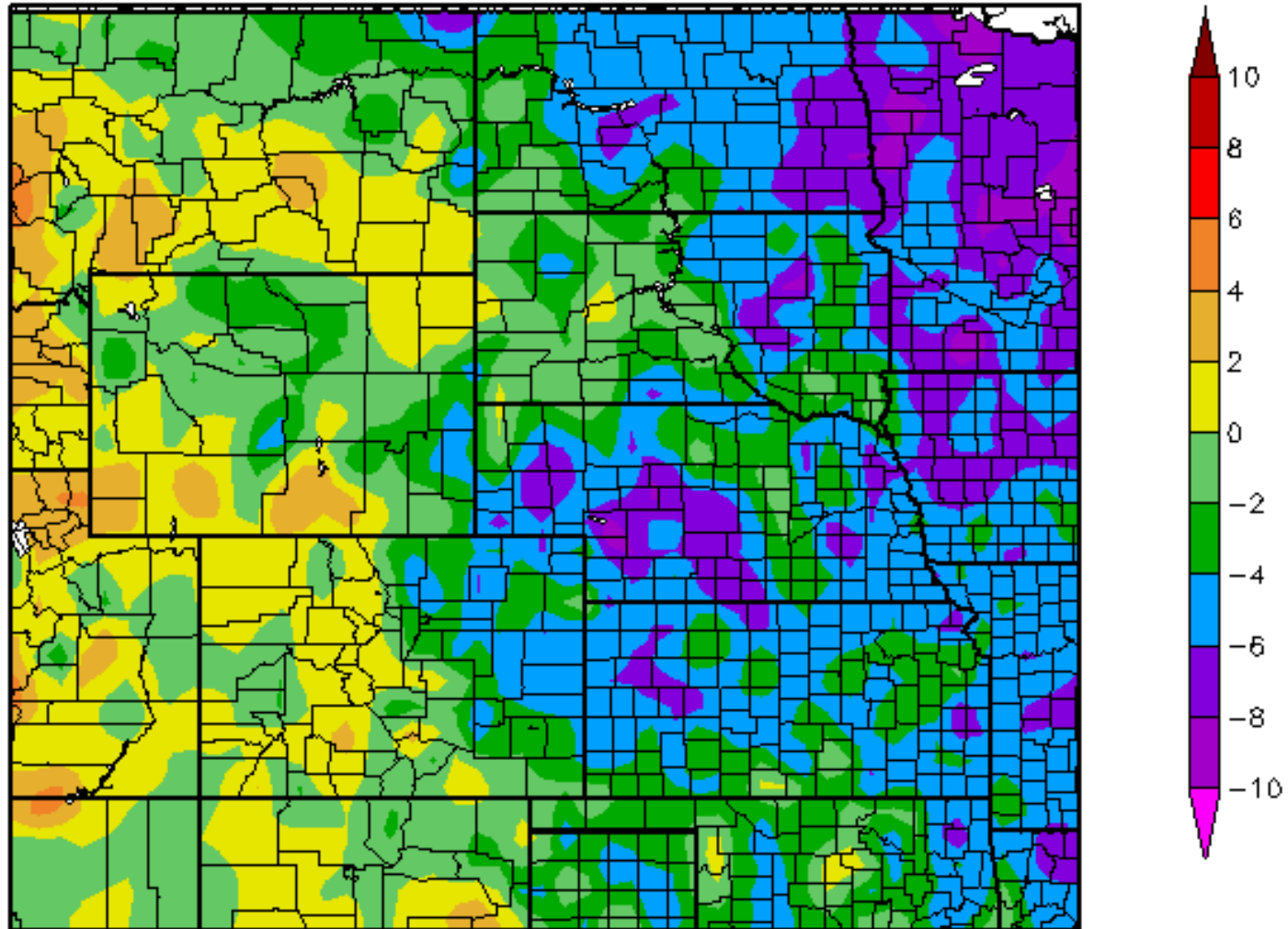


Explanation - Percentile classes			
			
Low	≤ 5	6-9	10-24
Extreme hydrologic drought	Severe hydrologic drought	Moderate hydrologic drought	Below normal

Water Demand

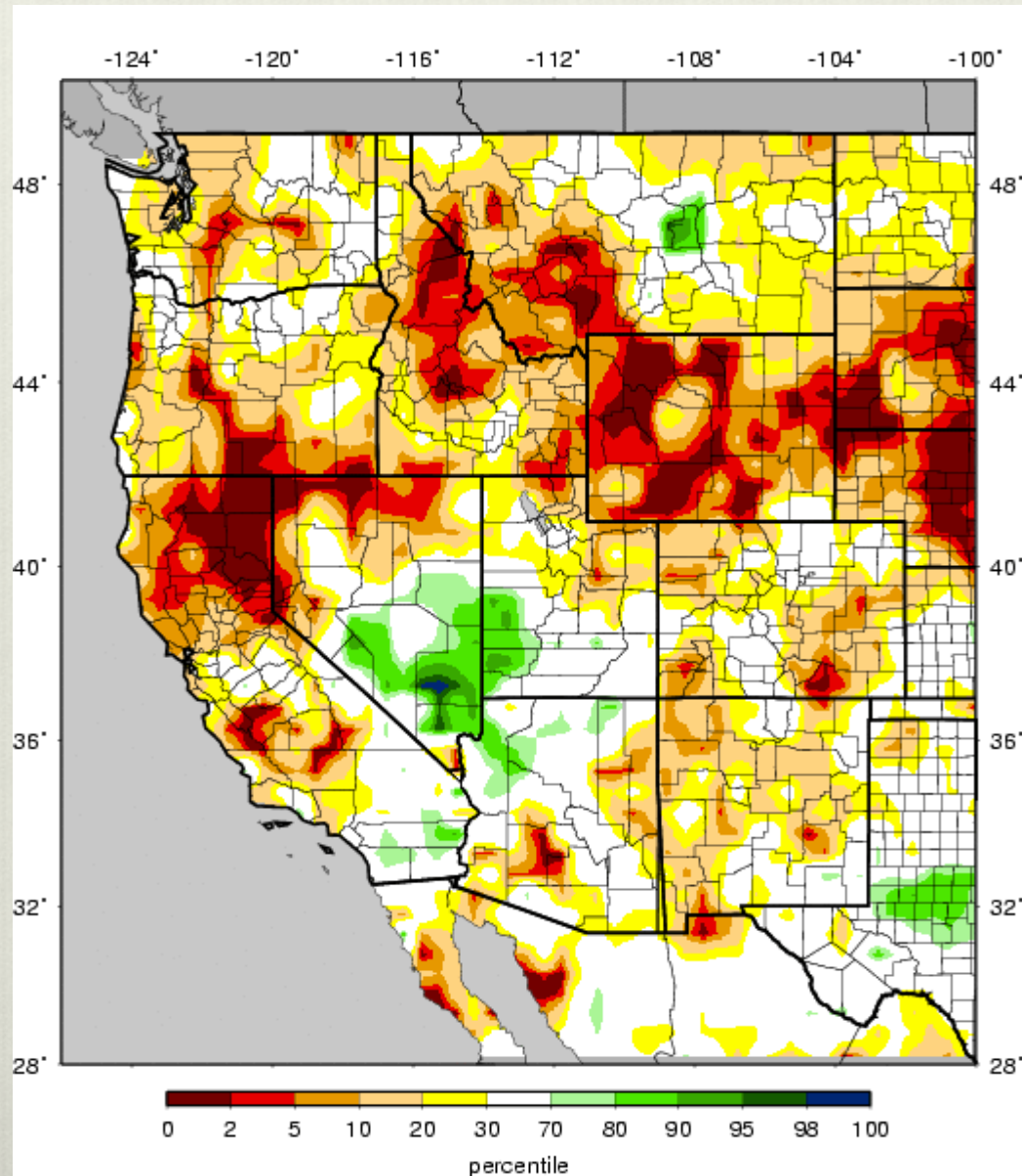


Temperature Departure from Normal 10/8/2012 – 10/14/2012



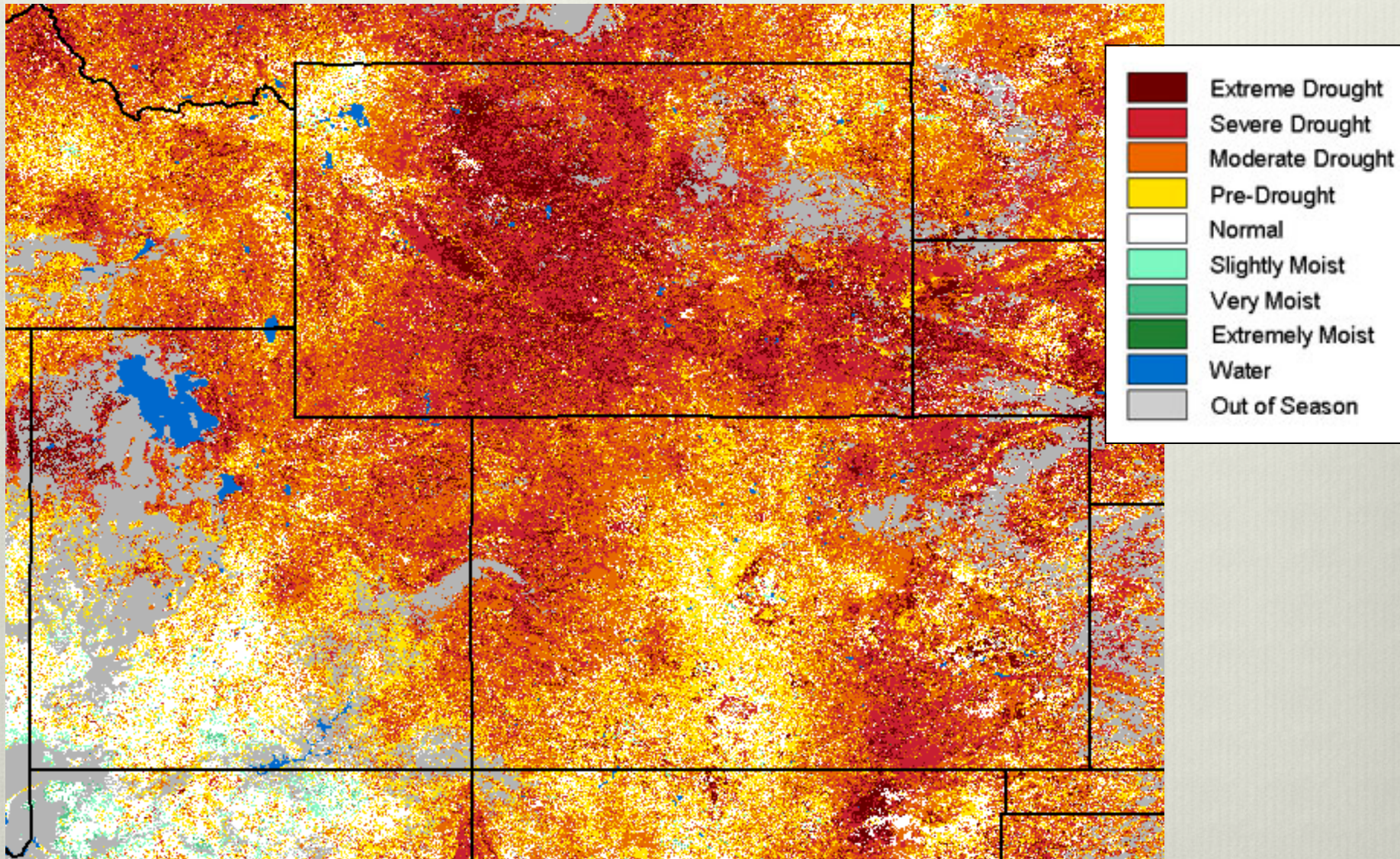
VIC Soil Moisture

14 October 2012

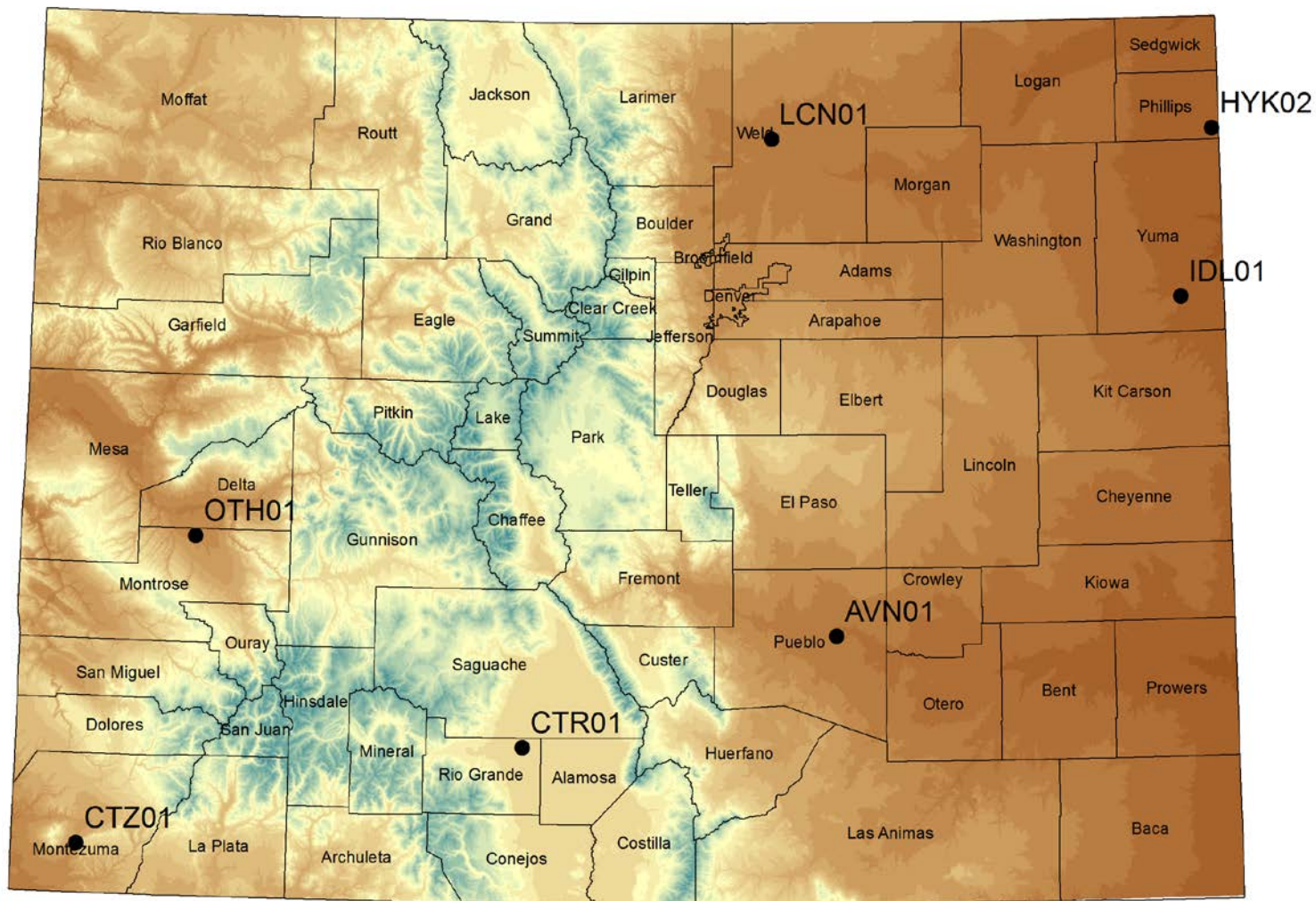


eMODIS VegDRI Vegetation

16 September 2012

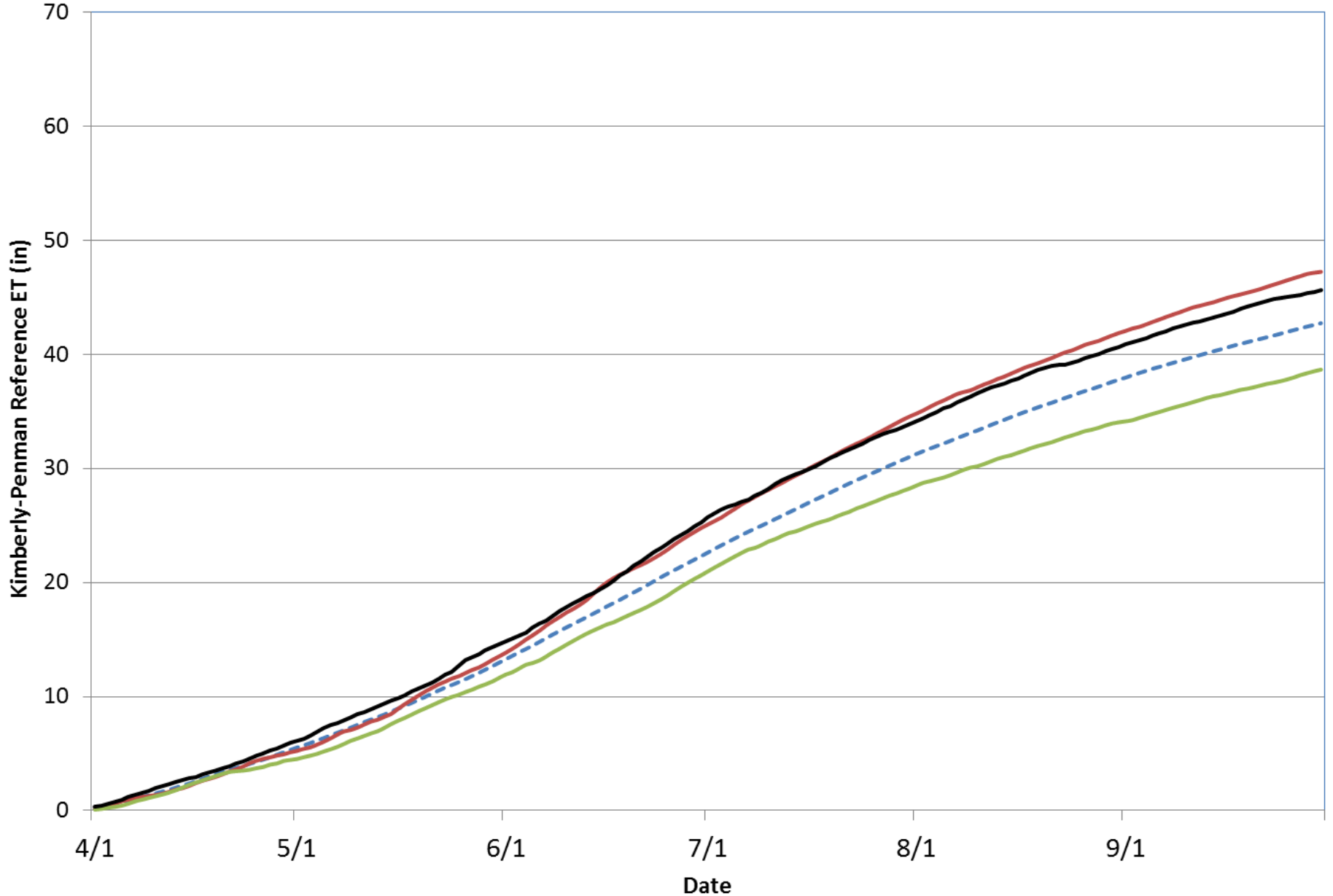


CoAgMet Reference Evapotranspiration Stations



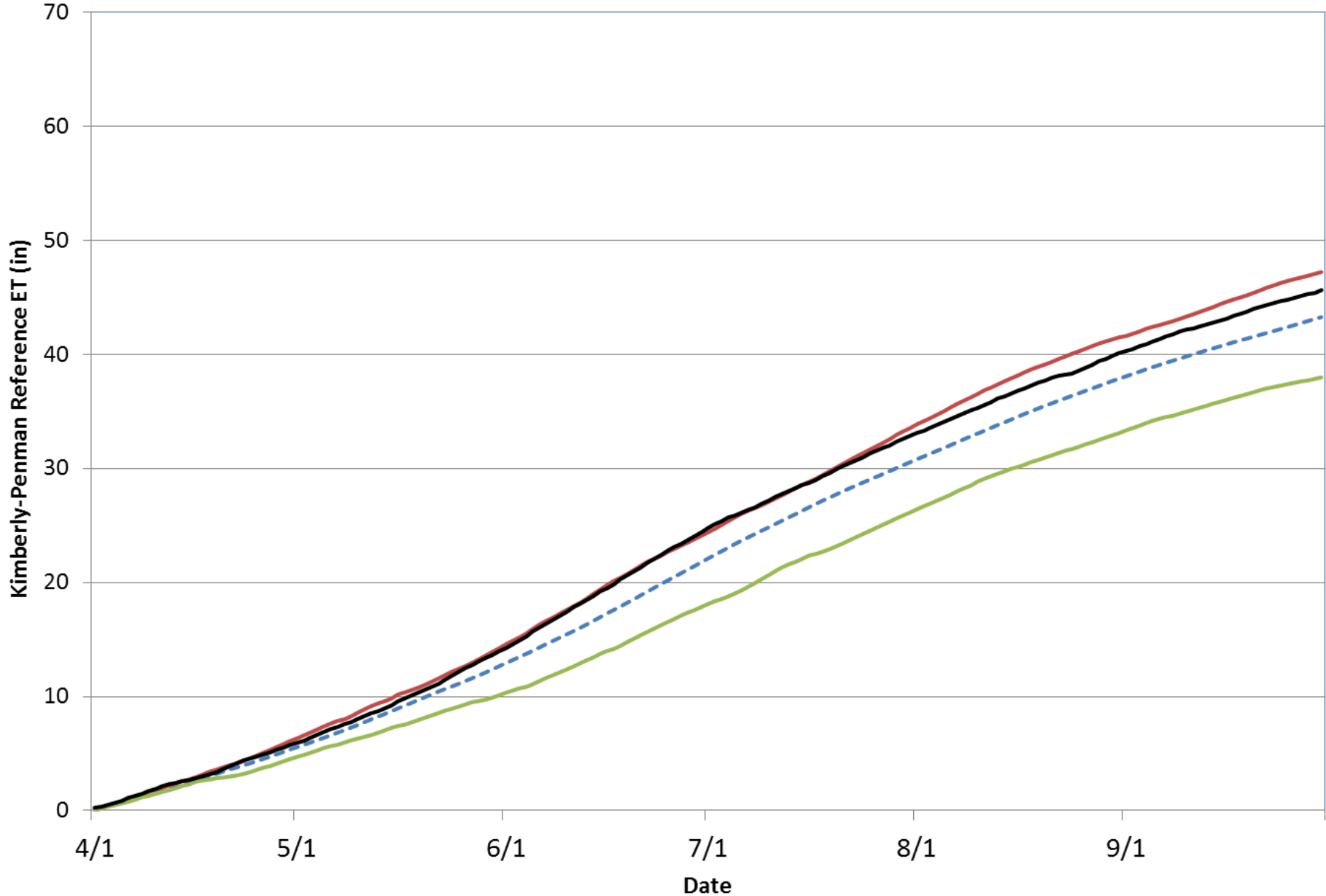
Olathe 1 & 2 Kimberly-Penman Reference ET (1993 - 2012)

--- Average — 1994 — 1999 — 2012



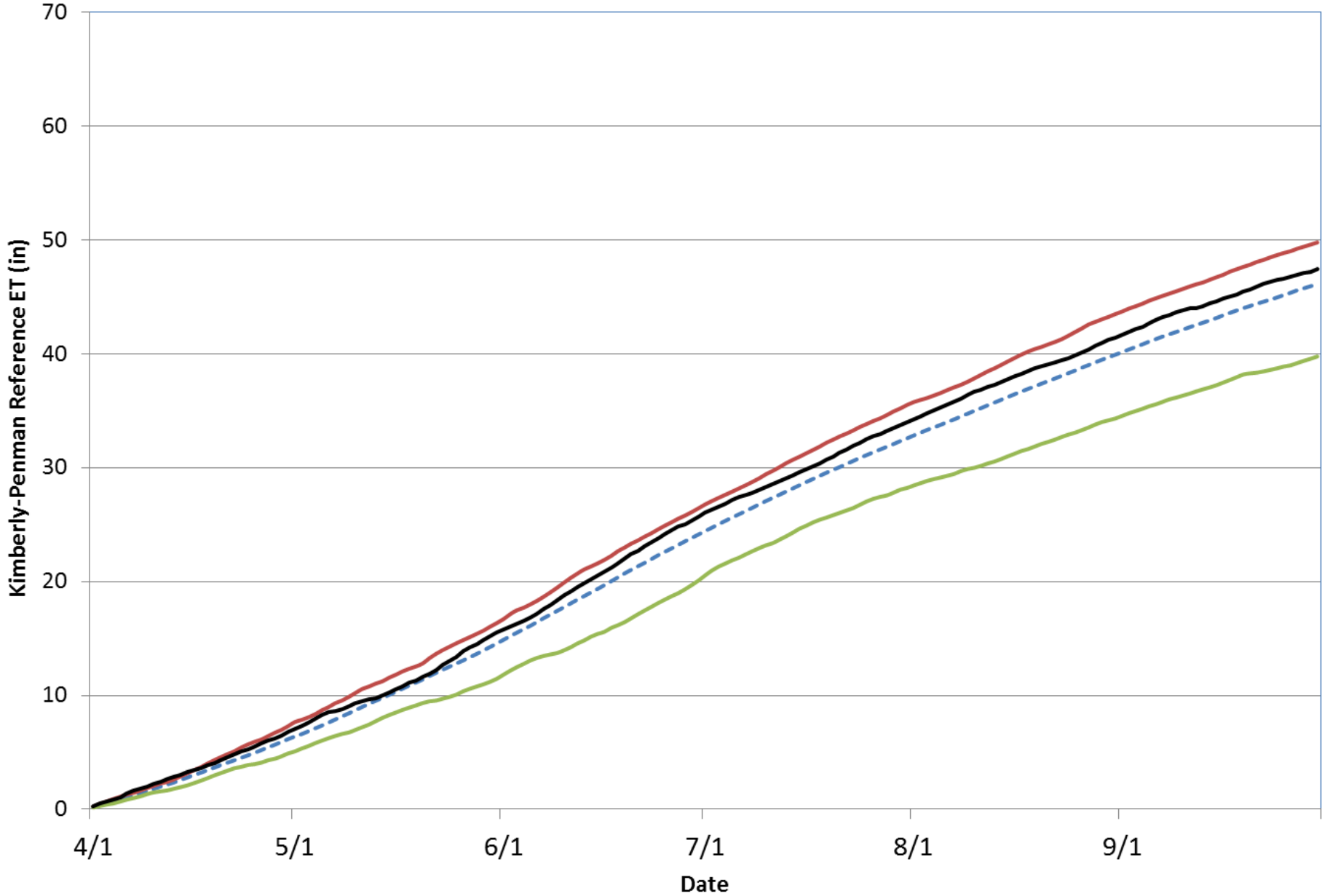
Cortez Kimberly-Penman Reference ET (1992 - 2012)

--- Average — 2000 — 1995 — 2012



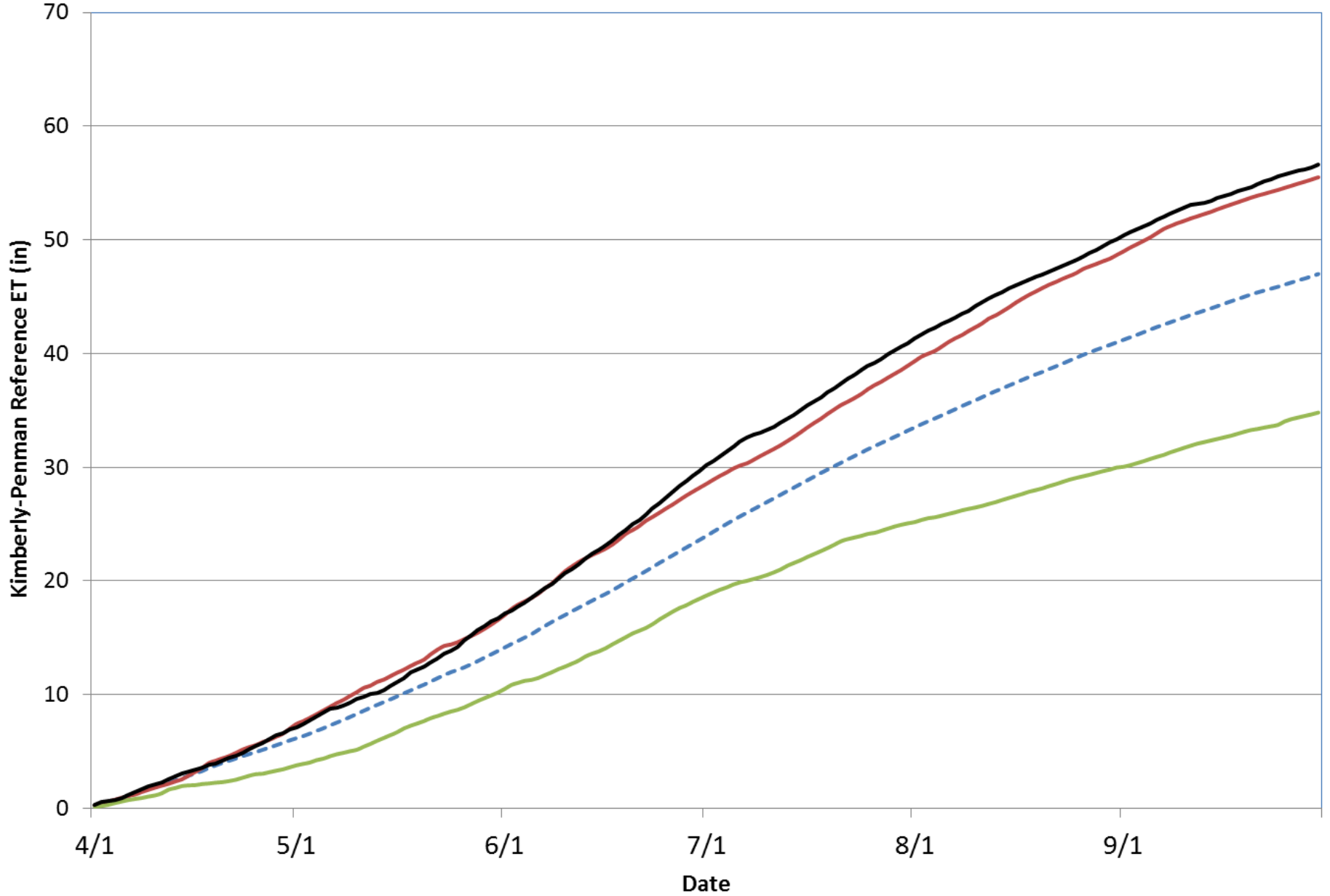
Center Kimberly-Penman Reference ET (1994 - 2012)

--- Average — 2002 — 1997 — 2012



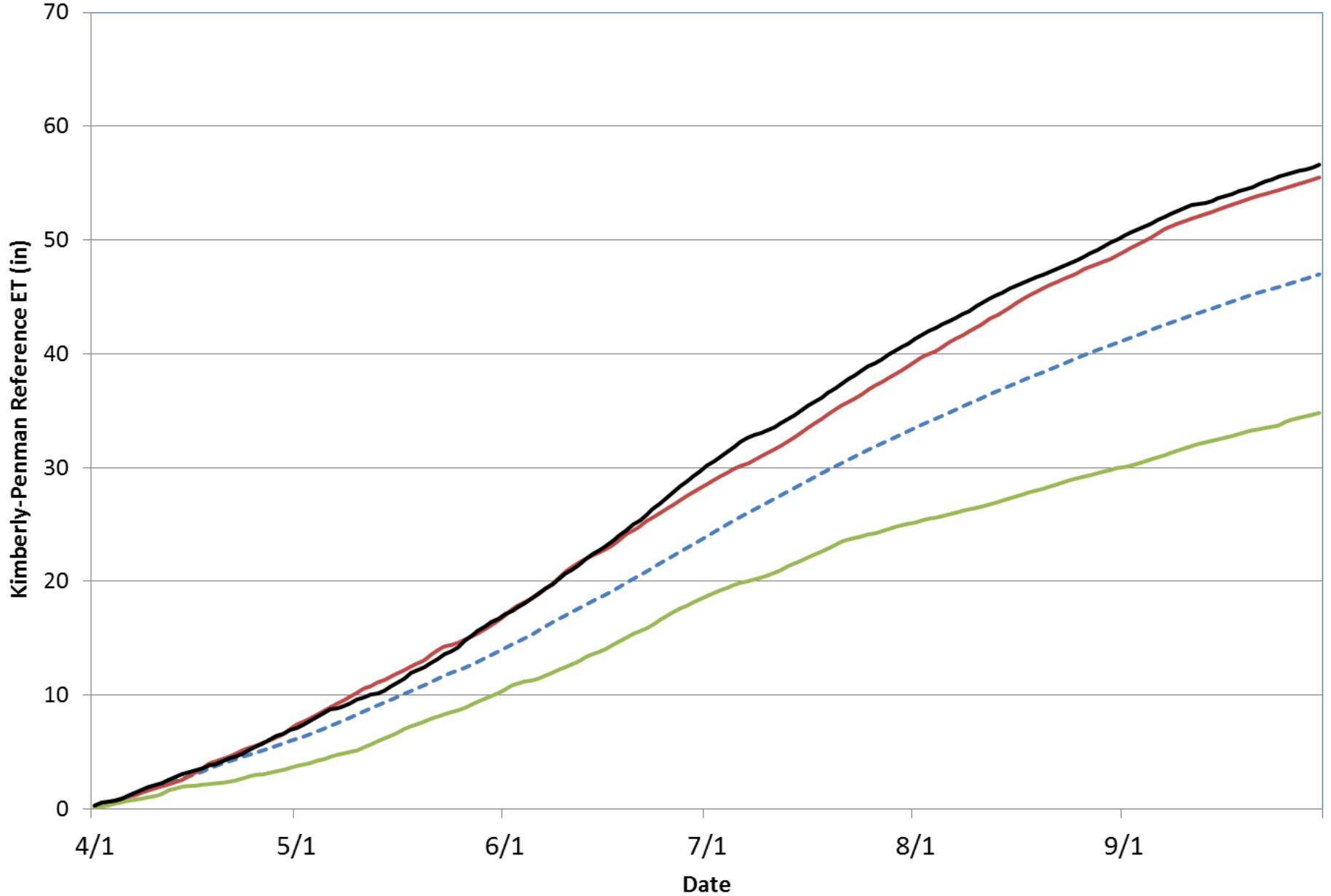
Avondale Kimberly-Penman Reference ET (1993 - 2012)

--- Average — 2002 — 1998 — 2012



Avondale Kimberly-Penman Reference ET (1993 - 2012)

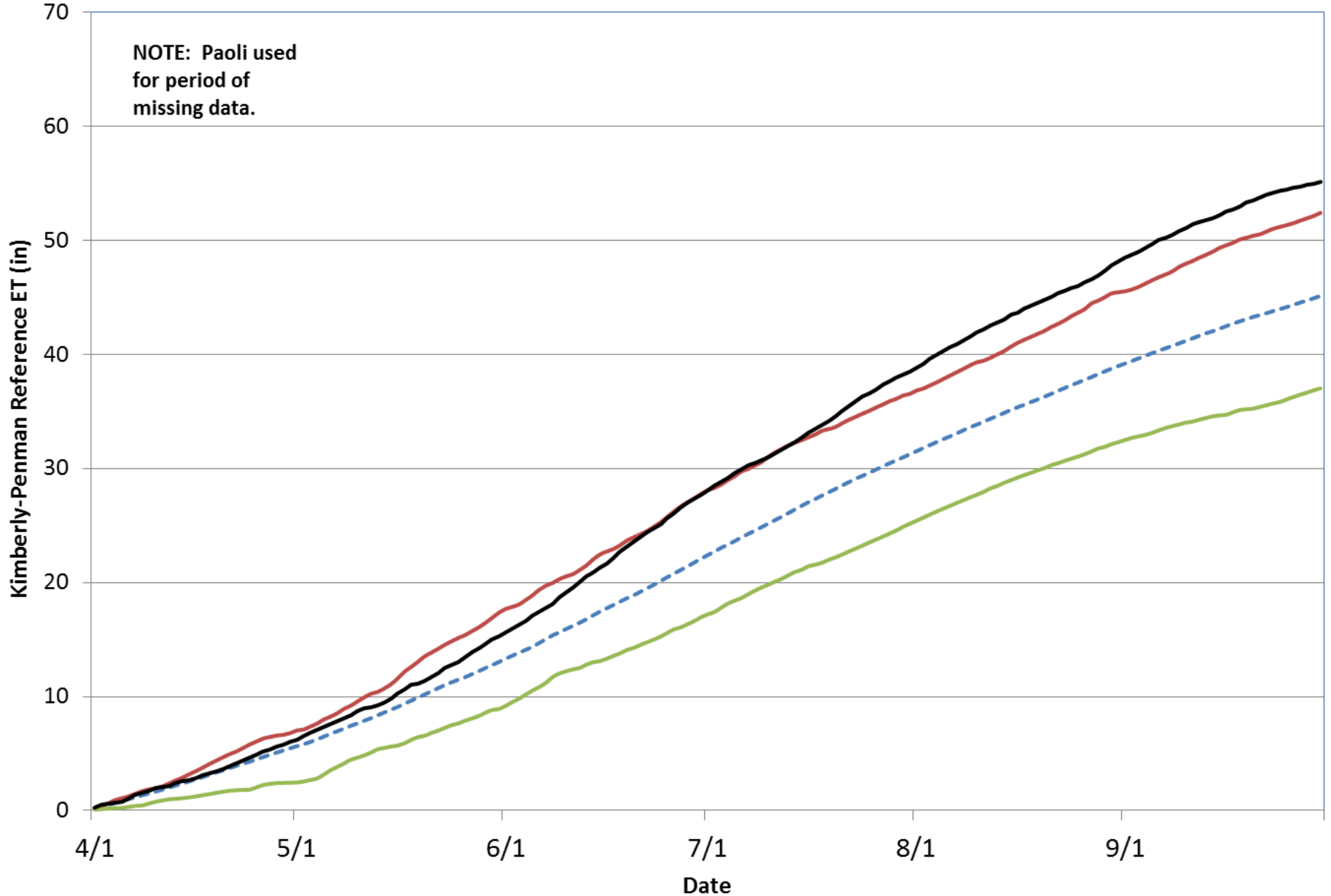
--- Average — 2002 — 1998 — 2012



Holyoke Kimberly-Penman Reference ET (1992 - 2012)

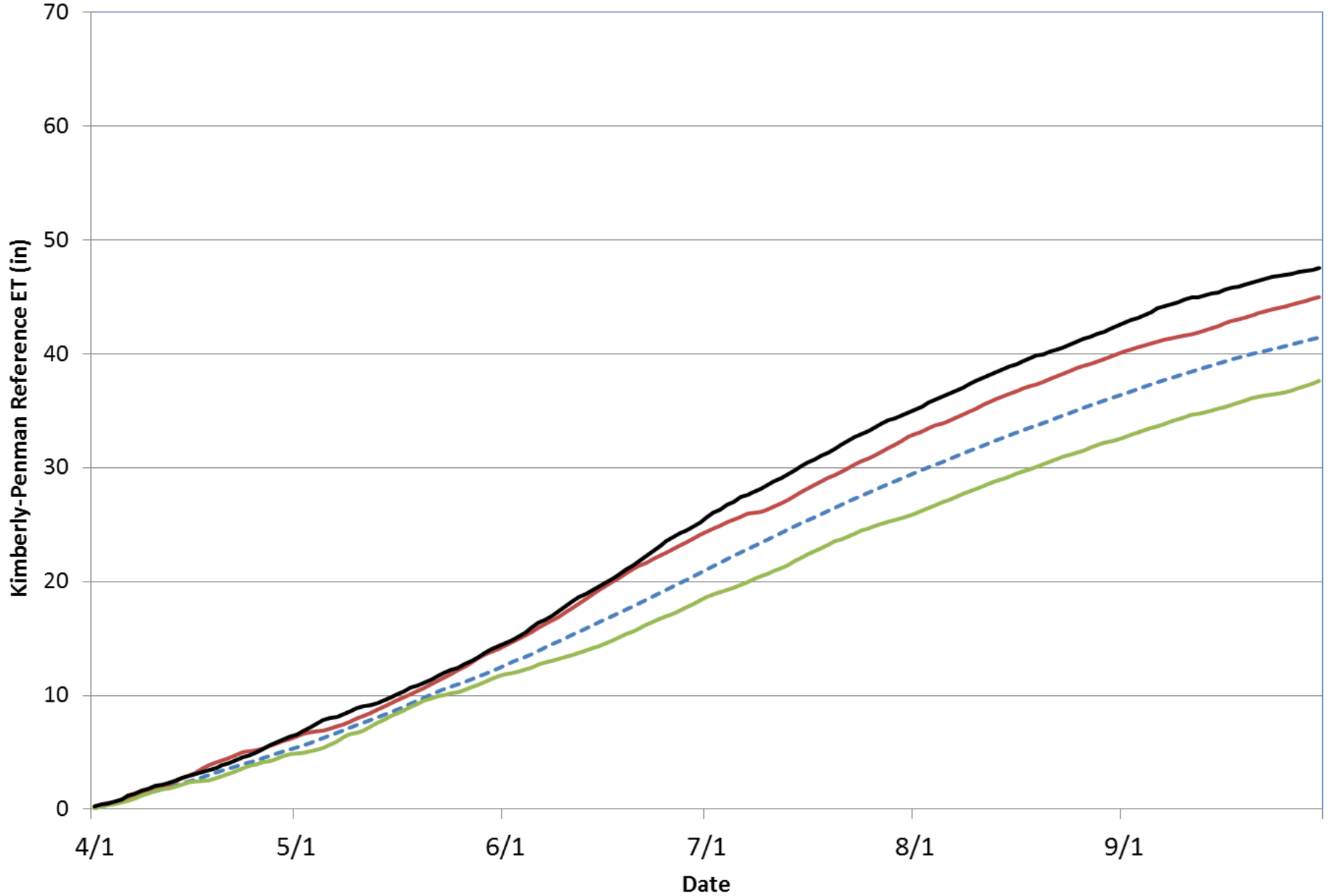
--- Average — 1994 — 1999 — 2012

NOTE: Paoli used
for period of
missing data.



Lucerne Kimberly-Penman Reference ET (1992 - 2012)

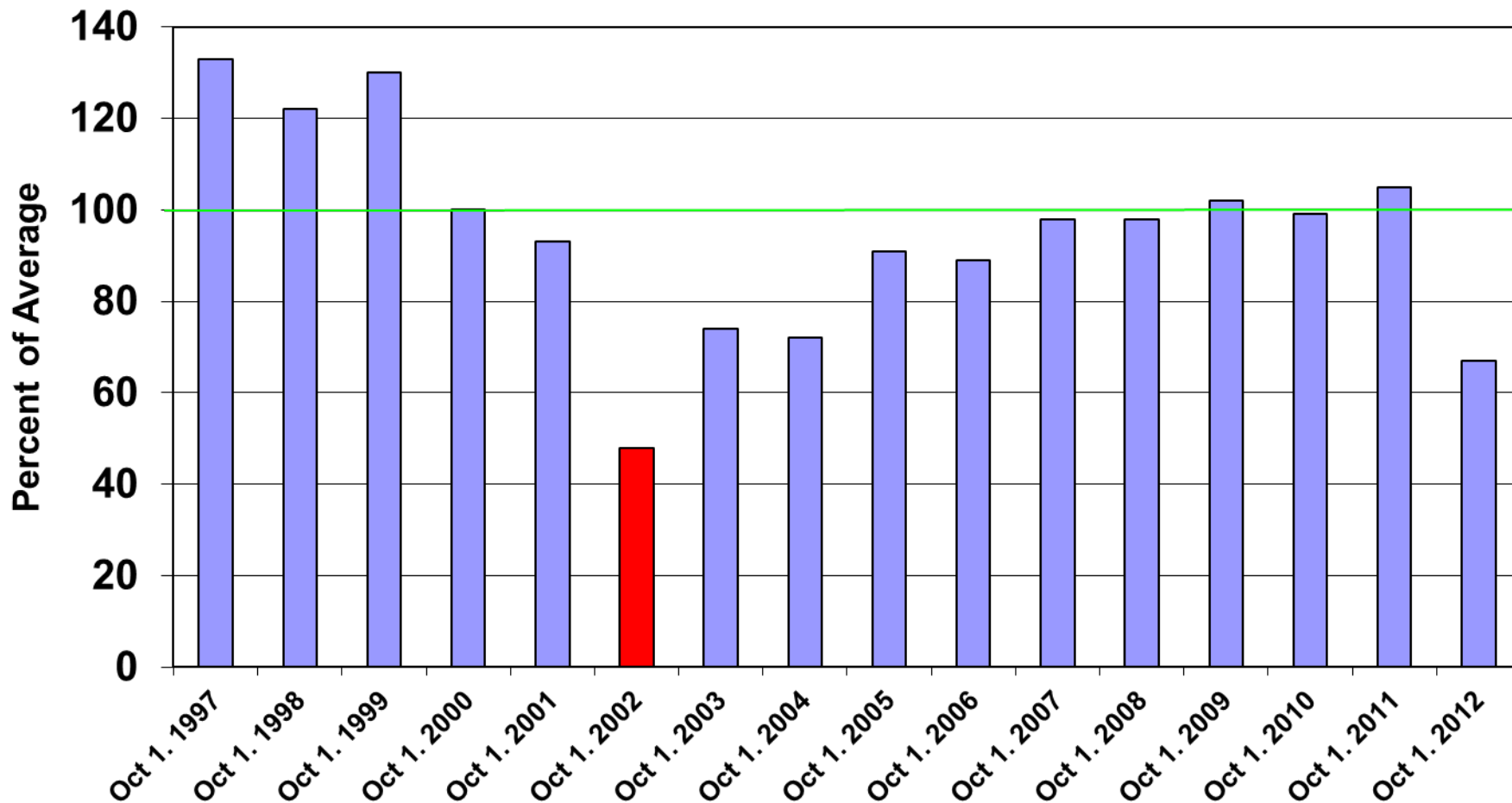
--- Average — 2006 — 2009 — 2012



Reservoir Update

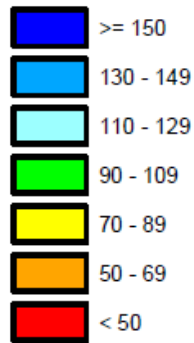


Colorado Statewide Reservoir Levels on October 1st for Years 1997- 2012

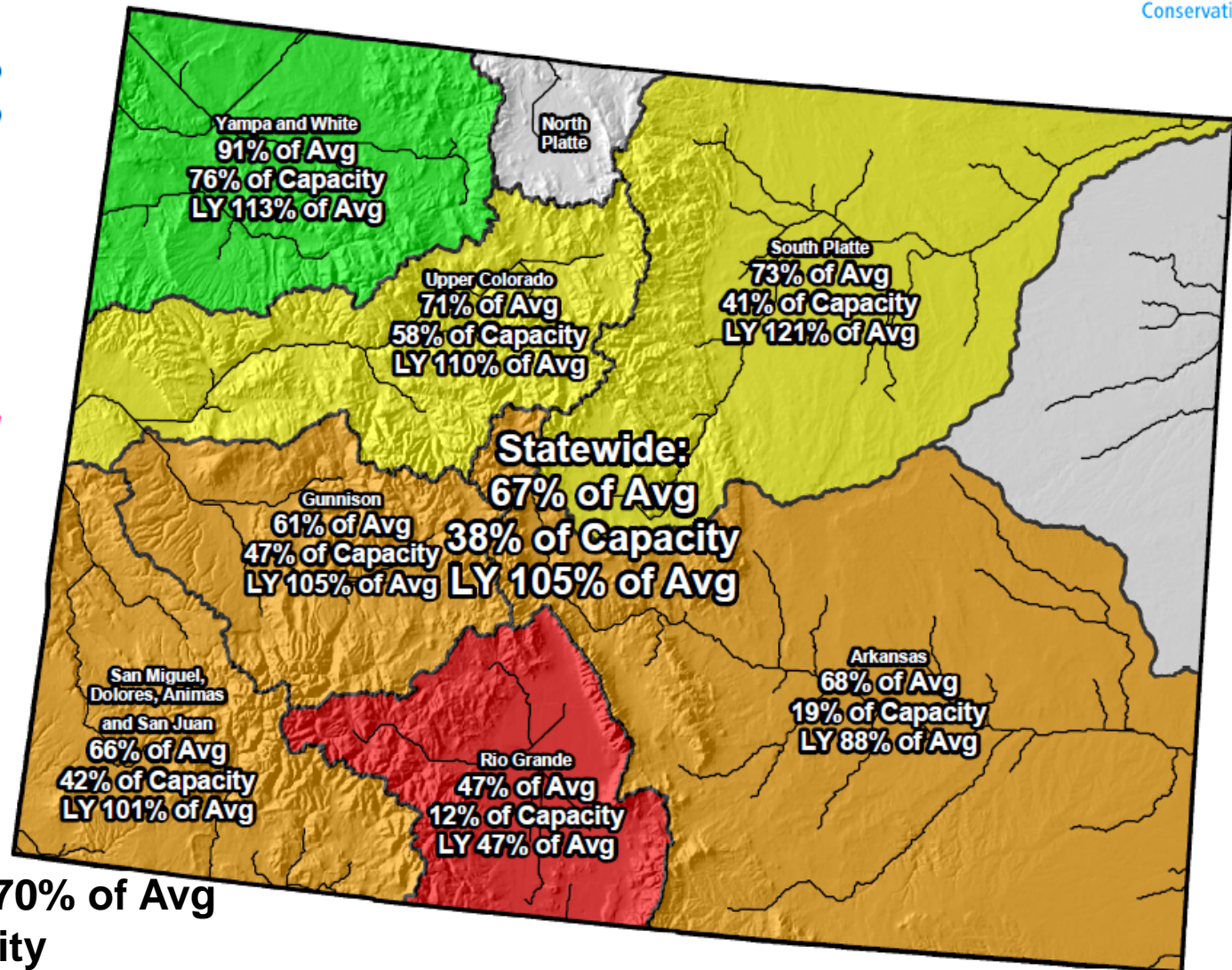


Colorado Reservoir Storage Map

Percent of Average



*Provisional Data
Subject to Revision*

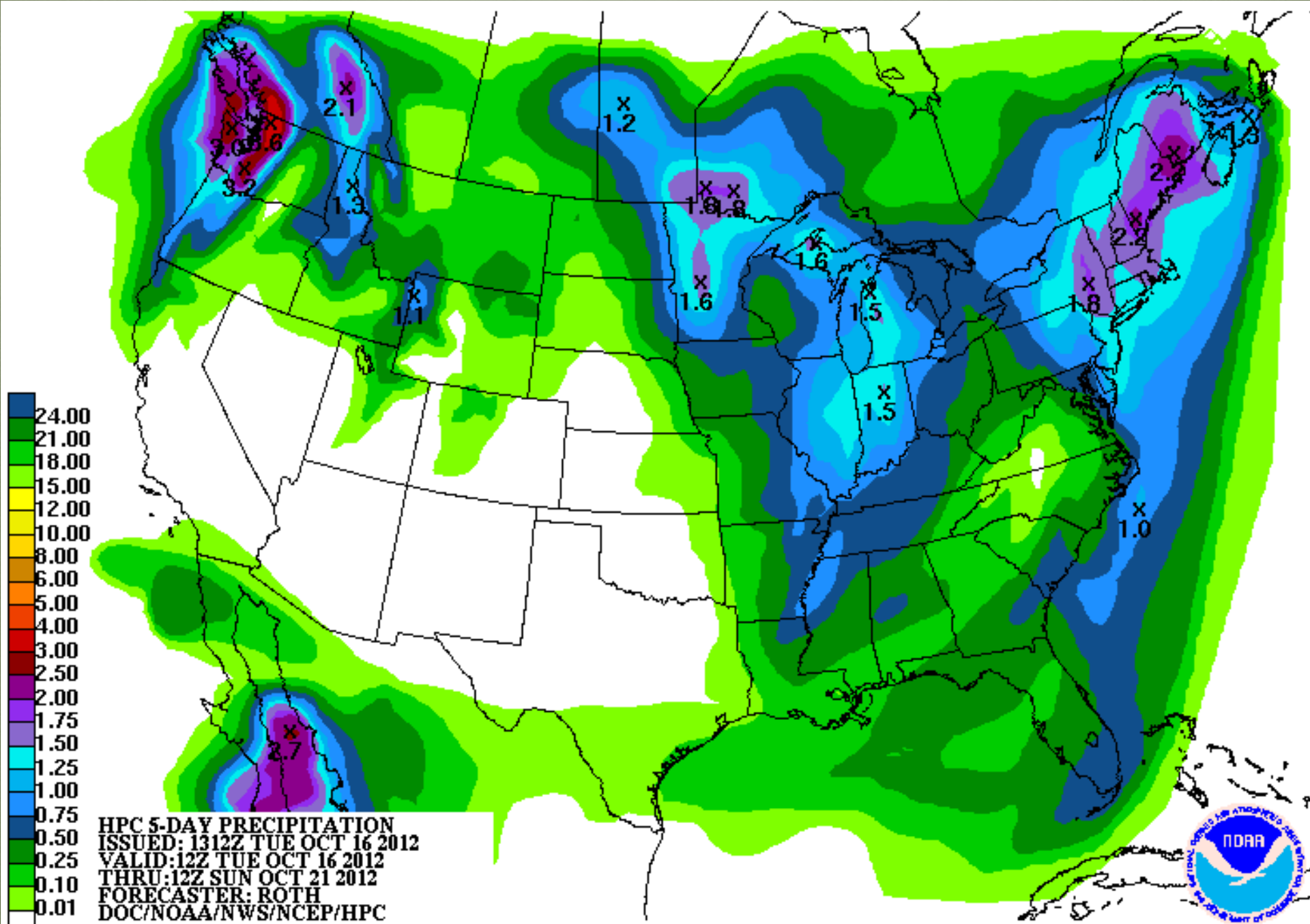


**Lake Powell: 70% of Avg
57% of Capacity**

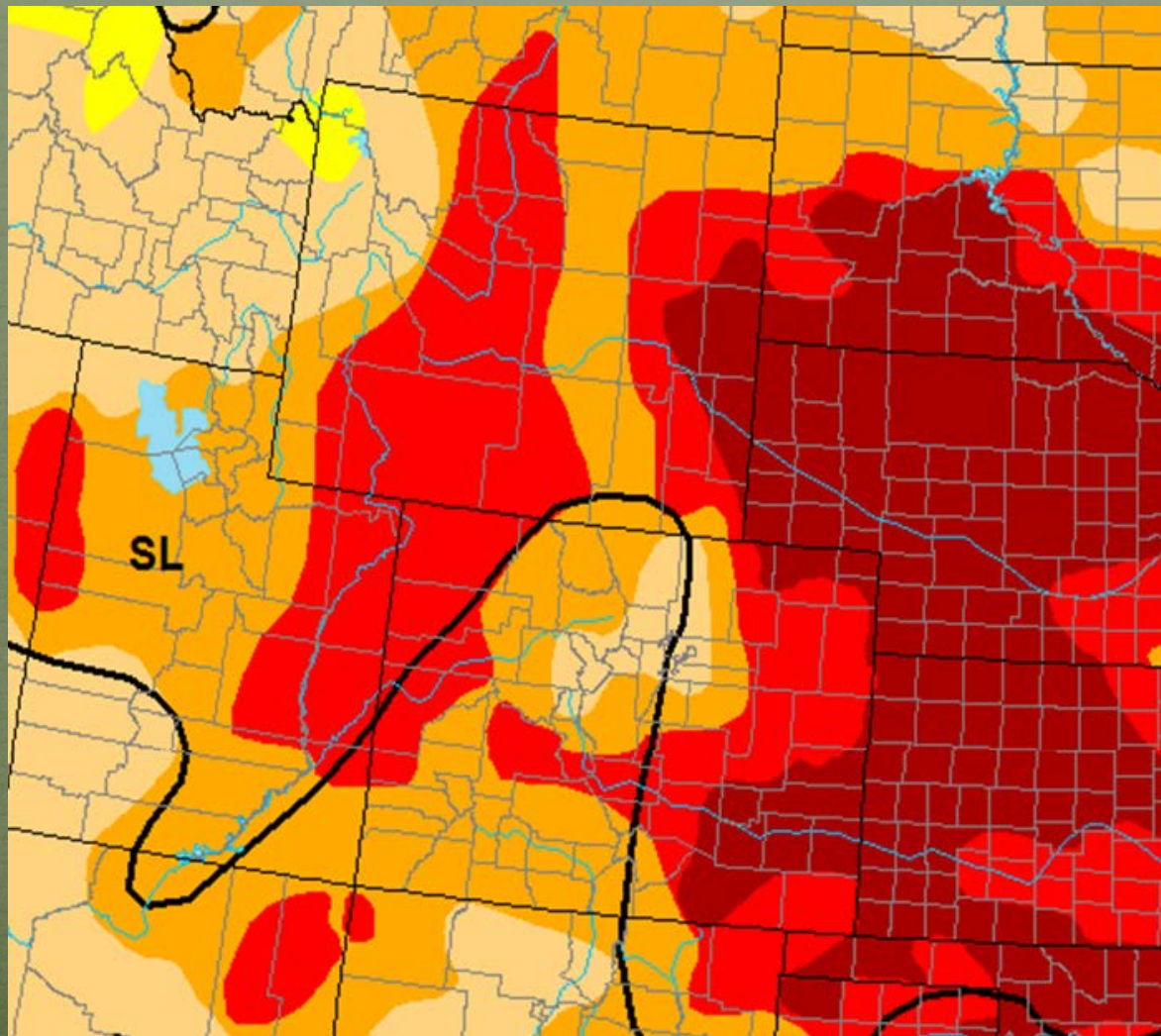
End of September 2012

Precipitation Forecast










Recommendations



Intensity:

-  D0 Abnormally Dry
-  D1 Drought - Moderate
-  D2 Drought - Severe
-  D3 Drought - Extreme
-  D4 Drought - Exceptional

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CONTACT:

COLORADO CLIMATE CENTER

COLORADO STATE UNIVERSITY

FORT COLLINS, CO 80523

970 - 491 - 8545

NIDIS - UPPER COLORADO BASIN PILOT PROJECT

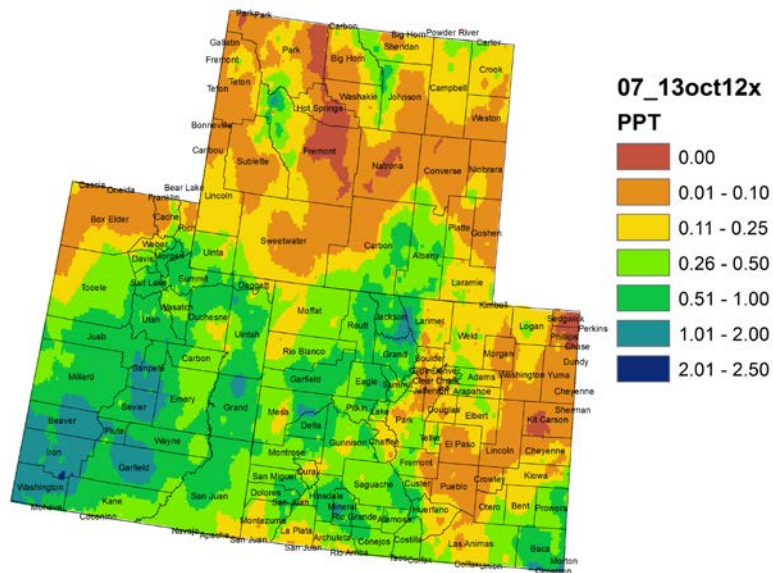
F o r m o r e i n f o r m a t i o n

NIDIS Weekly Climate, Water and Drought Assessment Summary

Upper Colorado River Basin

October 16, 2012

Colorado, Utah and Wyoming 7 Day Precipitation (in)
7 - 13 October 2012



Colorado, Utah and Wyoming Water Year 2012
Precipitation as Percentage of Normal (Oct 2011 - Sept 2012)

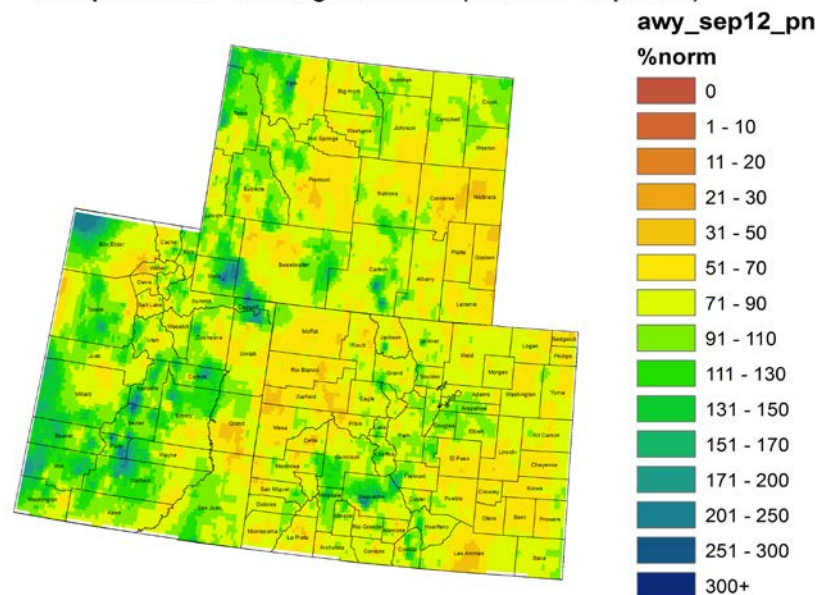


Fig. 1: October 7 - 13 precipitation in inches.

Fig. 2: Water Year 2012 precipitation as a percent of average.

Precipitation

Last week, beneficial precipitation fell in the Upper Colorado River Basin (UCRB), with most areas receiving between 0.25 and 1.00 inch. (Fig. 1). The northern part of the basin in WY received less than 0.25 inches. Eastern and Central Utah received between 1 and 2.5 inches of precipitation for the week. East of the basin, eastern CO was dry receiving less than 0.10 inches with areas closer to the mountains up to 0.25 inches. Southeast Colorado in Baca and Prowers Counties fared well, receiving up to 1.00 inches.

For Water Year 2012 most of the UCRB was drier than average (Fig. 2). Some parts in central Utah and southwest Wyoming saw above average precipitation for the water year. The San Juan mountains in CO received near average precipitation. Northwest CO was the driest part of the basin, with most areas receiving between 30% and 70% of average water year precipitation. East of the basin, most of eastern CO saw between 70% and 90% of average water year precipitation, with parts of the Front Range, Saguache County, and the Sangre de Cristos receiving near average precipitation for the water year.

Streamflow

As of October 15th, about 33% of the USGS streamgages in the UCRB recorded normal (25th – 75th percentile) 7-day average streamflows (Fig. 3). About 38% percent of the gages in the basin are recording much below normal or low (i.e. lowest on record) streamflows, and 3% of the gages are recording above normal flows. As flows return to a normal baseflow, the rivers are expected to run lower, and small changes could mean larger changes in percentiles rankings. Accumulated volumes for this time of year is a better indicator of how runoff has been affected by dry conditions.

Flows on all three key gages across the basin decreased slightly from last week (Fig. 4). The Colorado River near the CO-UT state line and the Green River at Green River, UT are both recording flows in the below normal range, at the 14th and 8th percentiles, respectively. Flows on the San Juan River near Bluff, UT increased slightly from last week from the 13th percentile to the 19th percentile.

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		

Fig. 3: 7-day average discharge compared to historical discharge for October 15th.

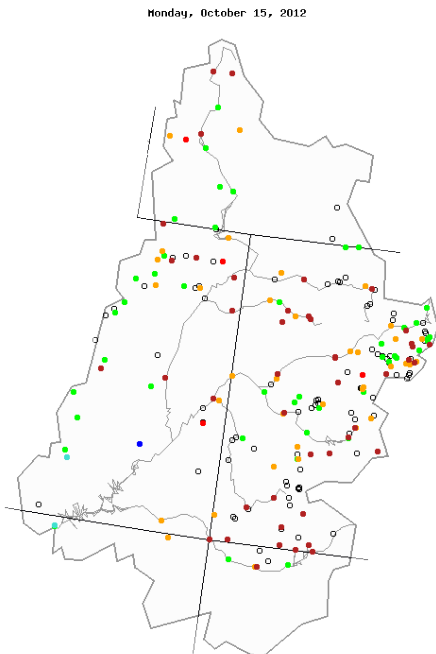
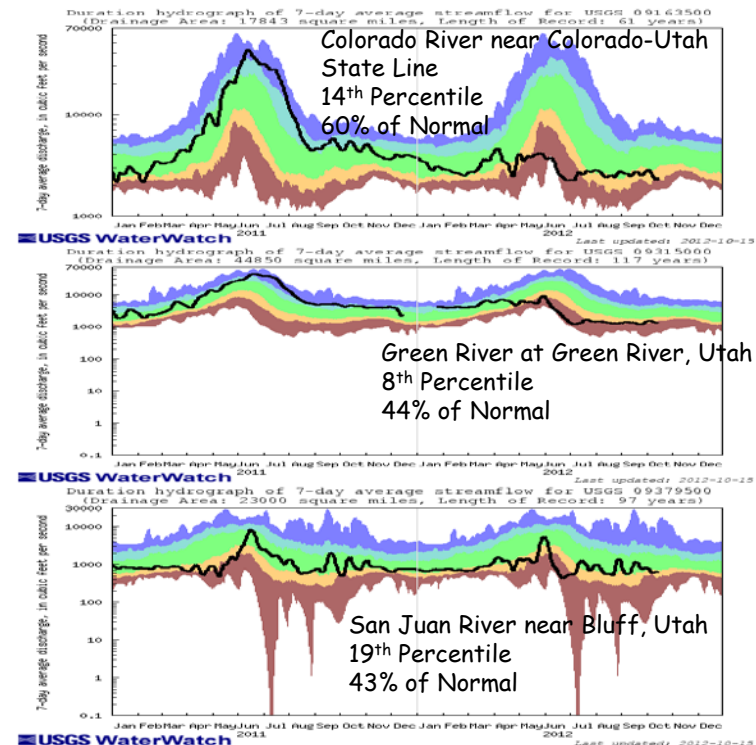


Fig. 4: USGS 7-day average discharge over time at the CO-UT stateline (top), Green River, UT (middle) and Bluff, UT (bottom).



Water Supply and Demand

The UCRB saw near normal temperatures last week with an isolated area in the Upper Green River Basin seeing 2 to 4 degrees above normal. East of the basin, the rest of CO experienced temperatures 2 to 6 degrees cooler than normal. Satellite vegetation conditions show very dry vegetation through much of the northern part of the UCRB and throughout eastern CO (Fig. 5). Improved vegetation conditions show up in the central and southern mountains of CO and also in southern UT, however still very dry. For the growing season, reference evapotranspiration (ET) rates were higher than average across the western slope. Stations in southeast and northeast CO reported near record or record high reference ET accumulations for the growing season.

For the month of September, all the major reservoirs in the UCRB saw a volume decrease, which is normal during this time of year. Navajo and Granby reservoirs decreased more than what is normal for this time of year, while Green Mountain decreased less than average. The Colorado statewide reservoir storage on October 1st was 67% of normal. Only 2002 was lower on October 1st in the past 15 years at 48% of average.

Precipitation Forecast

The upcoming week will see the UCRB sandwiched between a ridge of high pressure over the eastern Pacific and a deep area of low pressure developing over the northern plains. A strong jet streak moving down the west side of the plains low will be positioned directly over the basin on Wednesday and lead to gusty winds over the northern areas. Expect to see rain showers breaking out by Wednesday morning with some accumulating snow possible above 10,000 ft. through the day. Limited moisture associated with this system should keep any appreciable accumulation to the high terrain of WY and northern CO/UT, with generally less than 0.10 inches of liquid equivalent possible throughout the duration of the event. On Thursday the entire pattern begins to shift eastward, allowing the tall pacific ridge to move over the UCRB and bring a return to seasonal temperatures and dry conditions through the weekend. The potential for high mountain snow showers will return moving into early next week as moisture and a weak disturbance are expected to approach the northern sections of the basin on Monday.

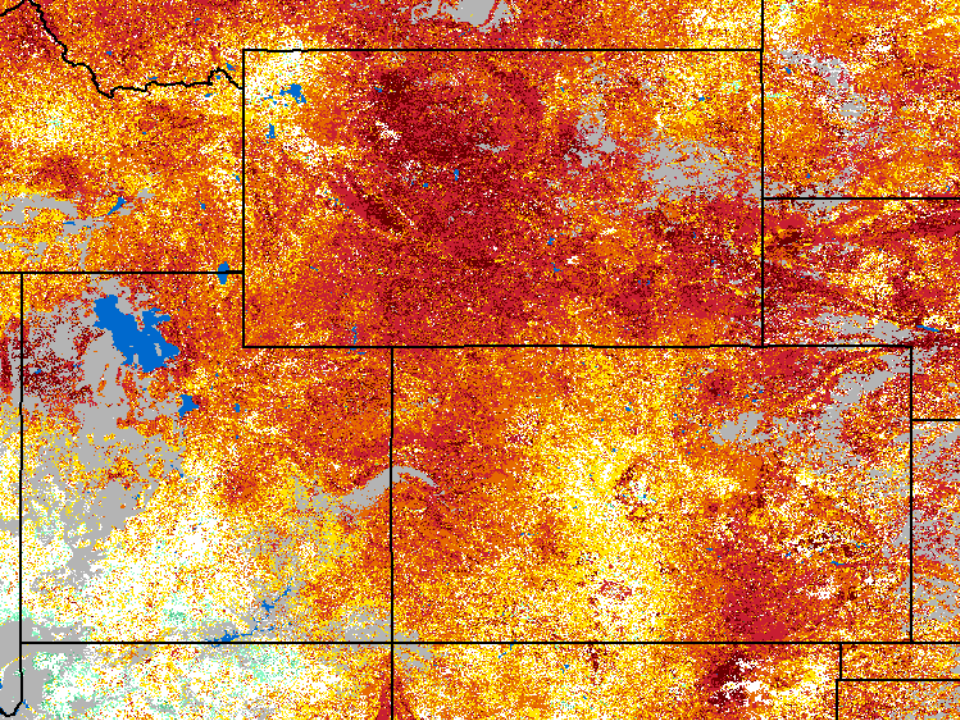


Fig. 5: eMODIS VegDRI showing satellite vegetation conditions as of October 16th.

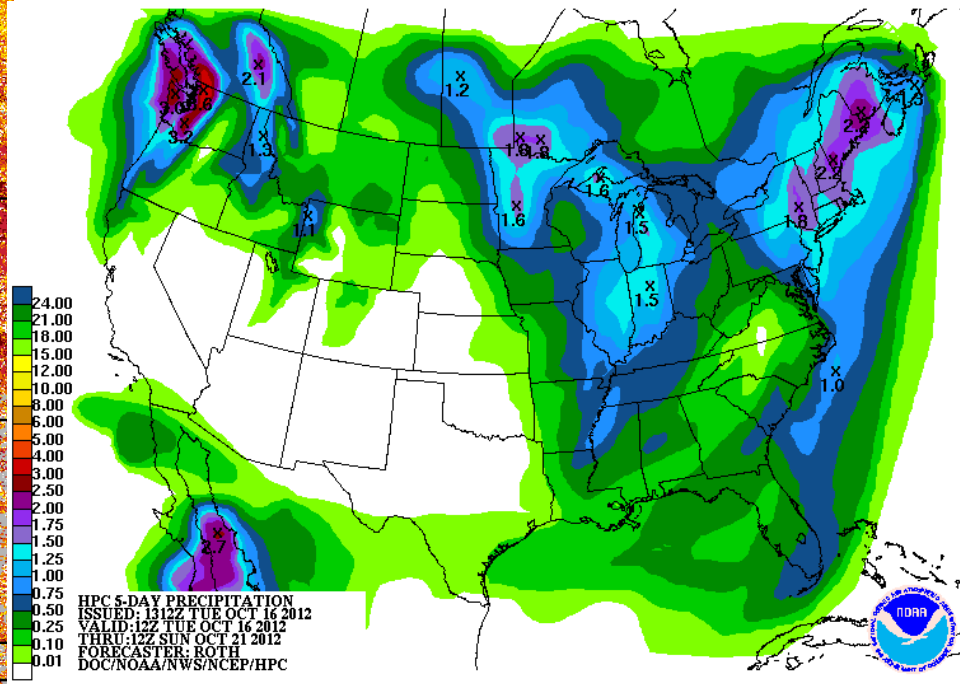


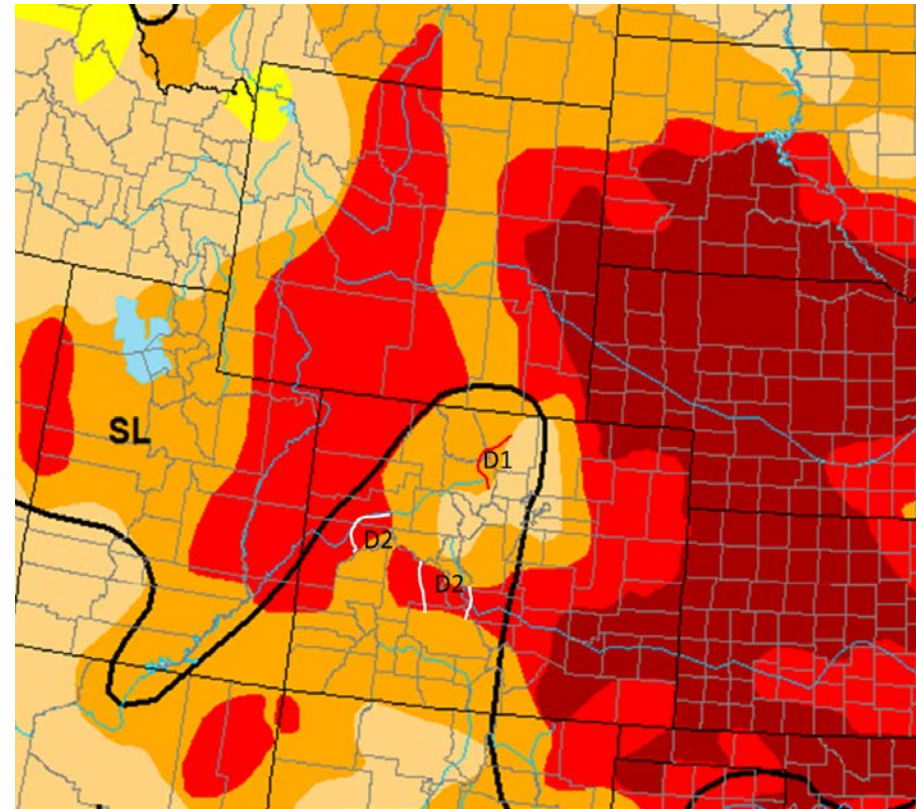
Fig. 6: Quantitative precipitation forecast (QPF) by the Hydrologic Prediction Center out to 12UTC Sunday, October 21st.

Drought and Water Discussion

Drought – Exceptional	0 to 2 (D4)
Drought – Extreme	2 to 5 (D3)
Drought – Severe	5 to 10 (D2)
Drought – Moderate	10 to 20 (D1)
Abnormally Dry	20 to 30 (D0)

Drought categories and their associated percentiles

Fig. 7: October 16nd draft of U.S. Drought Monitor for the UCRB with recommendations.



UCRB: Slight improvements for the UCRB are recommended (Fig. 7). A trimming of the D3 in Garfield and eastern Mesa Counties to D2. It is also recommended the D3 in eastern Gunnison County and Chaffee County be improved to D2. The D3 in western Gunnison County should remain there due to some of the lowest streamflows on record.

Eastern CO: Only a slight trimming of the D2 in SW Larimer County into SE Jackson and NE Grand Counties is recommended. The rest of Eastern CO is remaining status quo because of the long term dryness.