



Montana DWSAC Briefing

March 22, 2017



The Montana Department of
Natural Resources
& Conservation

Montana Drought Management Plan (MDMP) Update

- Timeline
- Working Group
- Defining Drought
- Response Strategy
- Long-term Mitigation Strategies

Timeline

Year 1

- State-wide Vulnerability Assessment
- Define Drought
- Develop Emergency Response Framework
- Report to Working Group

Year 2

- Mitigation Strategy Case Studies
- Continue Reporting to Working Group
- Draft Final Plan
- Public Comment Period

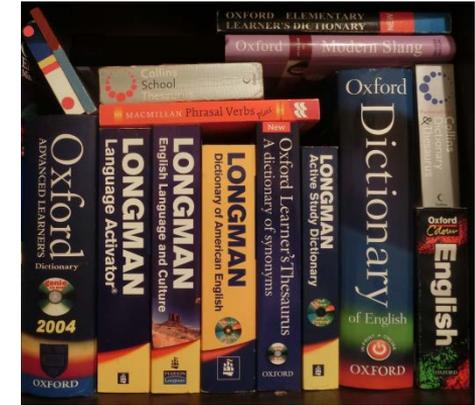
Working Group

- Trout Unlimited
- Department of Livestock, Director
- City of Bozeman, Water Conservation Specialist
- Watershed Restoration Council
- Indian Nations Conservation Alliance, Director
- Montana Fish Wildlife and Parks (FWP)
- Stockgrowers Association
- Institute for Tourism and Recreation
- Farm Bureau Federation
- Ecolab
- Montana Rural Water Systems
- Bureau of Reclamation
- Northwestern Energy
- Fishing and Outfitting Association of Montana (FOAM)
- Montana Water Resources Association (MWRA)
- Department of Agriculture
- Department of Environmental Quality (DEQ)

Defining Drought

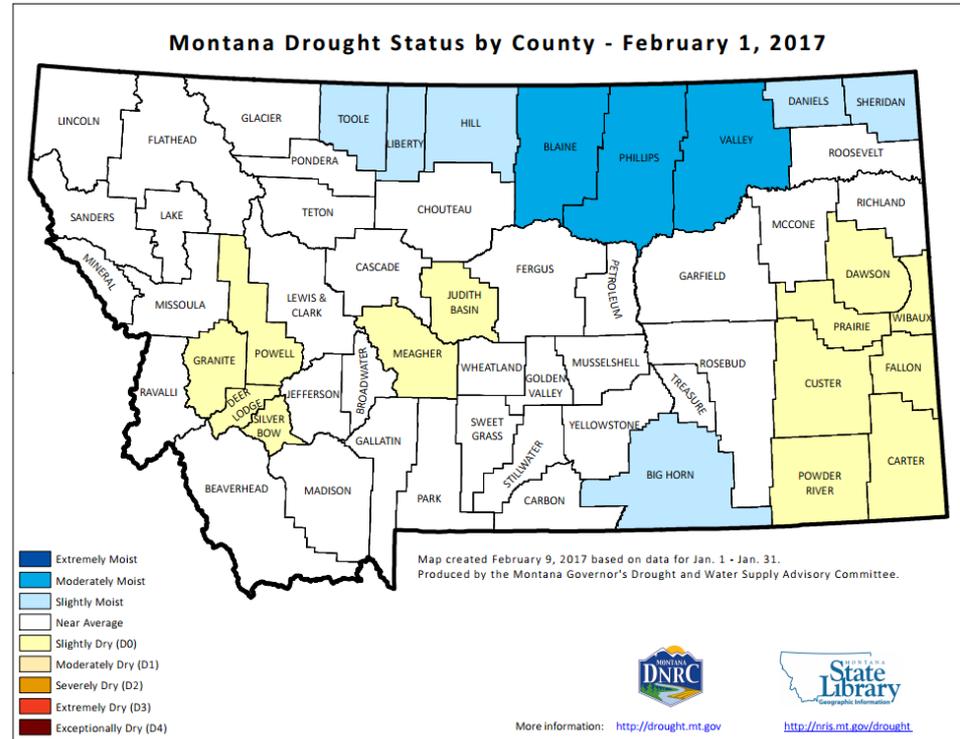
n. a prolonged period of abnormally low rainfall; a shortage of water resulting from this.

Precipitation products	<ul style="list-style-type: none"> - Point – NOAA NWS, NRCS SNOTEL, RAWS - Gridded- NOAA, HPRC/WRC, Gridded (PRISM and Daymet) - Snowpack – Snowcourse, SNOTEL
Temperature Products	<ul style="list-style-type: none"> - Point – NOAA NWS, NRCS, RAWS - Gridded – NOAA, HPRC/WRC, Gridded (Prism and TopoWx)
Water Supply	<ul style="list-style-type: none"> - USGS - SWAMP - Reservoirs
Derived Drought Products	<ul style="list-style-type: none"> - PDSI - SPI - SPEI - EDDI - VegDRI - DSI - Aridity Index (good proxy for soil moisture)

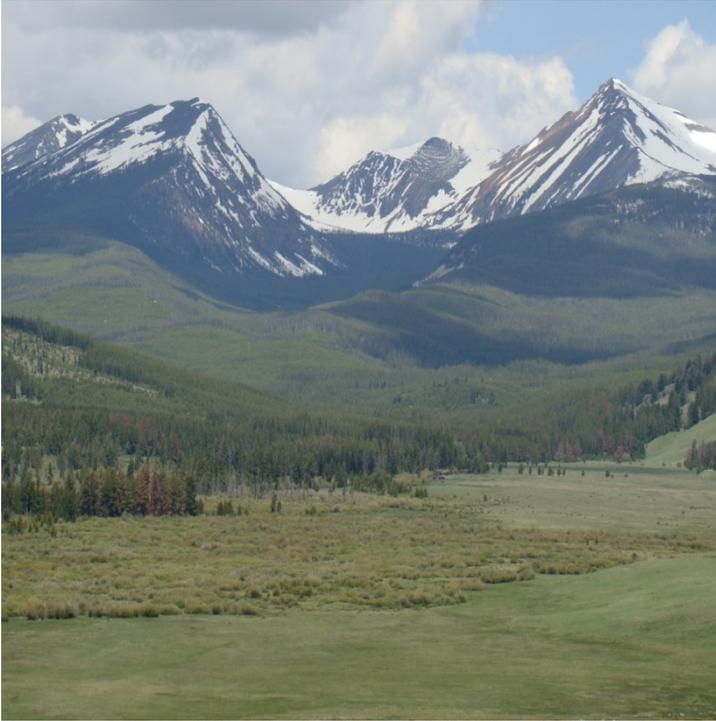


Response Strategy

- White = Mitigate
- Yellow = Communicate
- Orange = Collect Impact Reports
- Red = Find Money
- Blue = Flood Concern



Long-Term Mitigation



- Increase Natural Storage Potential
- Capture and retain water in the headwaters
- Manage uplands (Forests and Rangelands) to consider water yield
- Improve Soil Health & Water holding capacity
- Improve Floodplain management, connectivity & riparian health

Track Our Progress

www.drought.mt.gov

Ada Montague

amontague@mt.gov

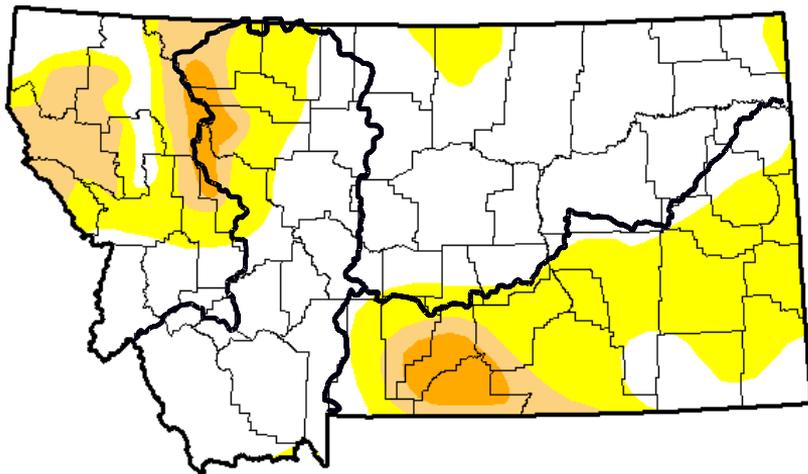
(406) 444-6628

12-Month Change

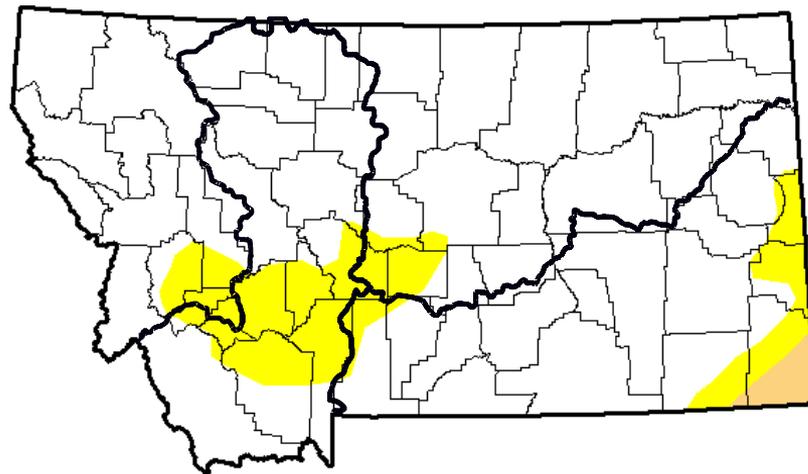


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& Conservation

Mar 22, 2016



March 14, 2017



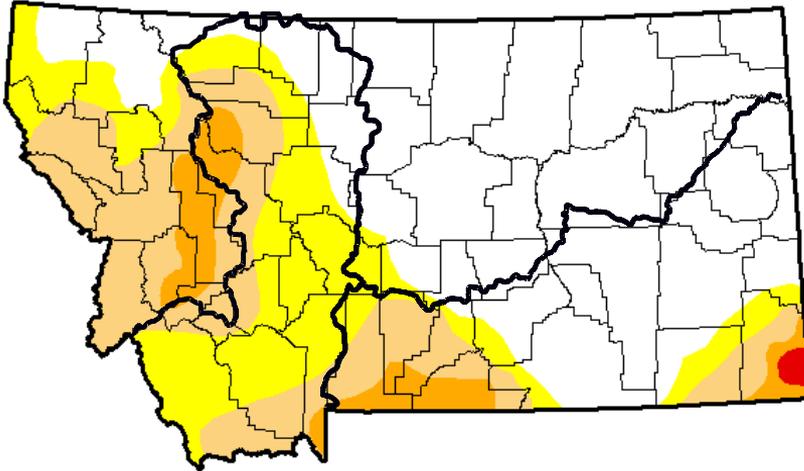
Week	None	D0	D1	D2	D3	D4
2017-03-14	86.71	13.29	1.11	0.00	0.00	0.00
2016-03-22	44.46	55.54	12.90	3.56	0.00	0.00

5-Month Change

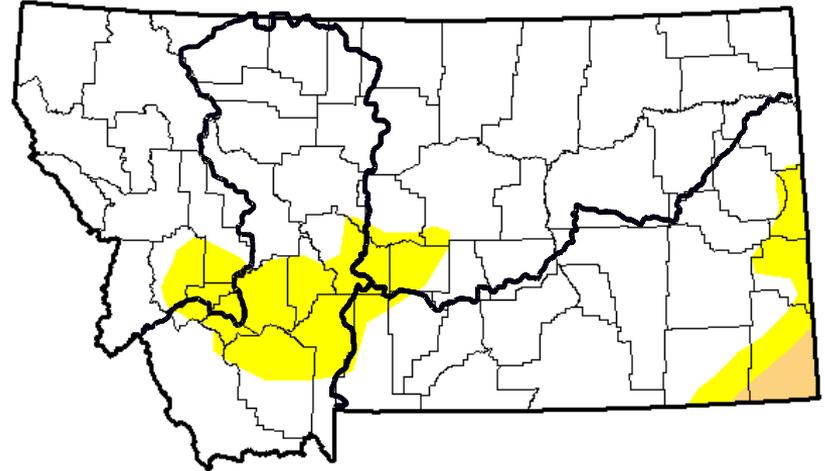


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Sep 27, 2016



March 14, 2017



Week	None	D0	D1	D2	D3	D4
2017-03-14	86.71	13.29	1.11	0.00	0.00	0.00
2016-09-27	55.14	44.86	25.49	5.86	0.33	0.00

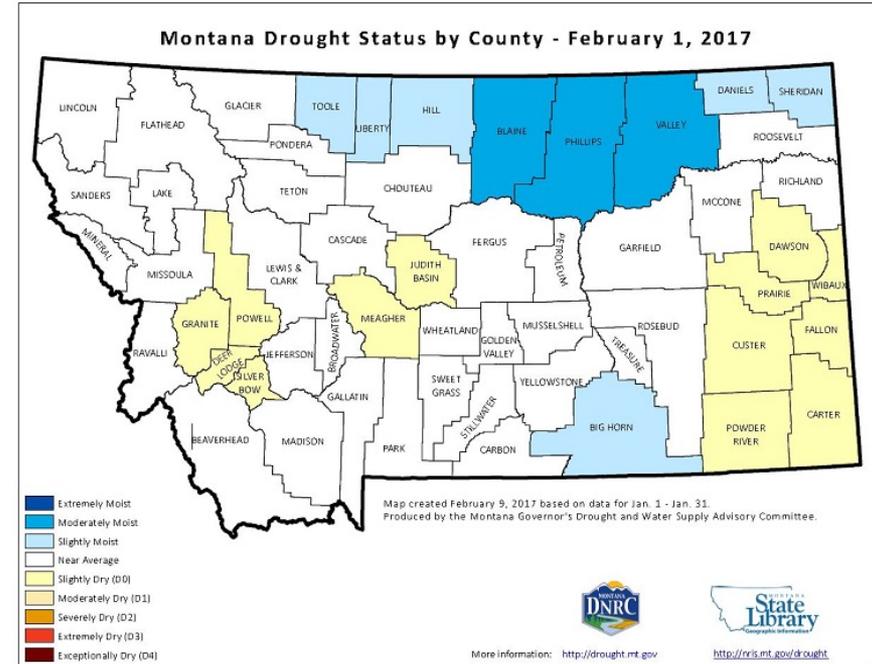
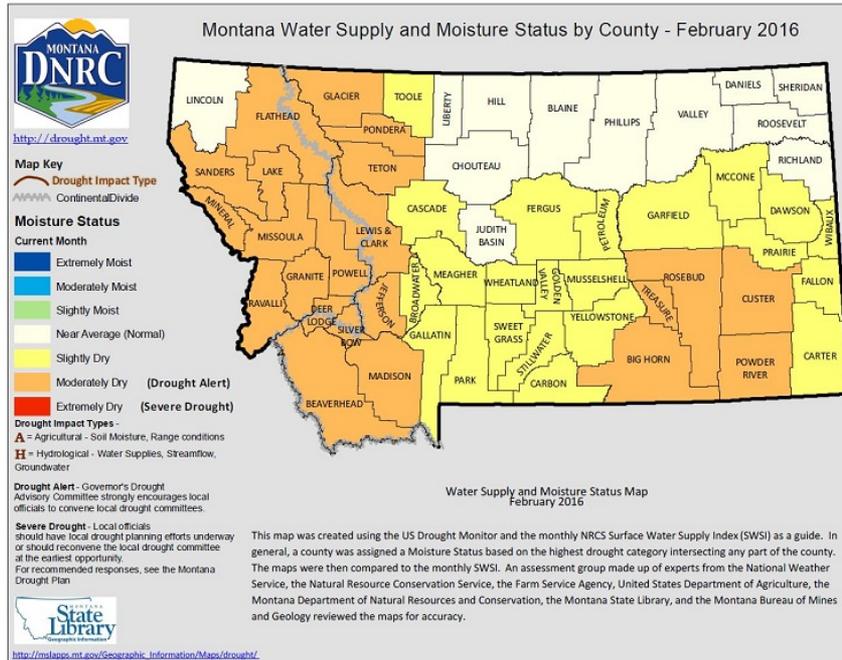
12-Month Change



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& Conservation

February 2016

February 2017



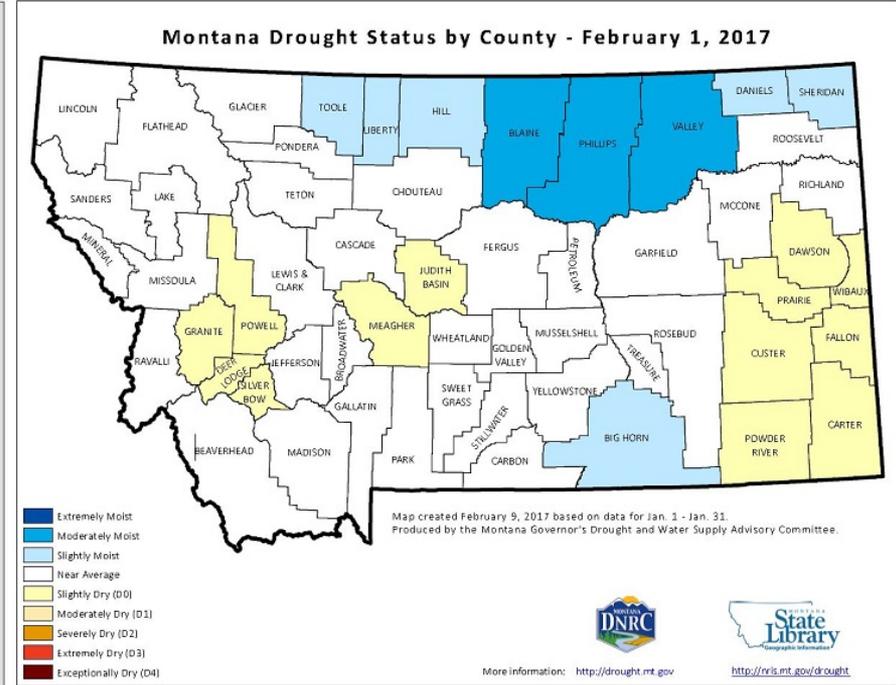
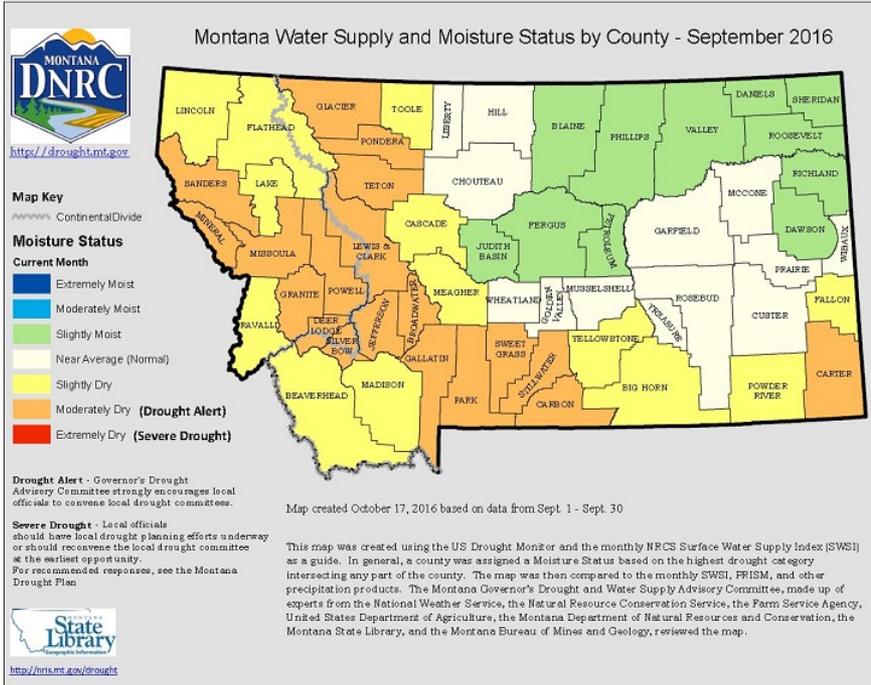
5-Month Change

September 2016



The Montana Department of
Natural Resources
& Conservation

February 2017





Montana DWSAC Briefing

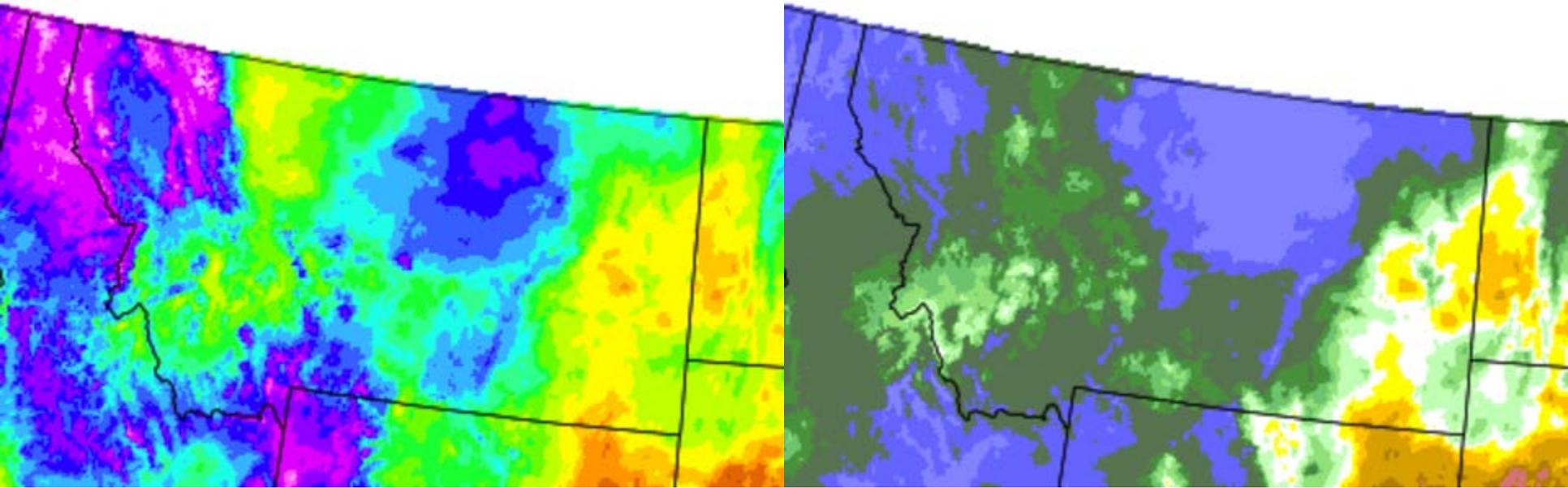


March 22, 2017

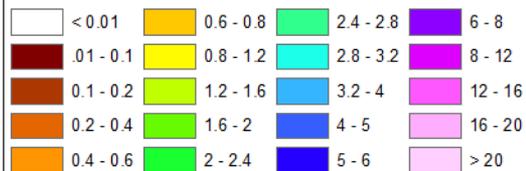


Weather-Ready Nation
National Oceanic and Atmospheric Administration

October 2016 Precip vs Anomaly



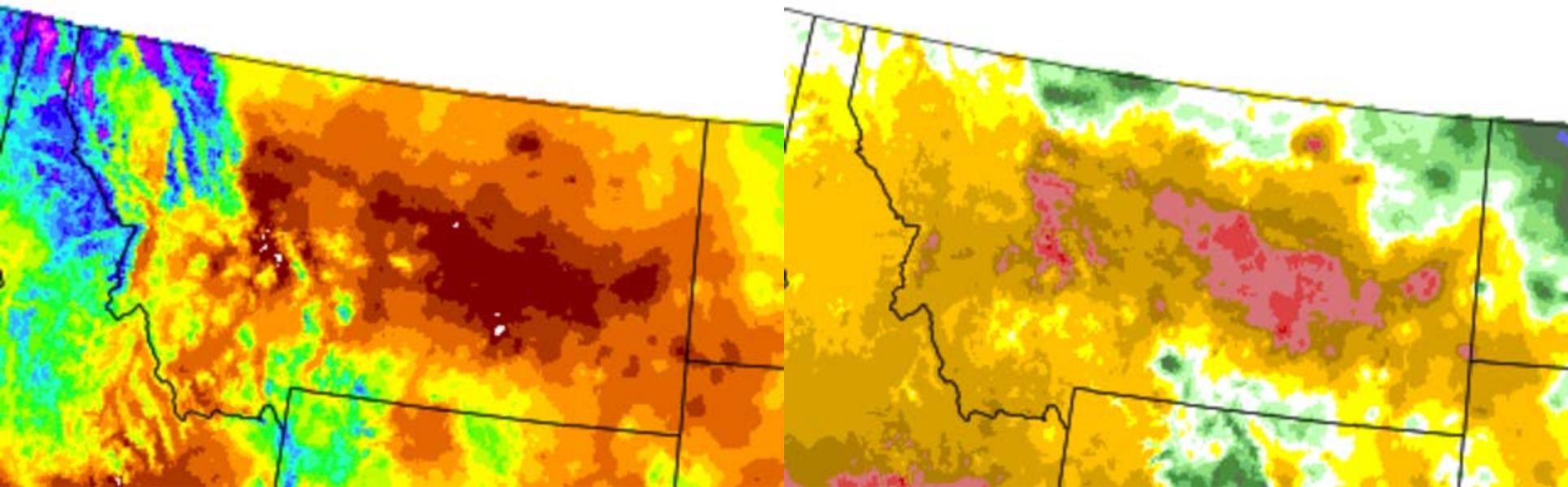
Monthly Precipitation (in.)



% of Average Precipitation



November 2016 Precip vs Anomaly



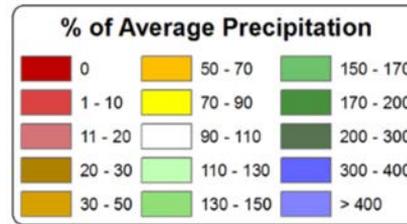
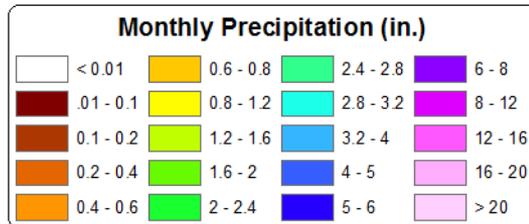
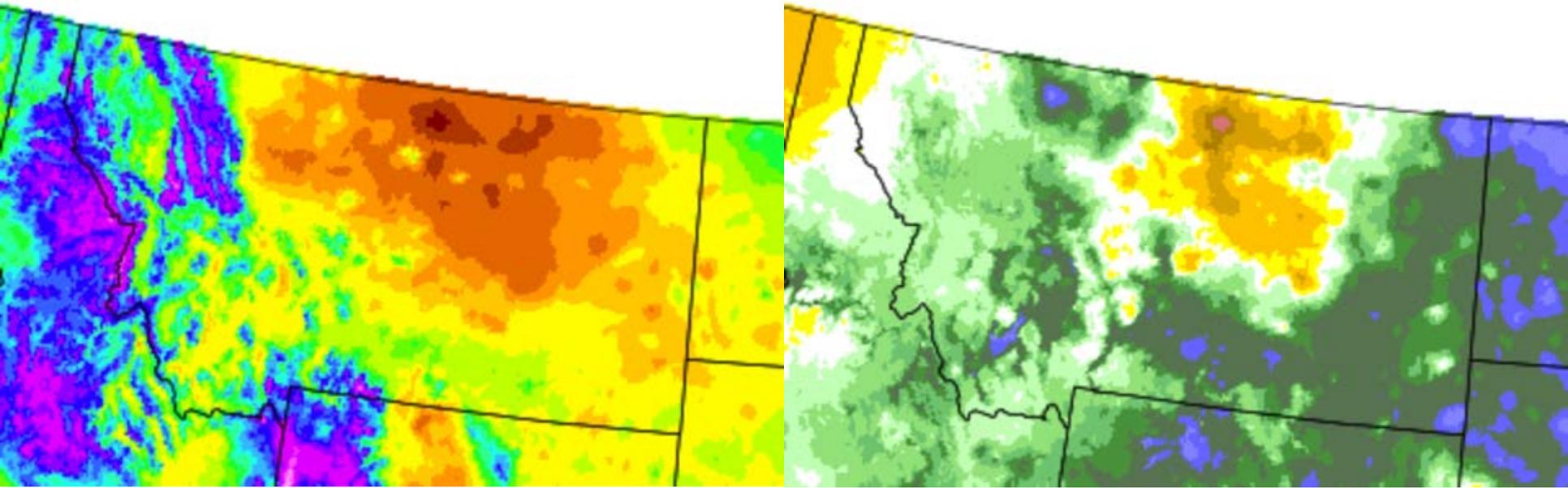
Monthly Precipitation (in.)



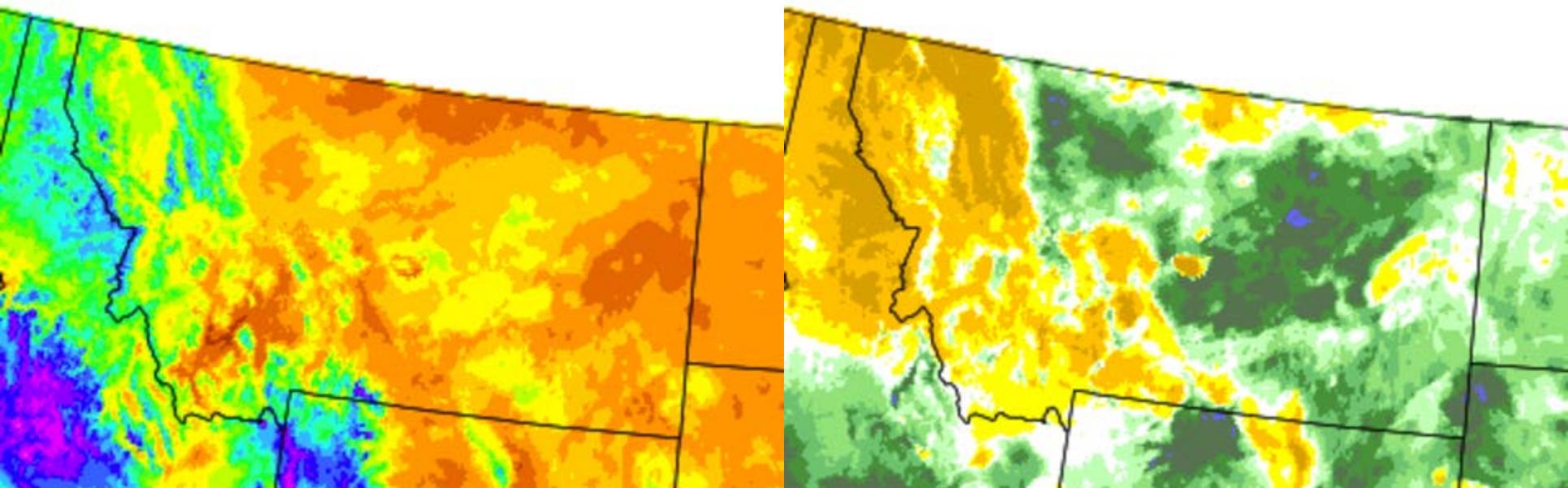
% of Average Precipitation



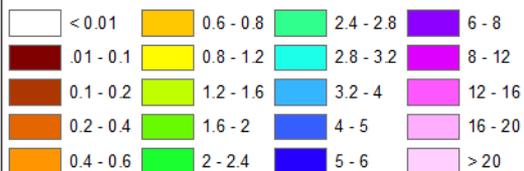
December 2016 Precip vs Anomaly



January 2017 Precip vs Anomaly



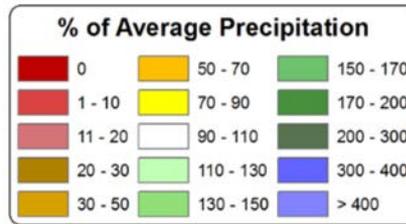
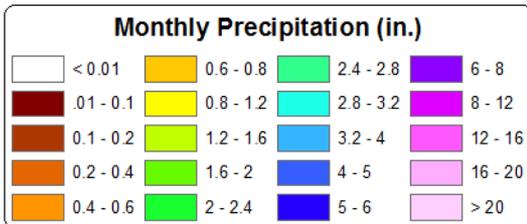
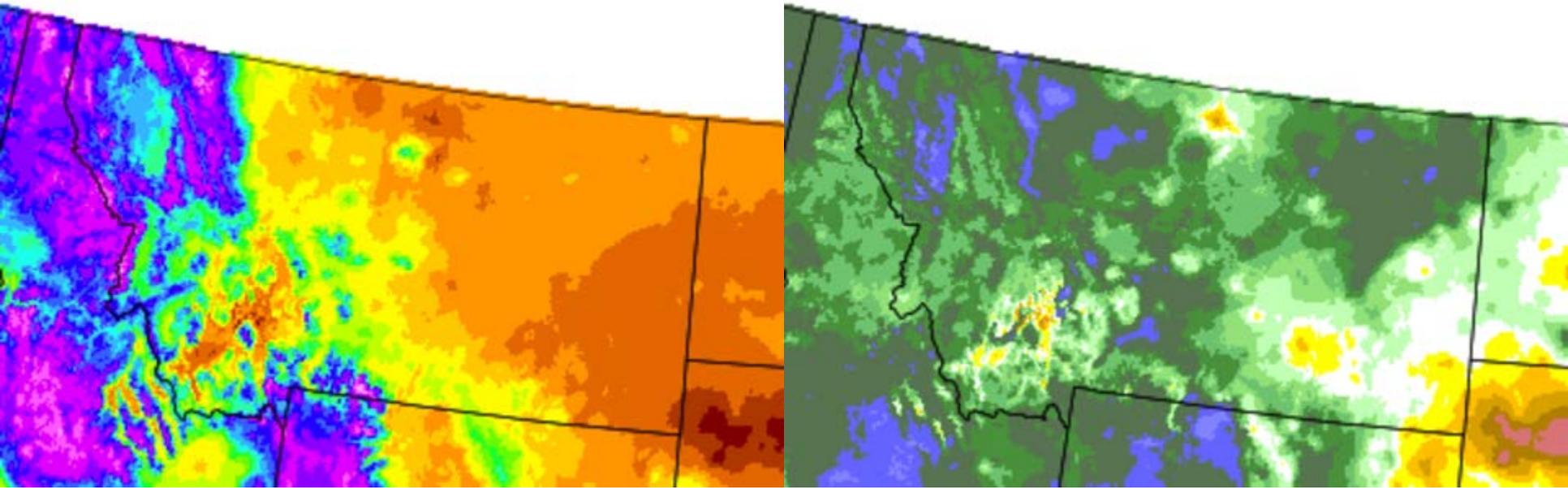
Monthly Precipitation (in.)

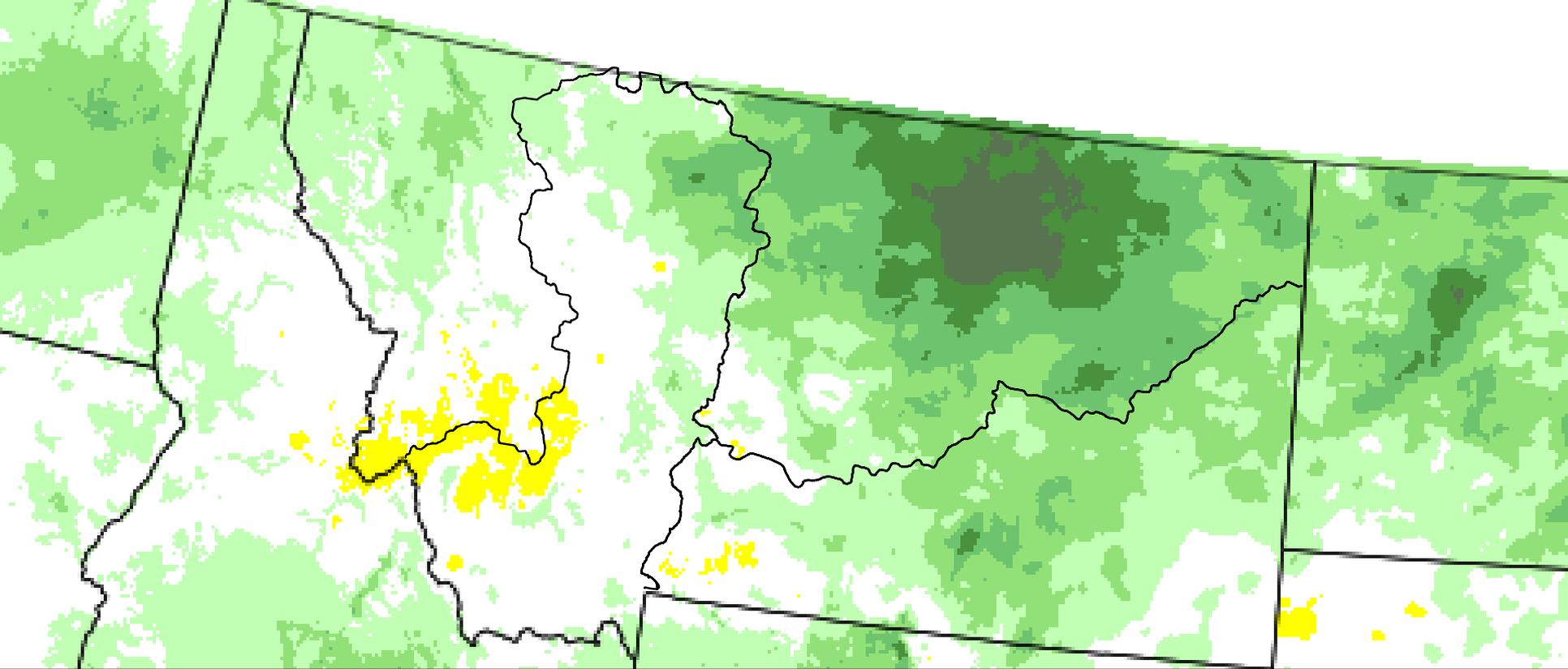


% of Average Precipitation

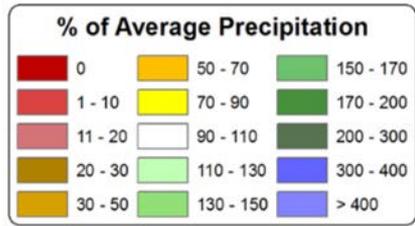


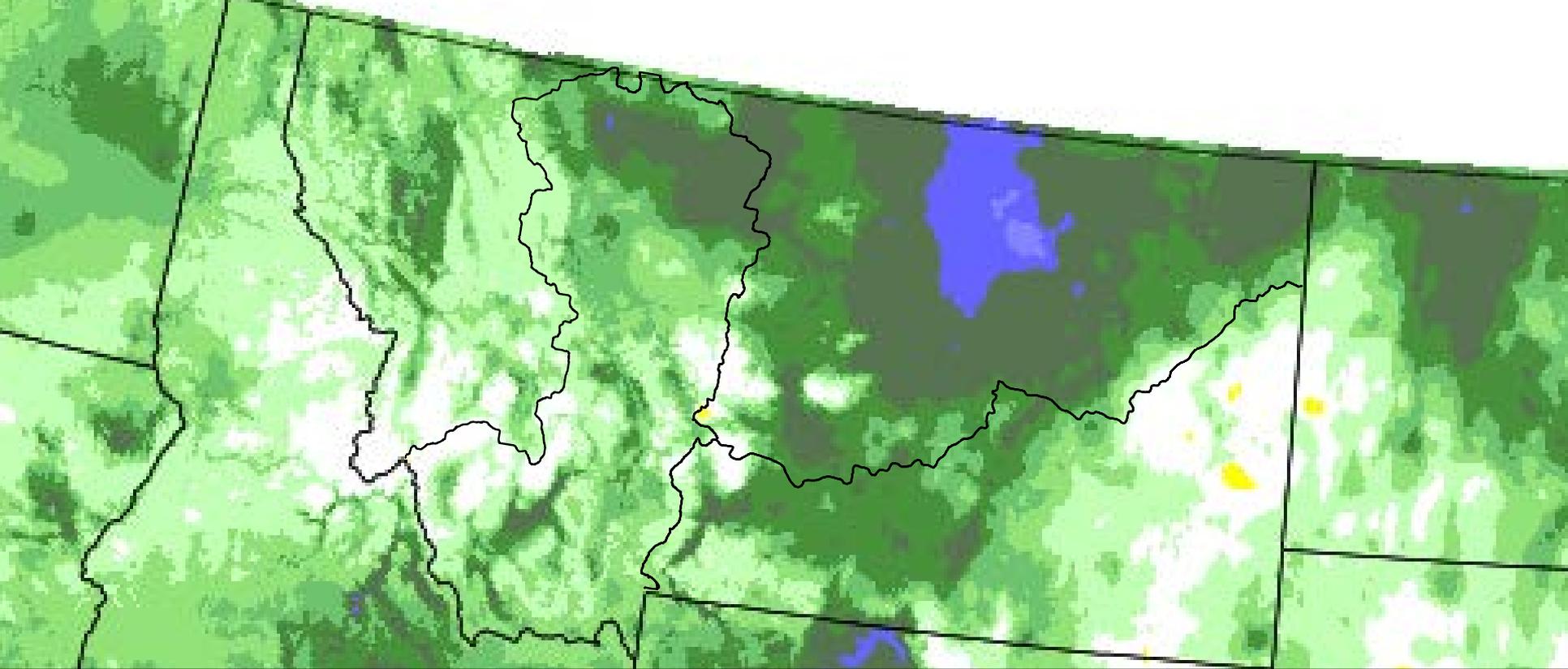
February 2017 Precip vs Anomaly



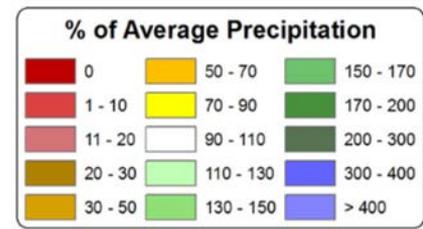


Mar 16 – Feb 17 Precip Anomaly





Water Year 2017 Precip Anomaly





Montana: Mar 2016 – Feb 2017

19th Warmest on Record

Avg Temp	20 th Century Average	Departure
43.3°F	41.2°F	2.1°F

11th Wettest on Record

Precip	20 th Century Average	Departure
22.08"	18.67"	3.41"

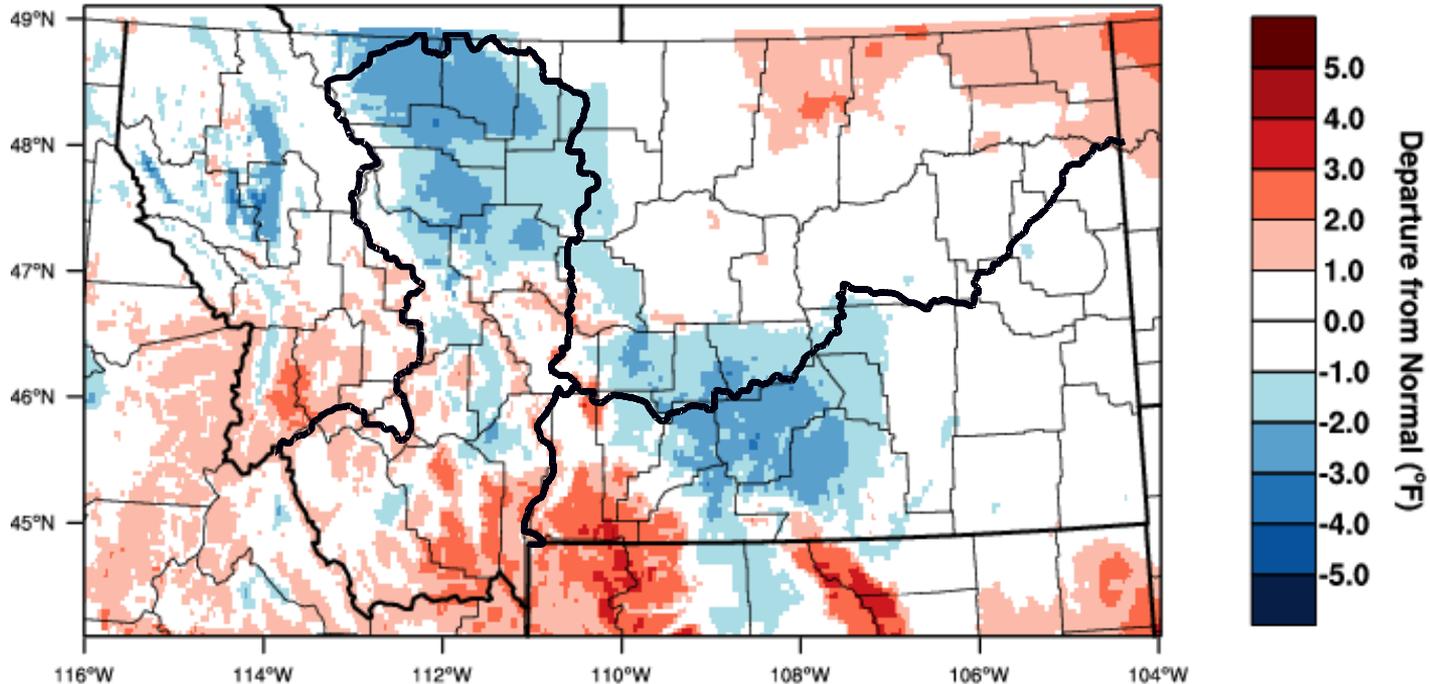


Mean Temperature

Water Year 2017

Montana - Mean Temperature

October-February 2017 Departure from 1981-2010 Normal



116°W 114°W 112°W 110°W 108°W 106°W 104°W

WestWide Drought Tracker, U Idaho/WRCC Data Source: PRISM (Prelim), created 16 MAR 2017



Reservoirs & Lakes

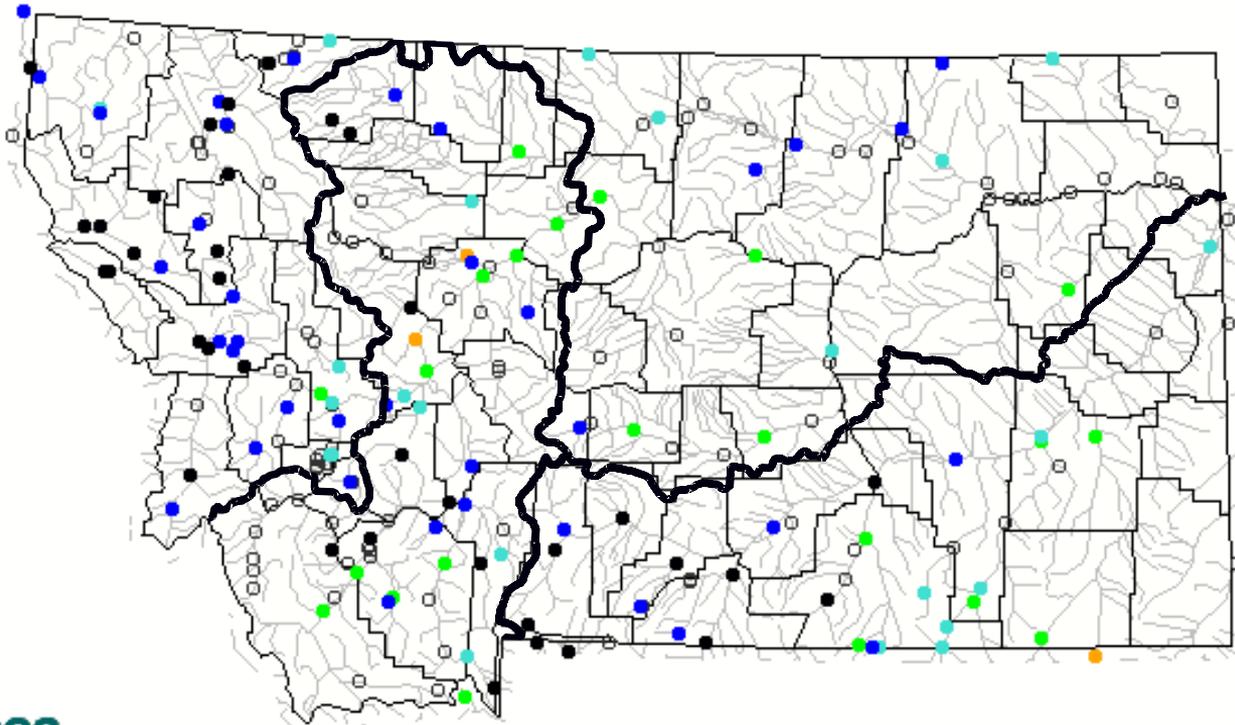


- West of the Divide: nearly all above normal
- East of the Divide: nearly all above normal (exceptions: Pishkun and Nelson)



Stream Gauges

March 21, 2017



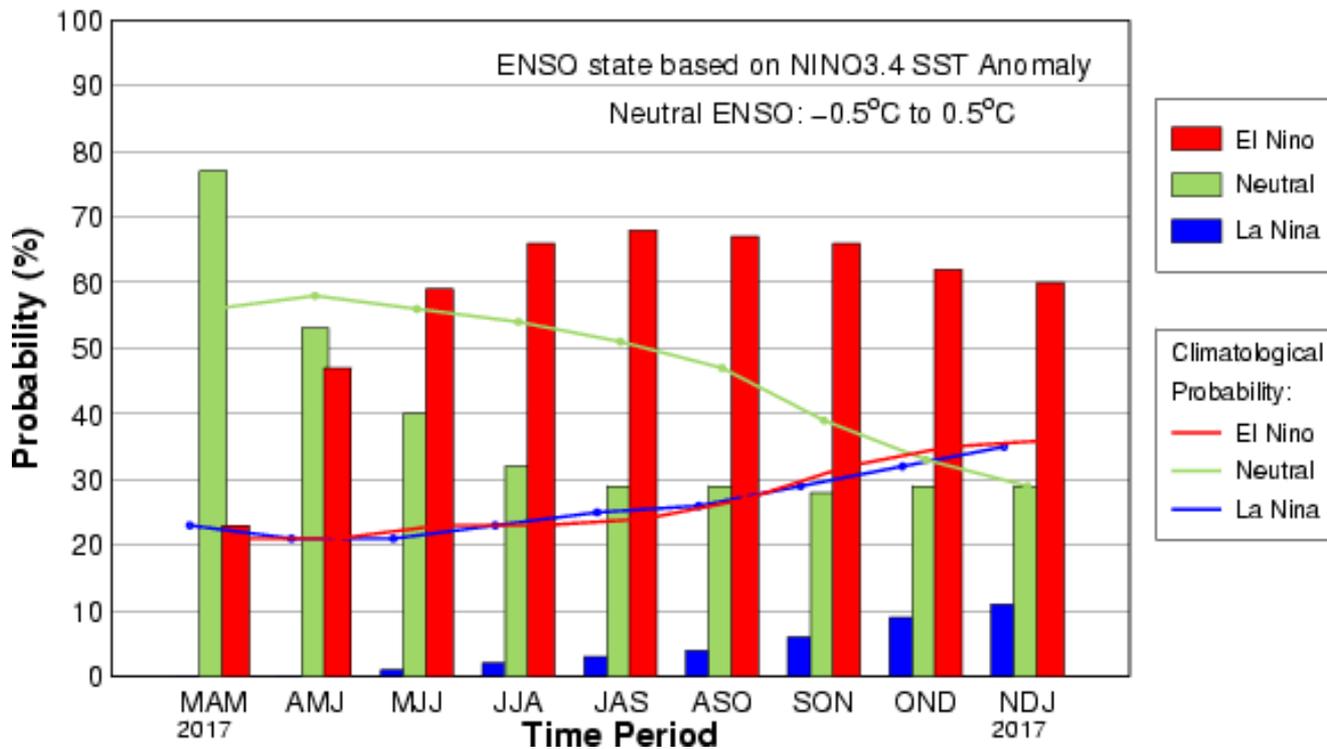
●	Low
●	<10
●	10-24
●	25-75
●	76-90
●	>90
●	High
○	NR



ENSO

Chance of El Nino Return this Summer

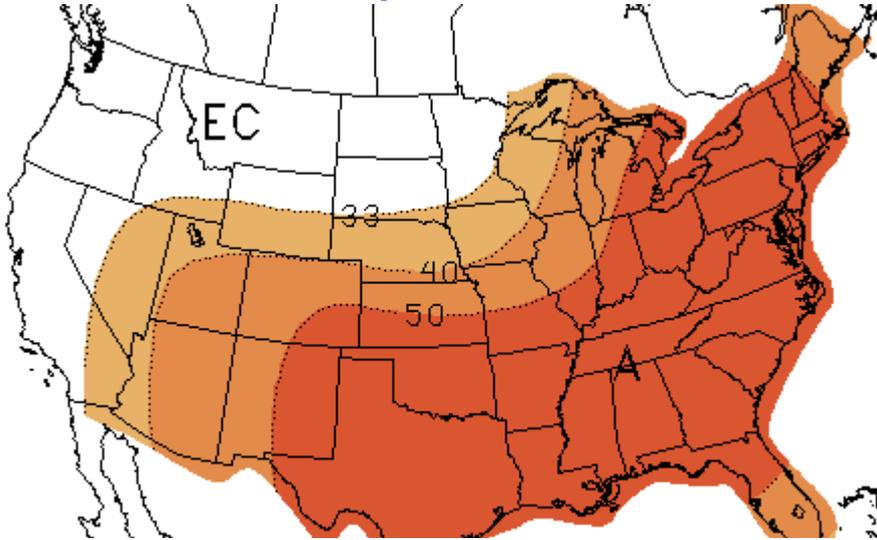
Mid-Mar IRI/CPC Model-Based Probabilistic ENSO Forecast



April – June Outlook

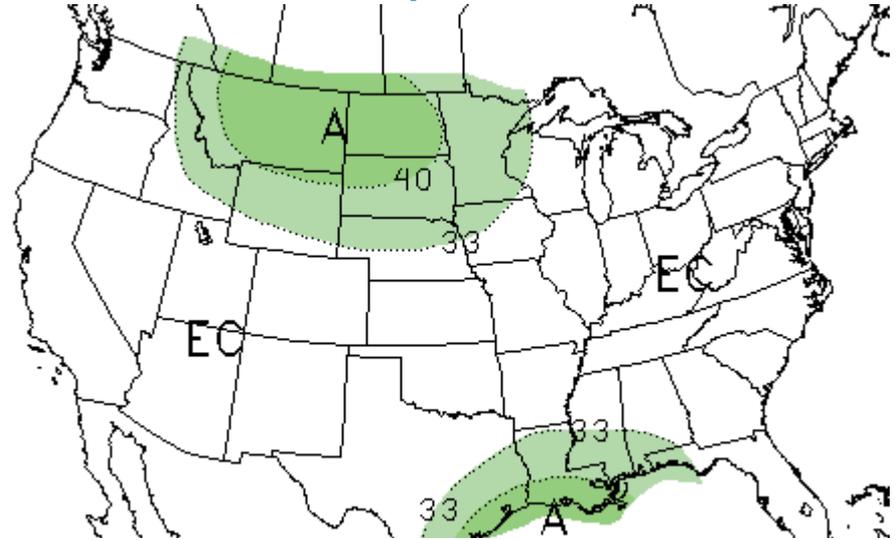
Created March 16

Temperature



Equal chances for above normal or below temperatures over Montana

Precipitation

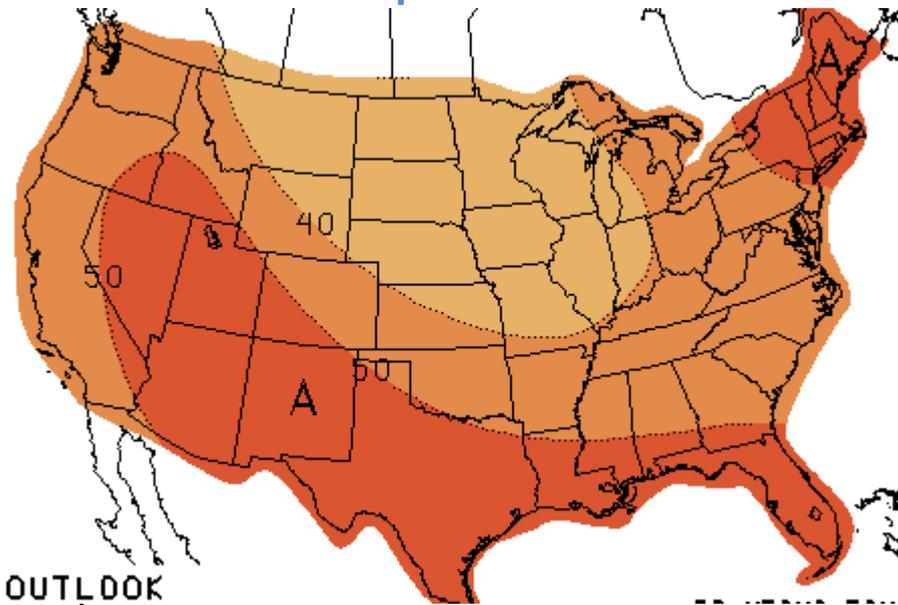


> 40% chance of above normal precipitation over most of Montana, but 33% chance of above precipitation extreme over western Montana

July – September Outlook

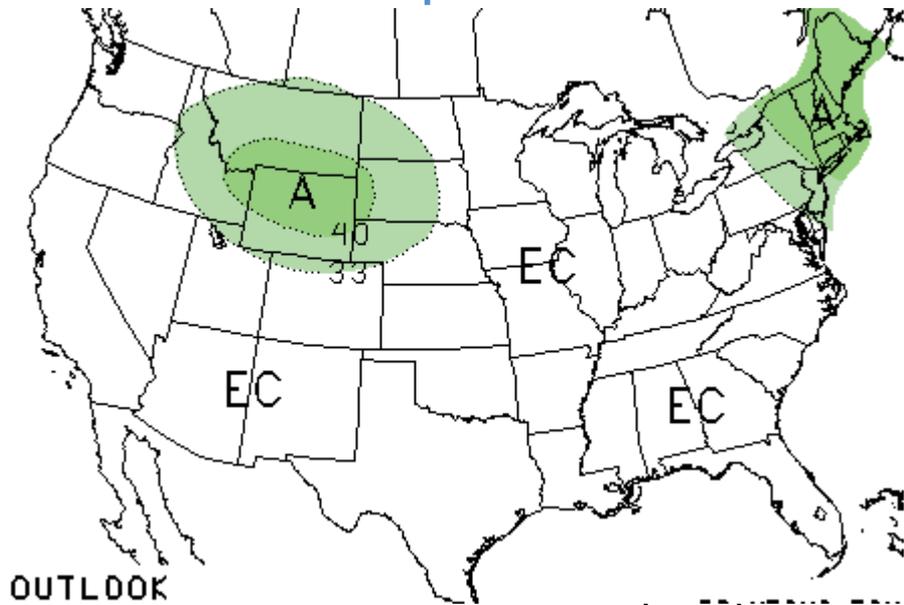
Created March 16

Temperature



temperatures over Montana

Precipitation

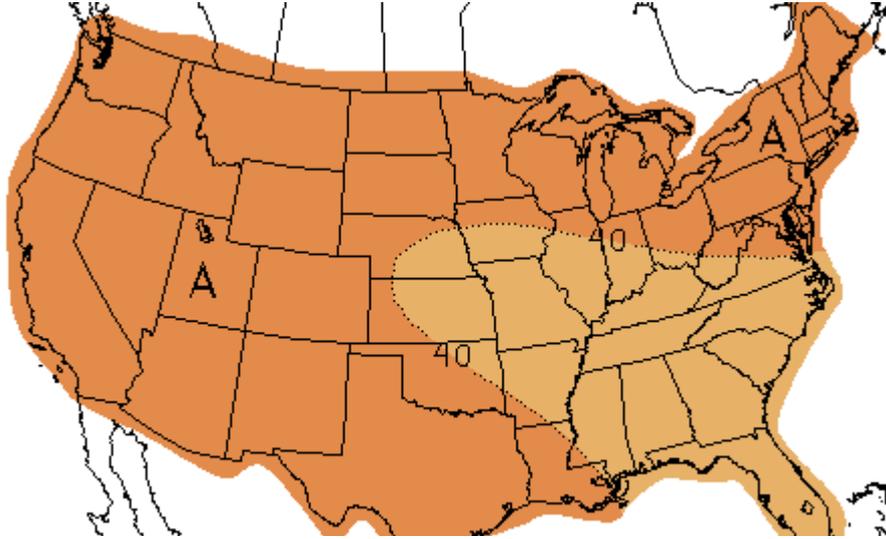


over most of Montana, but 33% chance of above precipitation extreme over western Montana

October – December Outlook

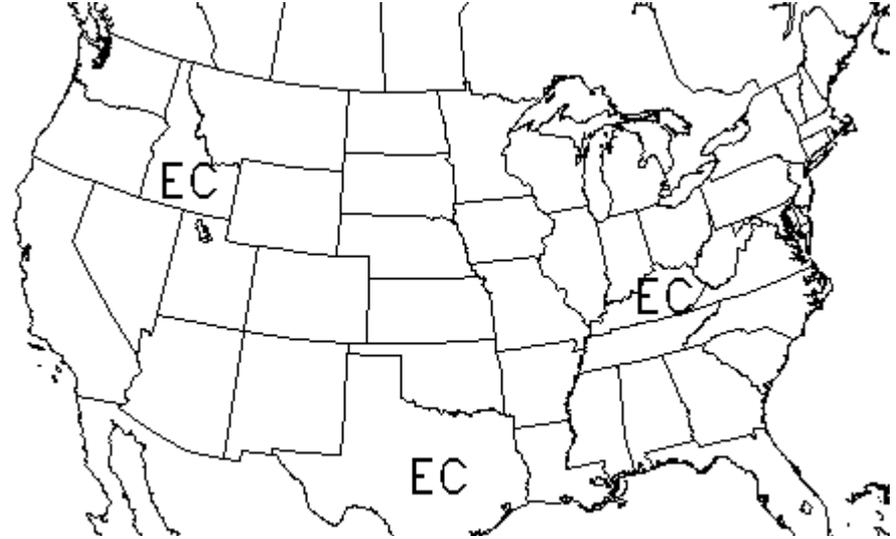
Created March 16

Temperature



>40% chance of above normal temperatures across the state.

Precipitation



Equal chances for above or below normal precipitation across the state.



[weather.gov](https://www.weather.gov)

[weather.gov/billings](https://www.weather.gov/billings)

[weather.gov/glasgow](https://www.weather.gov/glasgow)

[weather.gov/missoula](https://www.weather.gov/missoula)

[weather.gov/greatfalls](https://www.weather.gov/greatfalls)



Weather-Ready Nation

National Oceanic and Atmospheric Administration

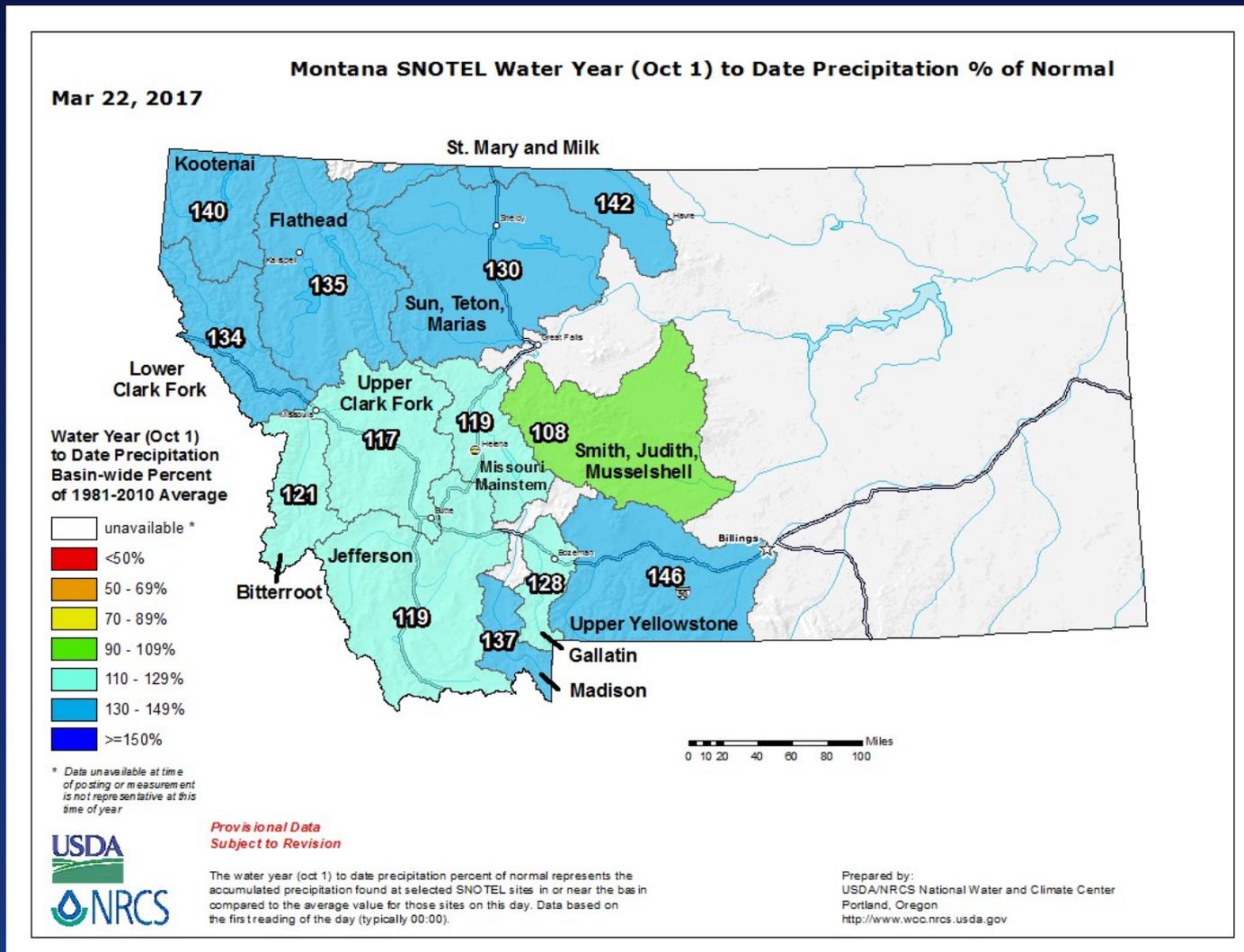
Governor's Drought Advisory Committee Snowpack and Streamflow Update March 22nd, 2017

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406-587-6843

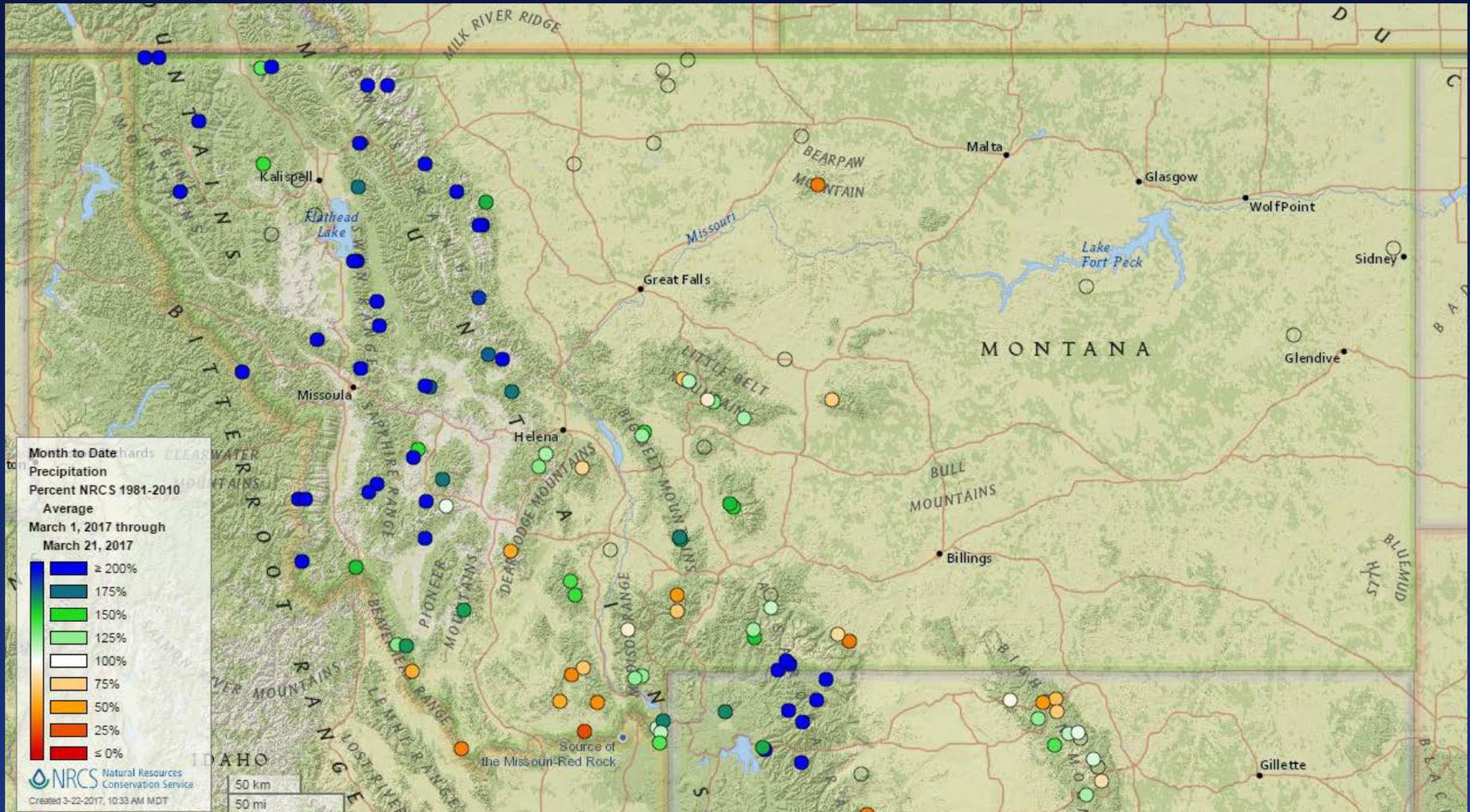
[http://www.nrcs.usda.gov/wps/portal/nrcs/main/
mt/snow/](http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/)

Mountain Precipitation

Water Year-to-Date Mountain Precipitation March 22nd, 2017

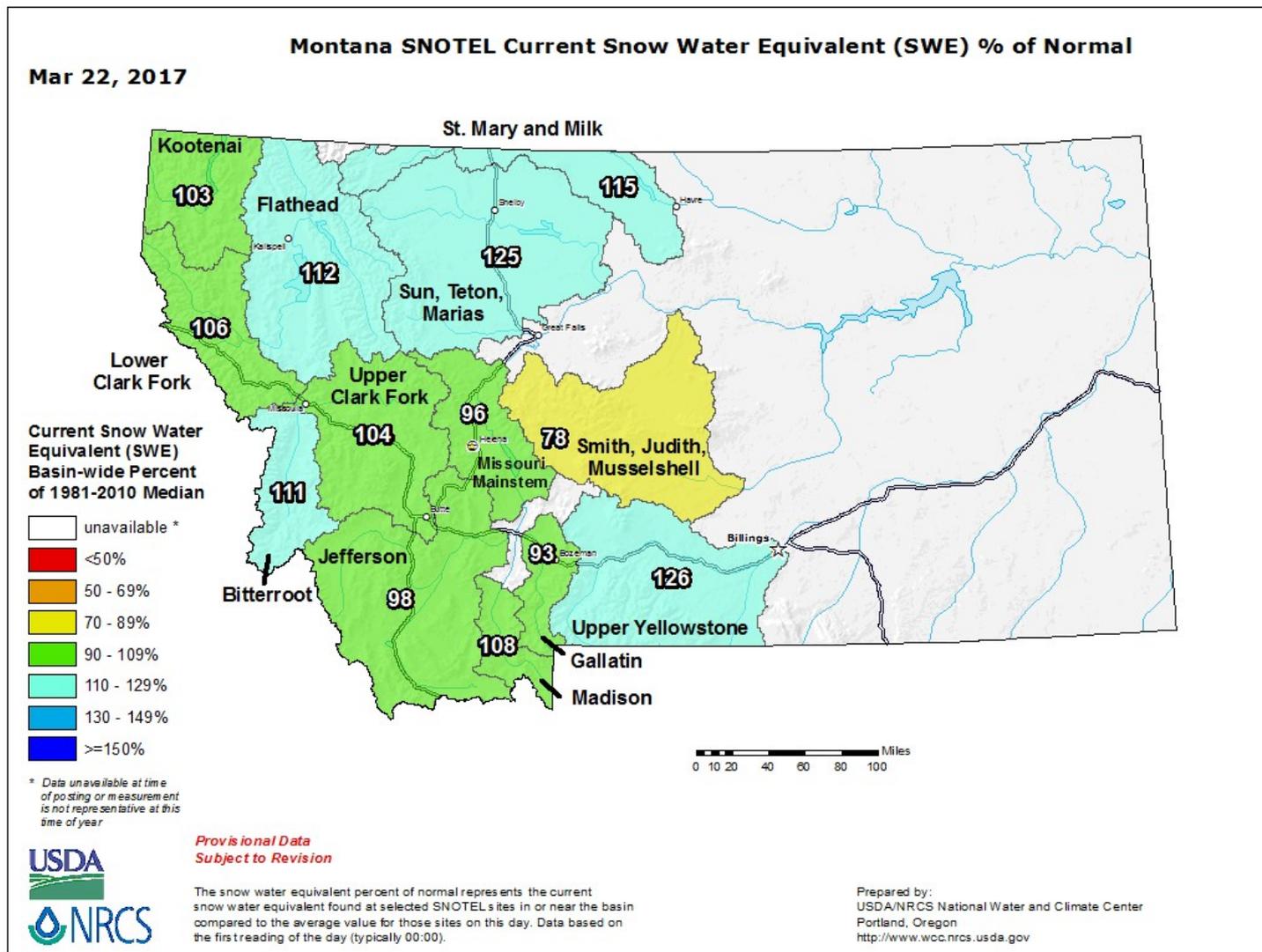


Month-to-Date Mountain Precipitation March 22nd, 2017



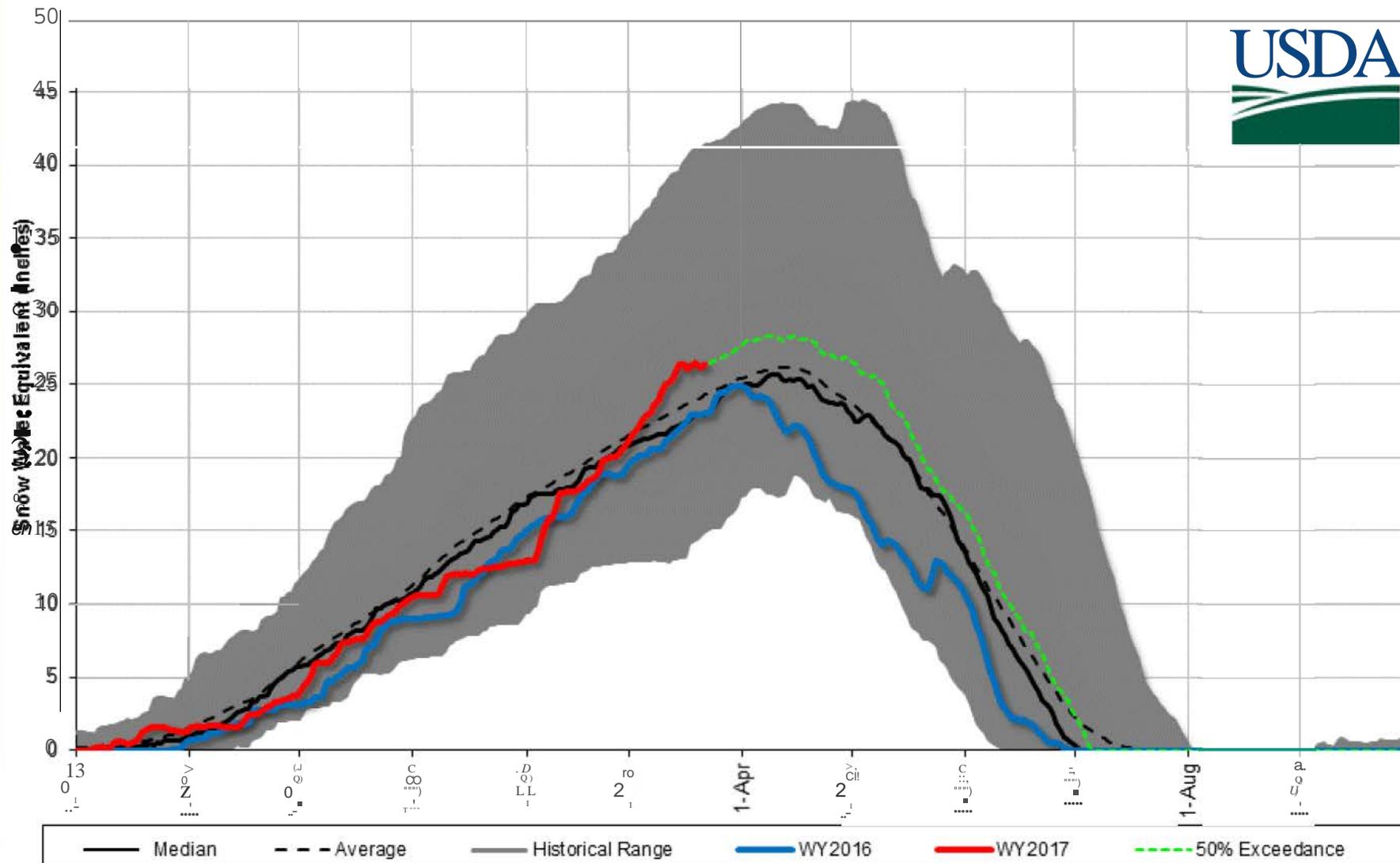
Snowpack

Snowpack Percentages March 22nd, 2017



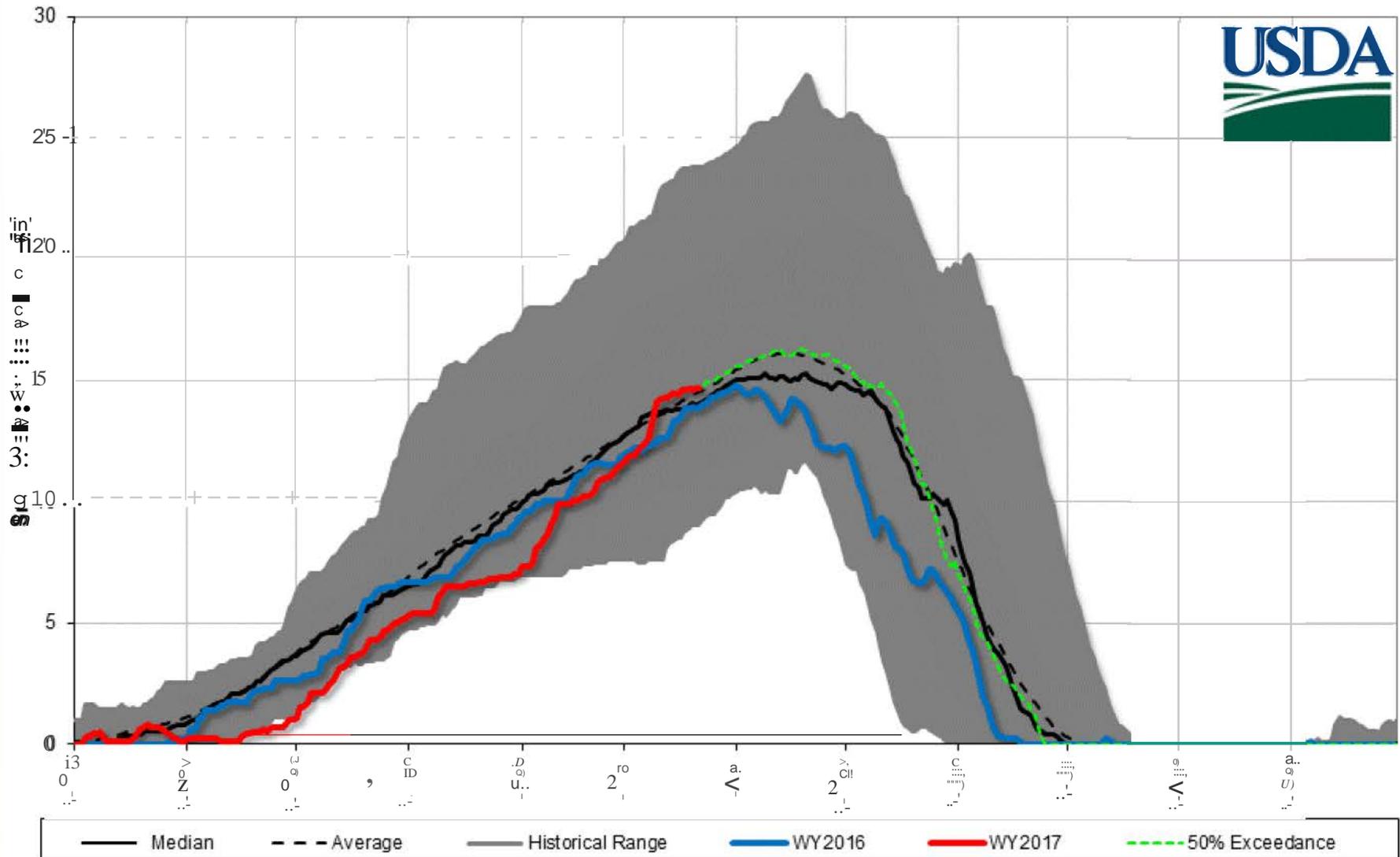
Flathead River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTEL daily data as of 3/22/2017



Upper Clark Fork River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTEL daily data as of 3/22/2017

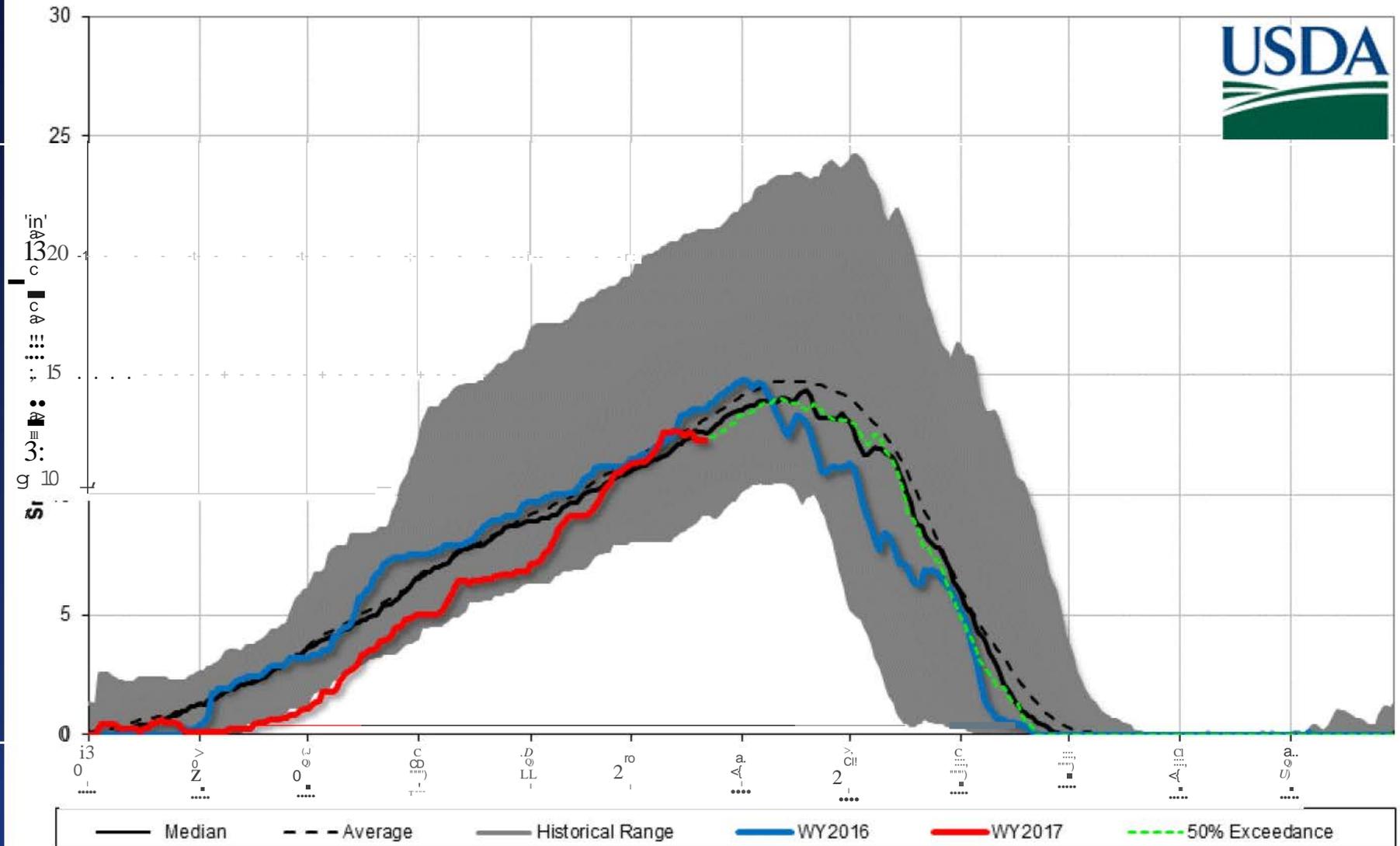


Montana Snow Survey



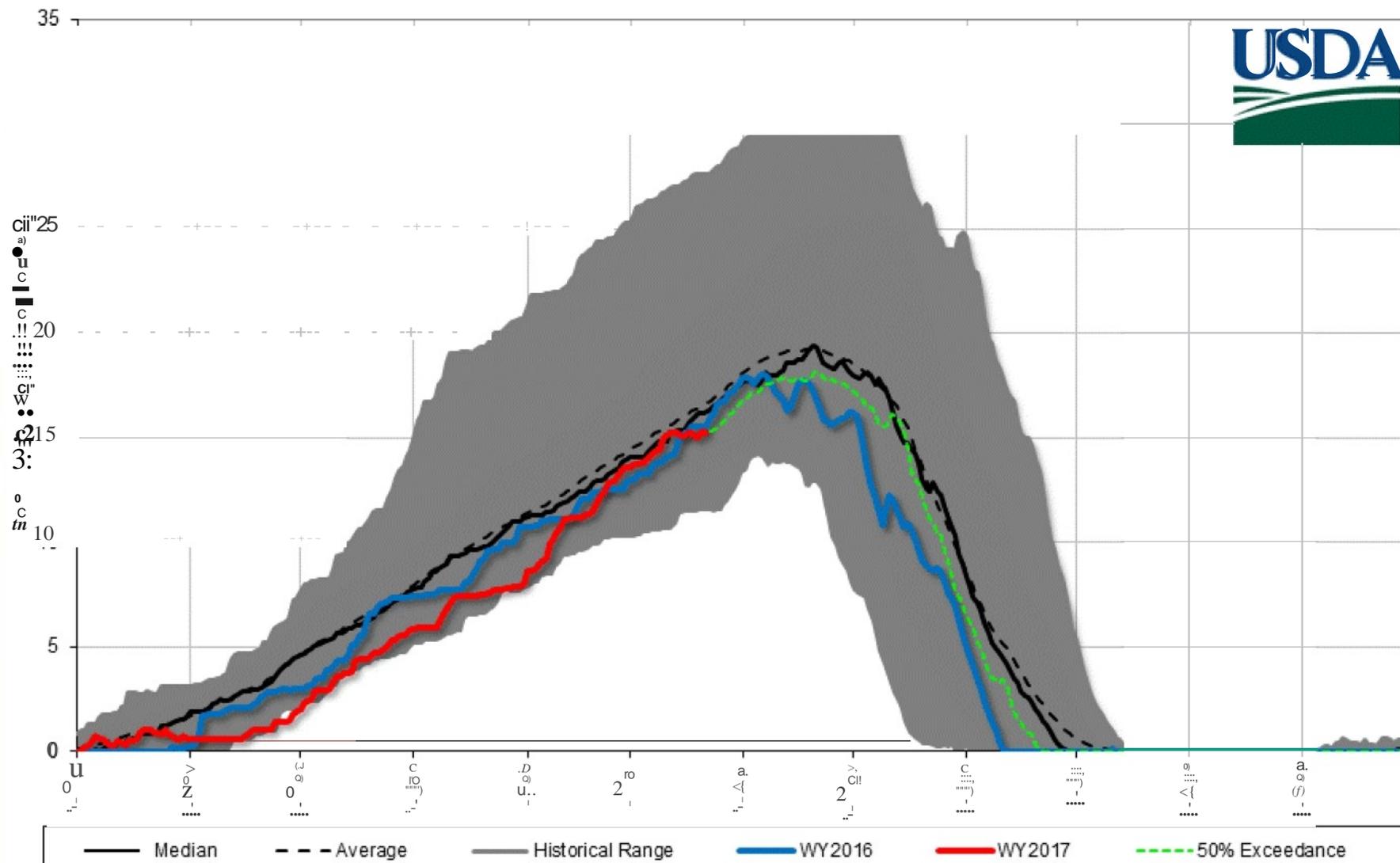
Jefferson River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTEL daily data as of 3/22/2017



Gallatin River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTELdaily data as of 3/22/2017

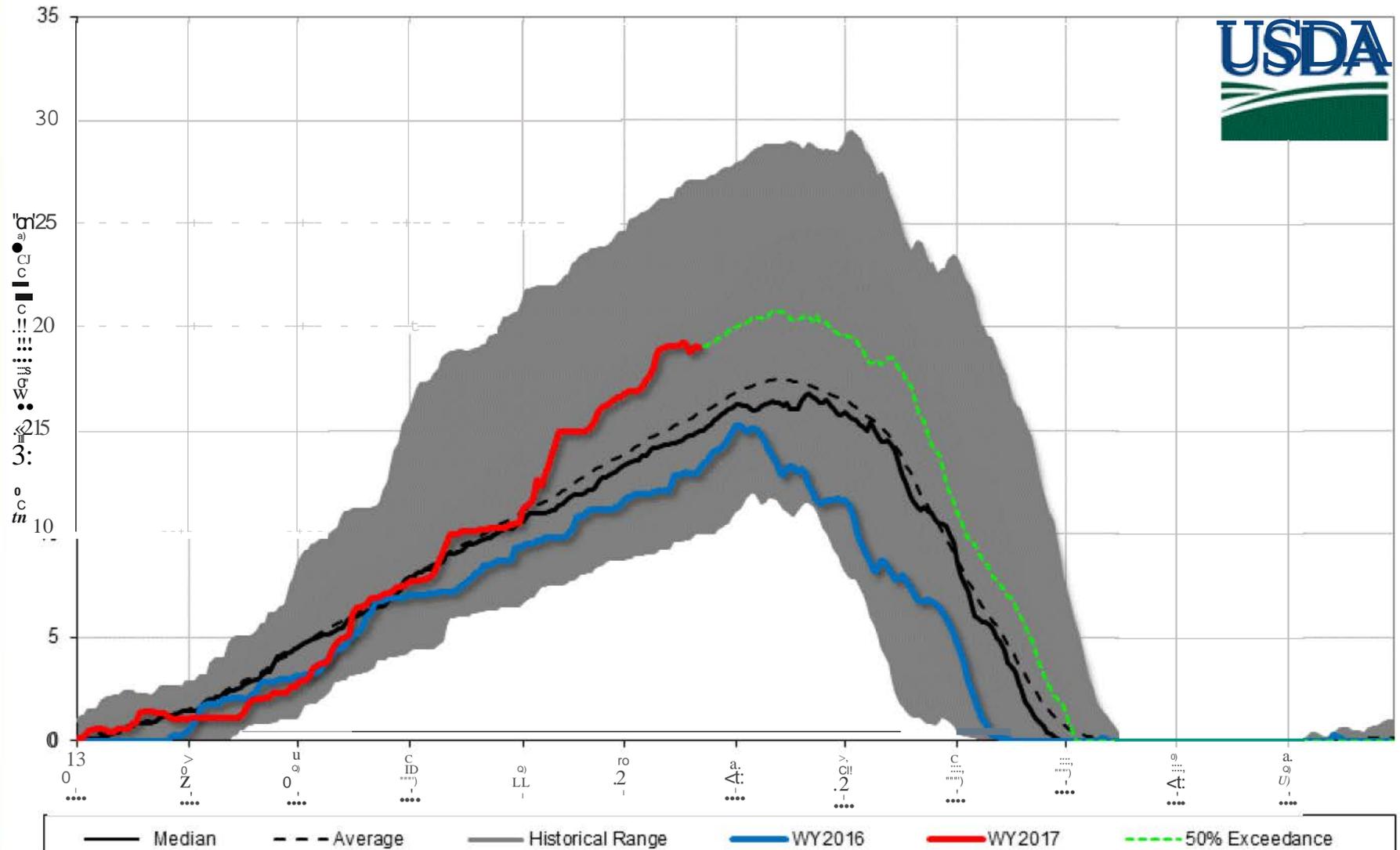


Montana Snow Survey



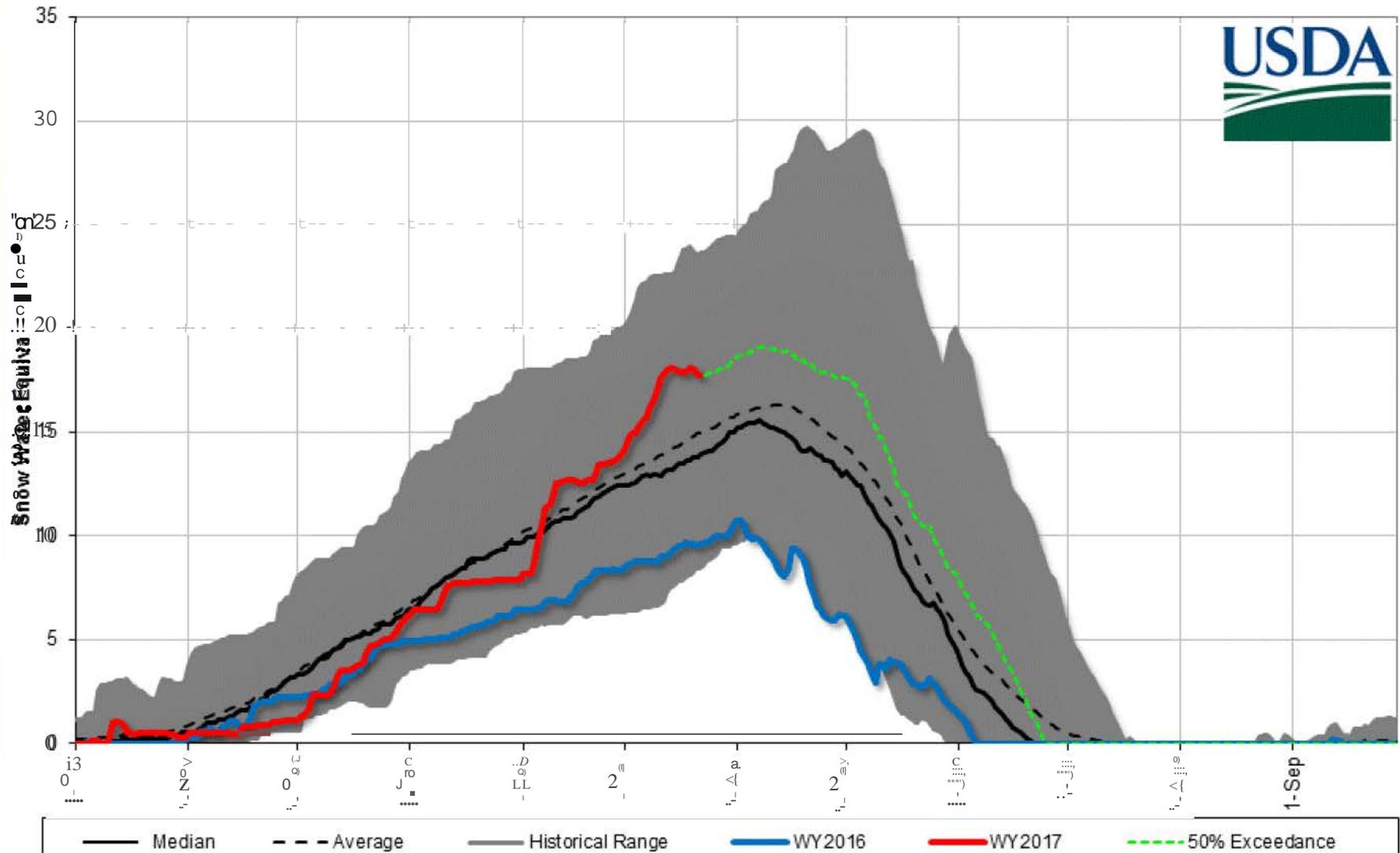
Upper Yellowstone River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTEL daily data as of 3/22/2017



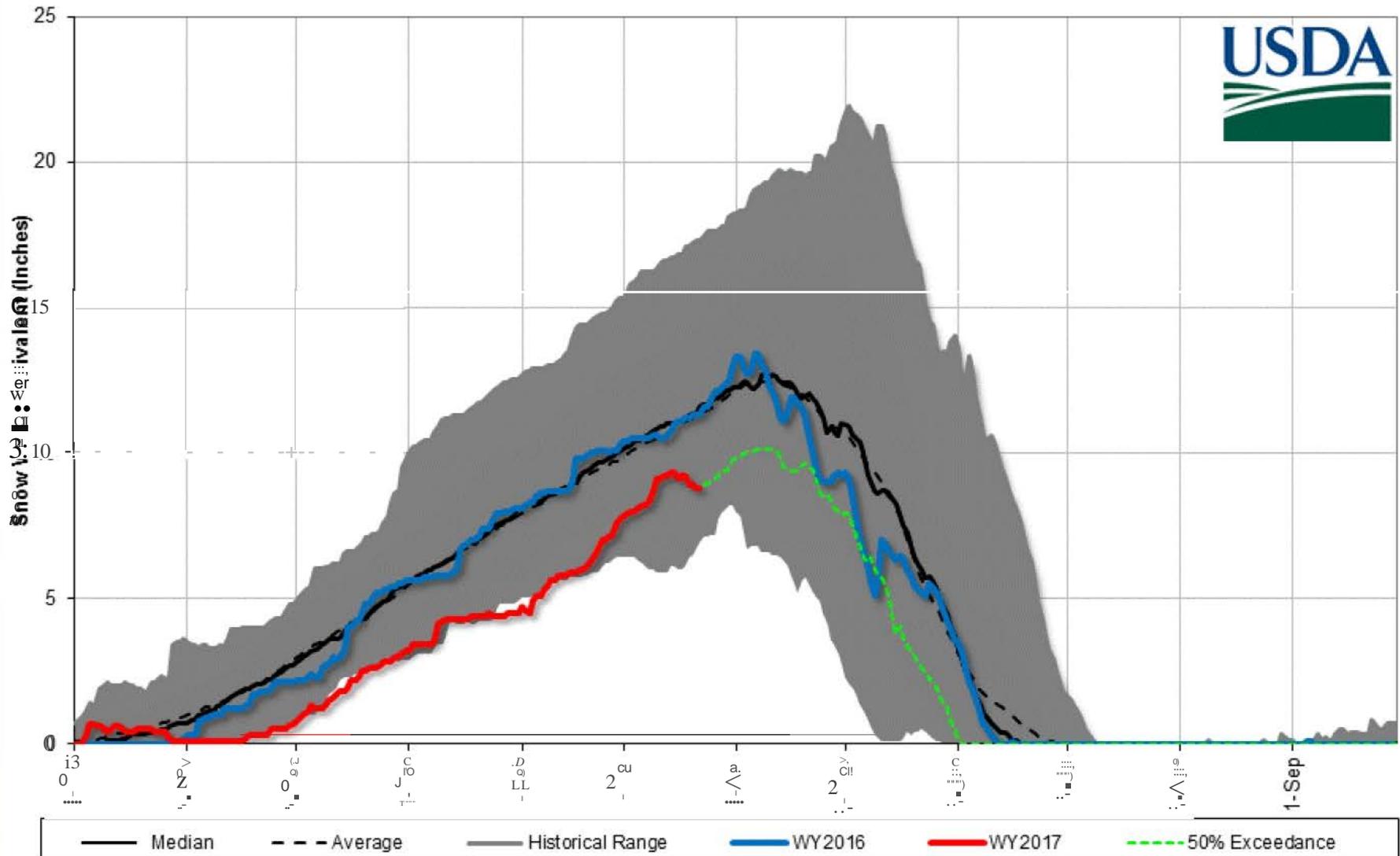
Sun-Teton-Marias River Basin Snowpack with Non-Exceedence Projections

Based on provisional SNOTEL data as of 3/22/2017



Smith-Judith-Musselshell River Basin Snowpack with Non-Exceedence Projections

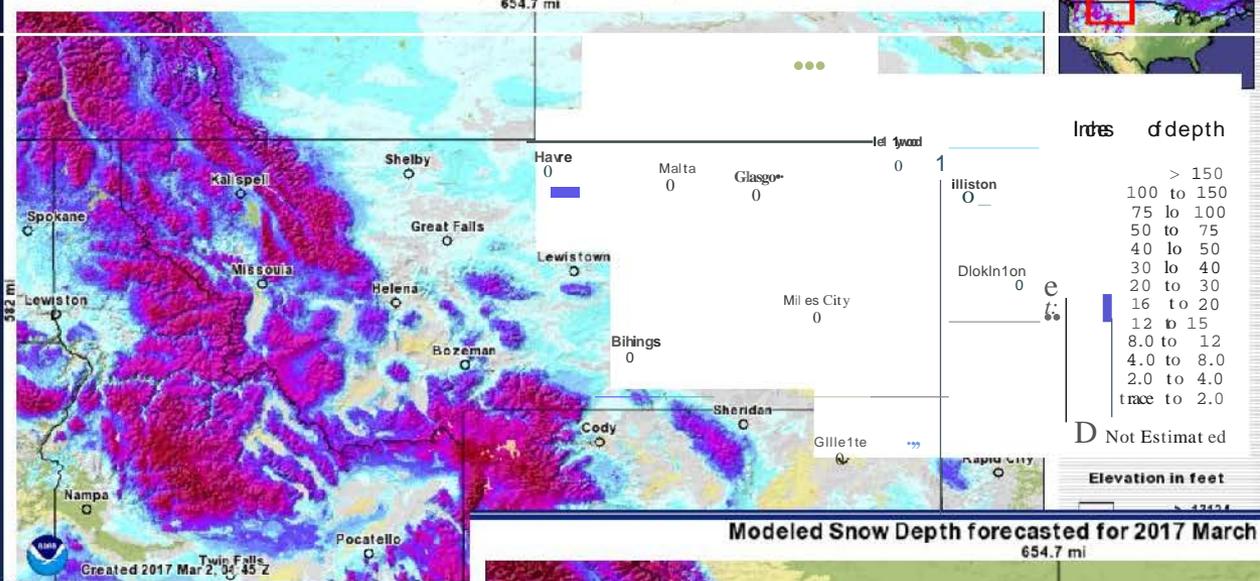
Based on provisional SNOTEL daily data as of 3/22/2017



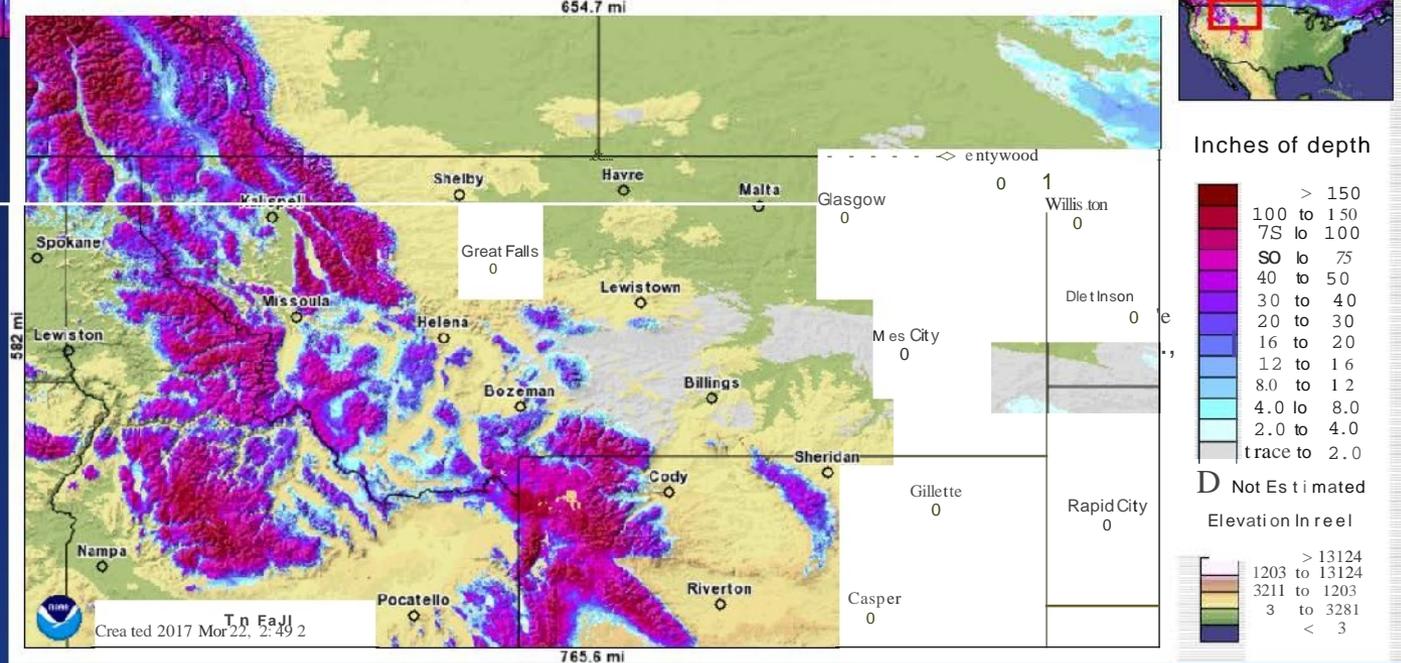
Montana Snow Survey



Modeled Snow Depth for 2017 March 1, 16:00 UTC



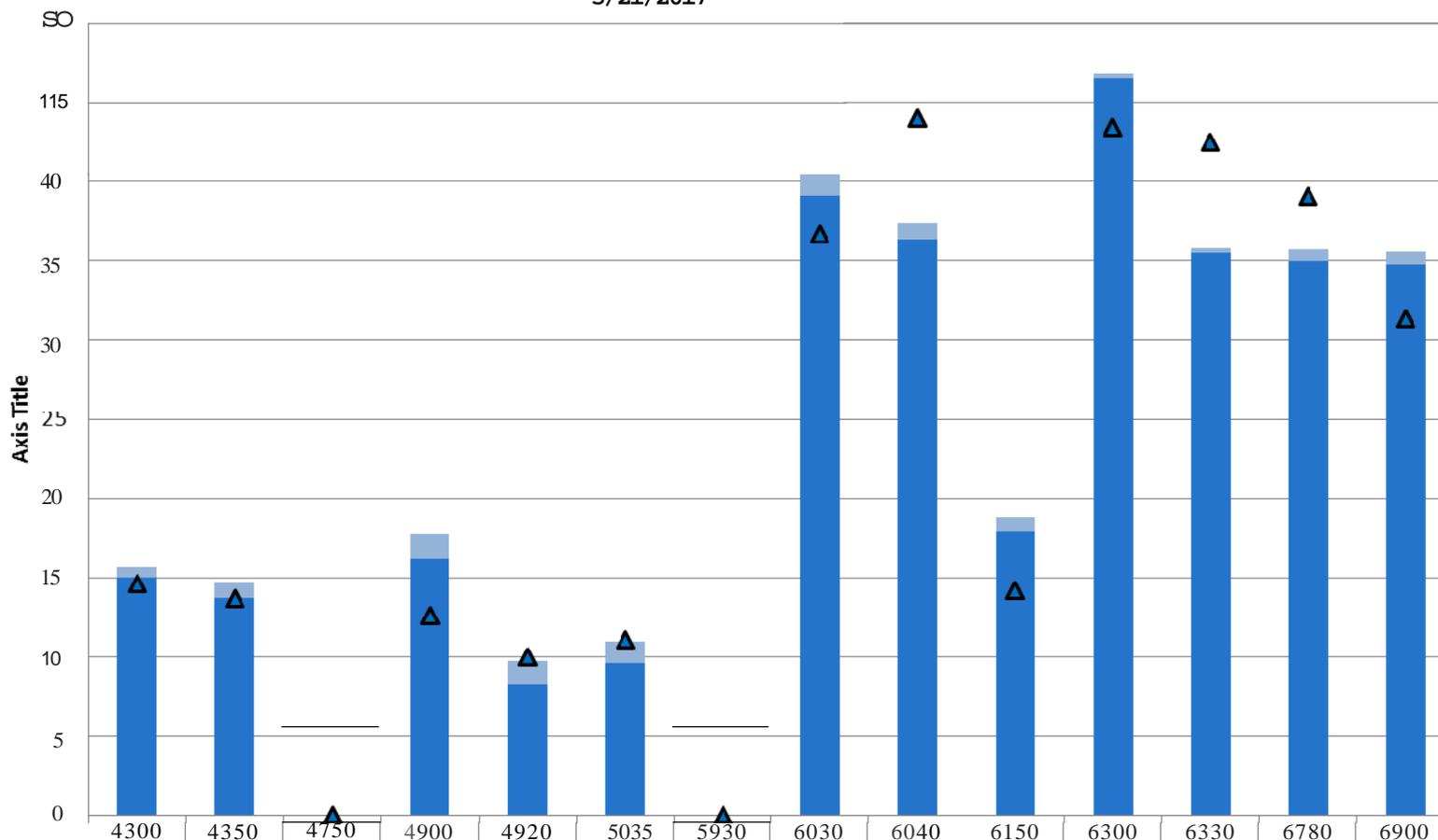
Modeled Snow Depth forecasted for 2017 March 22, 16:00 UTC



Flathead in Montana

Percent Remaining Snowpack

3/21/2017



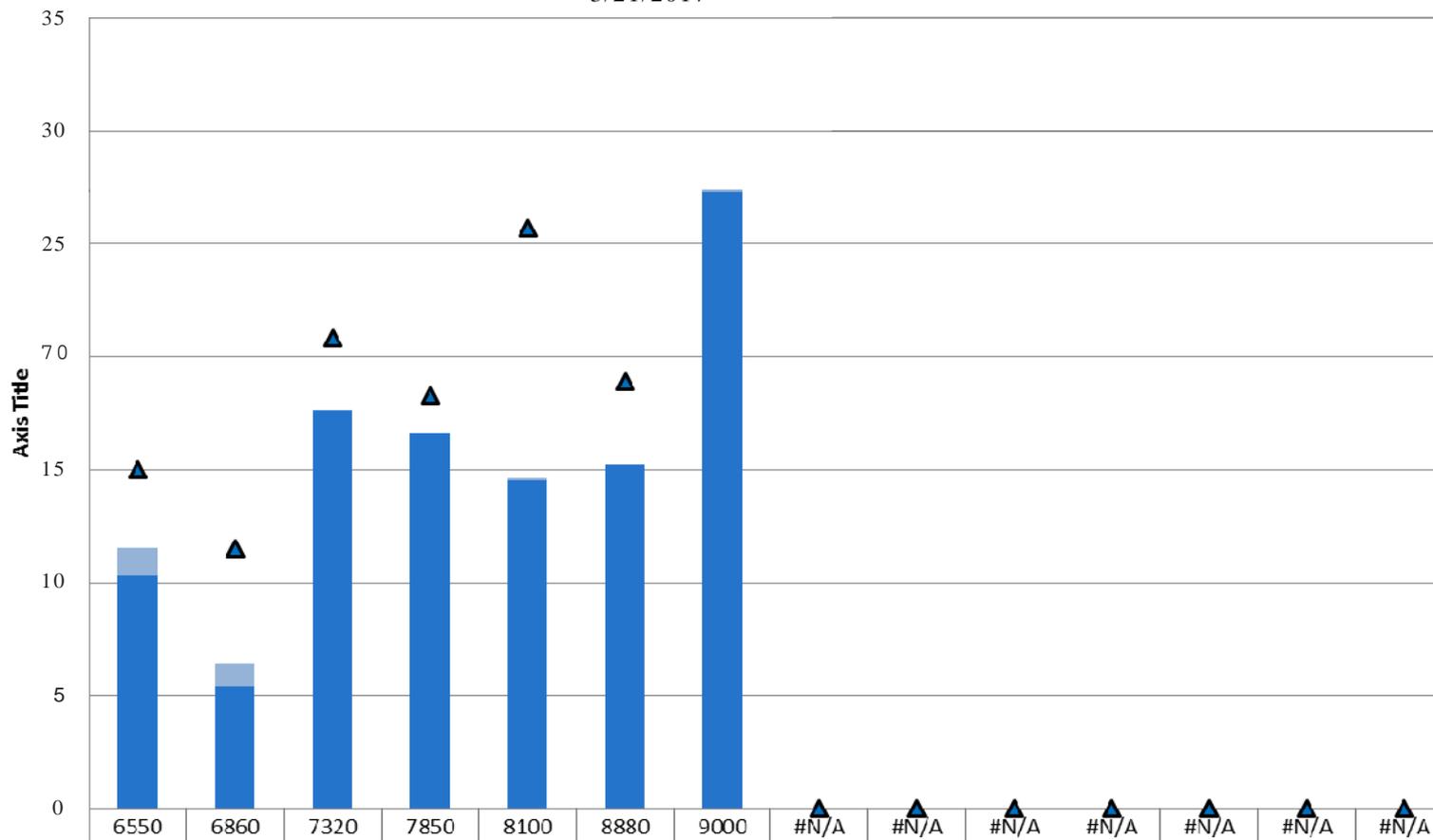
• PeakSWE	15.7	14.7	0	17.8	9.7	11	0	40.4	37.4	18.8	46.8	35.8	35.7	35.6
• CurrentSWE	15	13.7	0	16.2	8.3	9.6	0	39.1	36.4	17.9	46.5	35.5	35	34.8
& Normal Peak	14.6	13.7	0.0	12.6	10.0	11.1	0.0	36.7	44.0	14.2	43.4	42.5	39.1	31.3
Percent Remaining	96%	93%		91%	86%	87%		97%	97%	95%	99%	99%	98%	98%
PP.r.P.nt of Norm;il	106%	102%		131%	87%	98%		125%	102%	131%	119%	94%	109%	126%



Gallatin River Basin

Percent Remaining Snowpack

3/21/2017

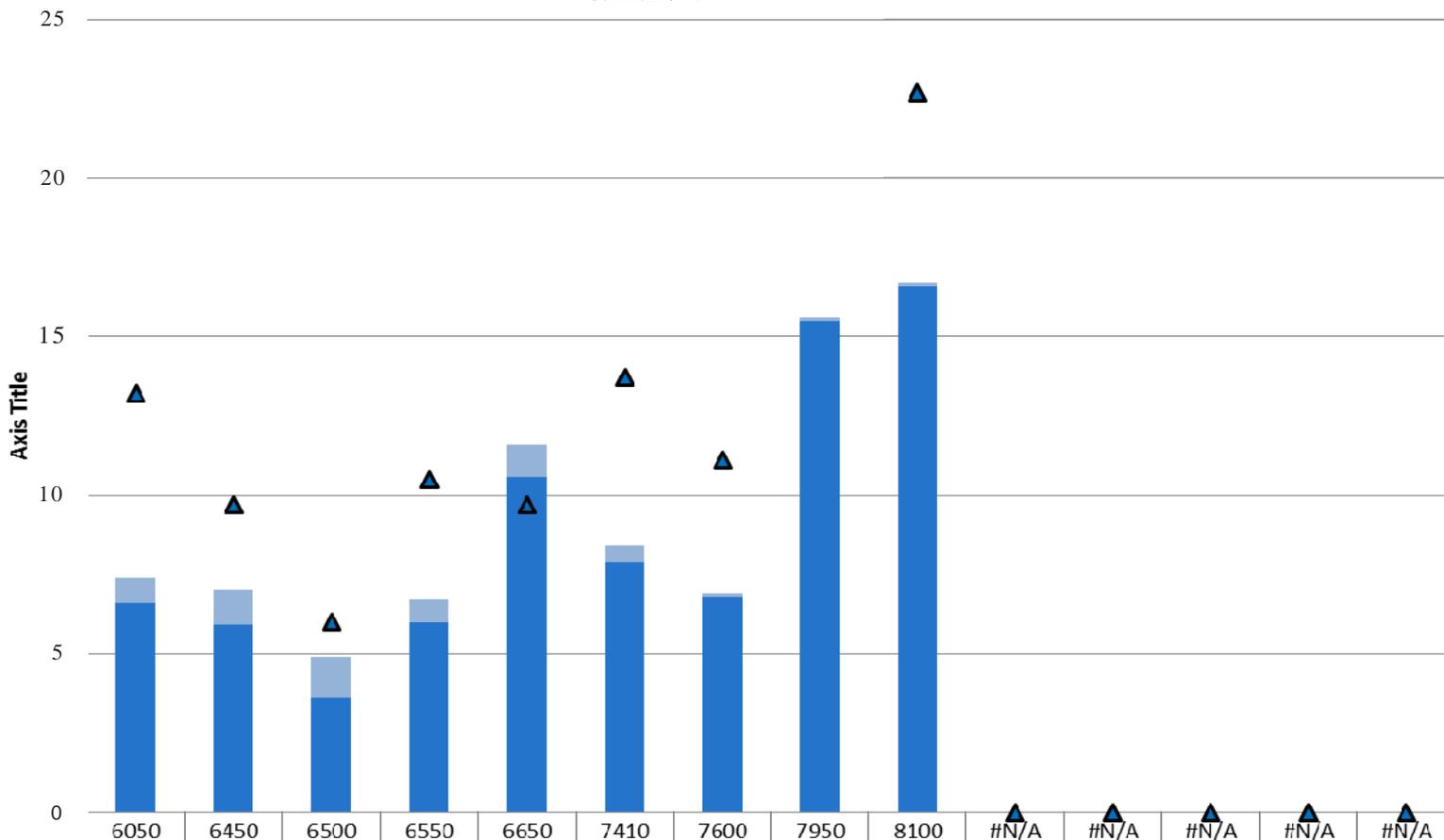


• Peak SWE			17.6	16.6				0	0	0	D	0	0	D
• Current SWE	10.3	5.4	17.6	16.6	14.5	15.2	27.3	0	0	0	0	0	0	0
• Normal Peak	15.0	11.5	20.8	18.3	25.7	18.9	28.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent Remaining	90%	84%	100%	100%	99%	100%	100%							
Percent of Normal	75%	57%	105%	105%	80%	99%	114%							

Smith-Judith-Musselshell

Percent Remaining Snowpack

3/21/2017



• Peak SWI:

• Current SWE

& Normal Peak

Percent Remaining

Percent of Normal

	6050	6450	6500	6550	6650	7410	7600	7950	8100	#N/A	#N/A	#N/A	#N/A	#N/A
Peak SWI:		7		6.7		8.4	6.9	15.6	16.7	0	0	0	0	0
Current SWE		5.9		6		7.9	6.8	15.5	16.6	0	0	0	0	0
& Normal Peak	13.2	9.7	GO	10.5	9.7	13.7	11.1	21.1	22.7	0.0	0.0	0.0	0.0	0.0
Percent Remaining	89%	84%	73%	90%	91%	94%	99%	99%	99%					
Percent of Normal	62%	65%	60%	65%	110%	68%	76%	86%	90%					

Water Supply

	APR-JUL 50 % Exceedance Forecasts		
<i>River Basin</i>	Highest Point Forecast*	Lowest Point Forecast**	Basin Avg Forecast***
<i>Columbia River Basin</i>	143%	93%	104%
Kootenai River Basin	107%	100%	105%
Flathead River Basin	143%	93%	110%
Upper Clark Fork	115%	100%	105%
Bitterroot River Basin	102%	94%	99%
Lower Clark Fork	108%	98%	103%
<i>Missouri River Basin</i>	129%	58%	102%
Jefferson	129%	82%	106%
Madison	122%	108%	115%
Gallatin	101%	91%	96%
Headwaters Mainstem	106%	100%	104%
Smith Judith Musselshell	89%	58%	74%
Sun Teton Marias	119%	85%	106%
St Mary	113%	110%	111%
<i>Yellowstone River Basin</i>	199%	83%	118%
Upper Yellowstone	148%	83%	119%
Lower Yellowstone	199%	90%	118%

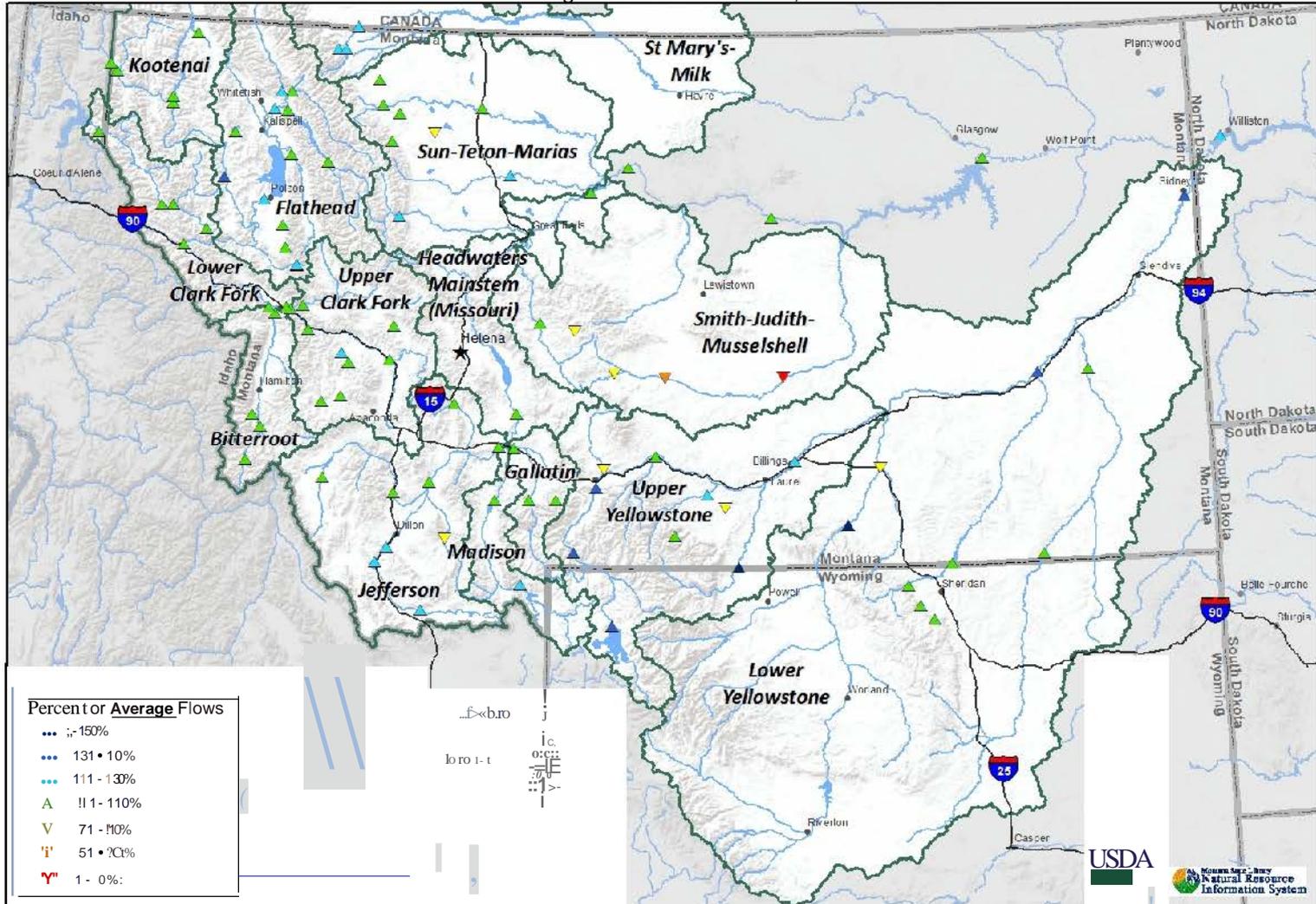
NOTE: Streamflow forecasts are issued for multiple points on rivers and streams within a major river basin and are given as a range of exceedance probabilities. Consult the individual river basin of interest to see the range of values for streams of interest.

*Highest point forecast is the highest 50% forecast of all forecast points within the basin

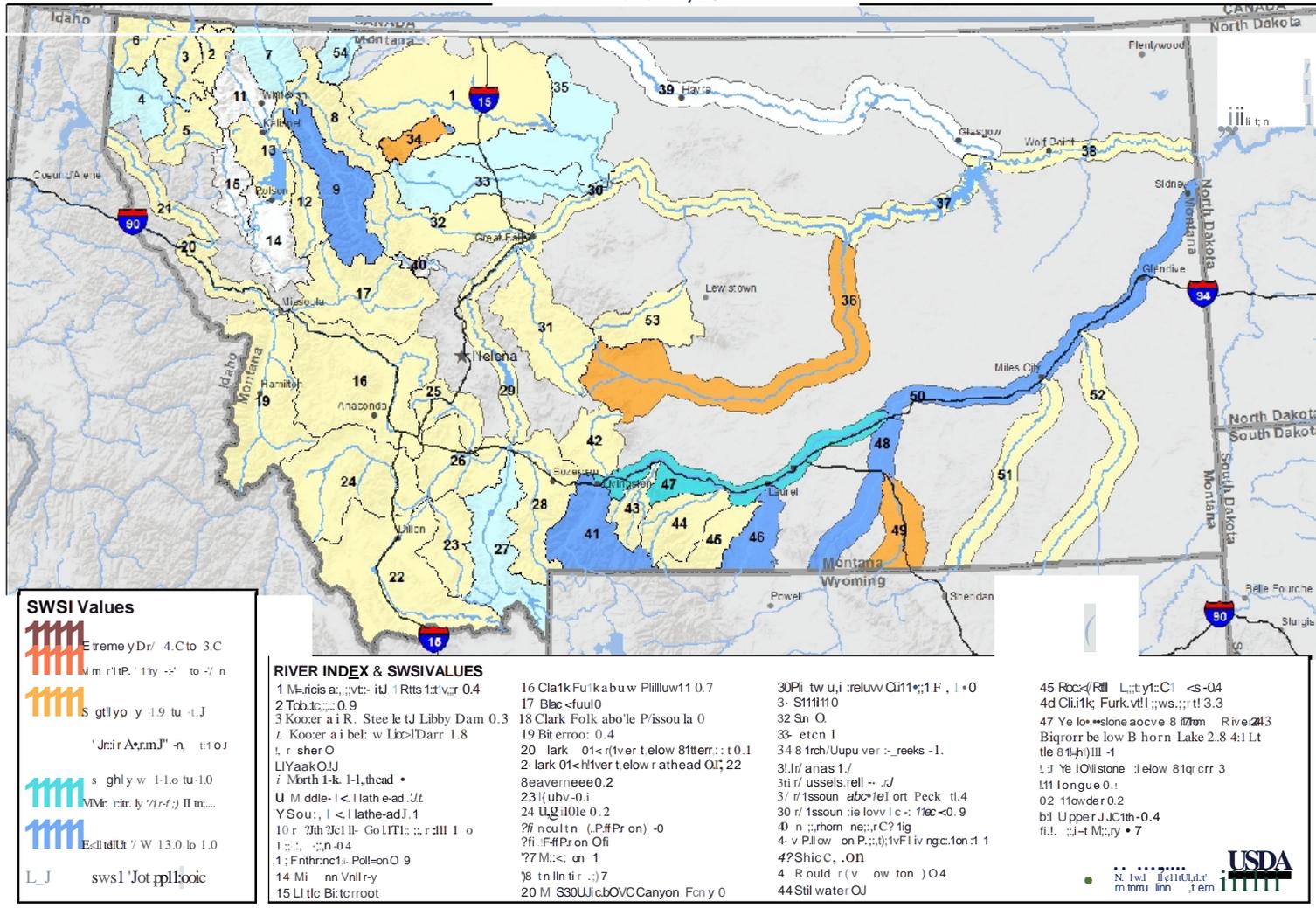
**Lowest point forecast is the lowest 50% forecast of all forecast points within the basin

***Basin Average Forecast is an average of all 50% forecasts within the basin

Montana Data Collection Office
Streamflow Forecast
Percentage of Normal - March 1, 2017



Montana Data Collection Office Surface Water Supply Index (SWSI) March 1, 2017



Note: Data used to generate this map are PROVISIONAL and SUBJECT TO CHANGE.

Summary

- Water year mountain precipitation (Oct 1st – Current) is above to well above average at mountain locations across the state. October, December and February precipitation was well above average for all mountain locations.
- Snowpack is near normal for this date in many basins, and above normal in a few basins in the northern and southern parts of the state. Only one basin is well below normal for snowpack, the Smith-Judith-Musselshell River basin.
- Well above average temperatures and sunny days has resulted in snowmelt at valley to mid-elevations in the mountains, causing small streams to rise in the last week.
- Streamflow forecasts as of March 1st indicate near to above average seasonal river volumes for the April 1st – July 31st time period, only a few central river basin forecasts indicate below average flows.
- Melt and lack of precipitation in some basins during March will likely impact the forecasts on April 1st.

Governor's Drought Advisory Committee Snowpack and Streamflow Update March 22nd, 2017

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[http://www.nrcs.usda.gov/wps/portal/nrcs/main/
mt/snow/](http://www.nrcs.usda.gov/wps/portal/nrcs/main/mt/snow/)

FLOODPLAIN MANAGEMENT in Montana



MARCH 2017
Drought & Water Supply
Advisory Committee

STATE OF MONTANA
Floodplain Program



WHY MANAGE FLOODPLAINS?

- ▶ Make federal flood insurance available to the community
- ▶ Maintain eligibility for federal disaster relief funds
- ▶ Identify areas of flood risk using best scientific data
- ▶ Guide development and planning in flood-risk areas

REDUCE FLOOD LOSS AND KEEP PEOPLE
SAFE BY BUILDING SMARTER

NATIONAL FLOOD INSURANCE PROGRAM

What is it?

COMMUNITIES adopt and enforce a floodplain management ordinance



FEDERAL GOVERNMENT makes flood insurance available to anyone living in a participating community (and provides federal disaster relief, when necessary)



FEMA



REGULATIONS

INSURANCE

MAPPING

MITIGATION

PROGRAM ROLES



FEMA

Administers the National Flood Insurance Program



STATE OF MONTANA

Coordinates administration of the National Flood Insurance Program with FEMA



LOCAL COMMUNITIES

Enforce National Flood Insurance Program requirements via a local floodplain ordinance



FLOODPLAIN MAPS

FEMA's Map Service Center

www.msc.fema.gov

Looking for a Flood Map? 

Enter an address, a place, or longitude/latitude coordinates:

Search

Looking for more than just a current flood map?

Visit [Search All Products](#) to access the full range of flood risk products for your community.



Search Results—Products for **LIVINGSTON, CITY OF**

The flood map for the selected area is number **30067C0591C**, effective on **10/18/2011** 



VIEW MAP



SAVE MAP



INTERACTIVE MAP

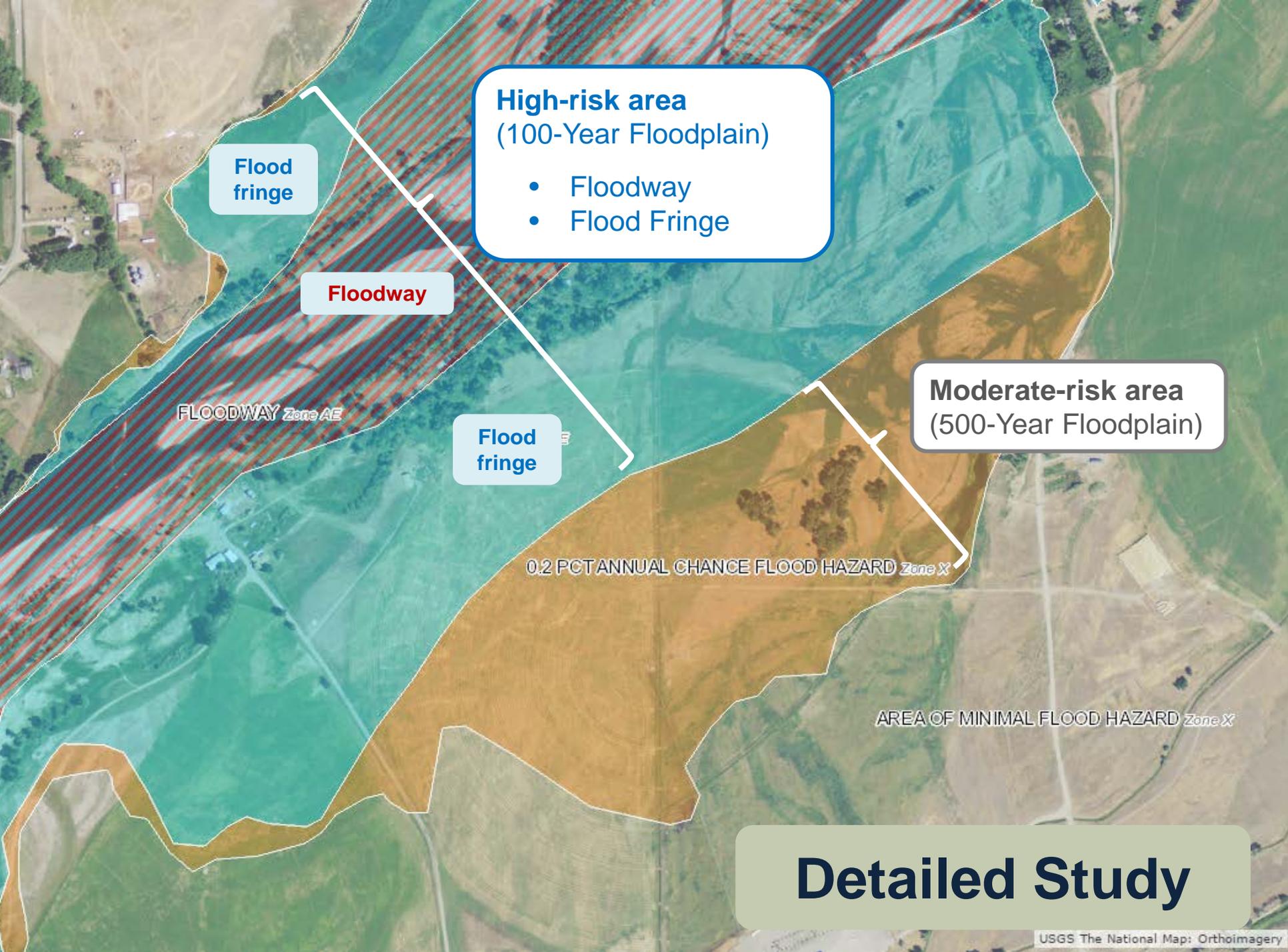
Show **all products** for this area 

Letters of Map Change

-  Revisions (0)
-  Amendments (2)
-  Revalidations (0)

Locator Map





High-risk area
(100-Year Floodplain)

- Floodway
- Flood Fringe

Flood fringe

Floodway

Flood fringe

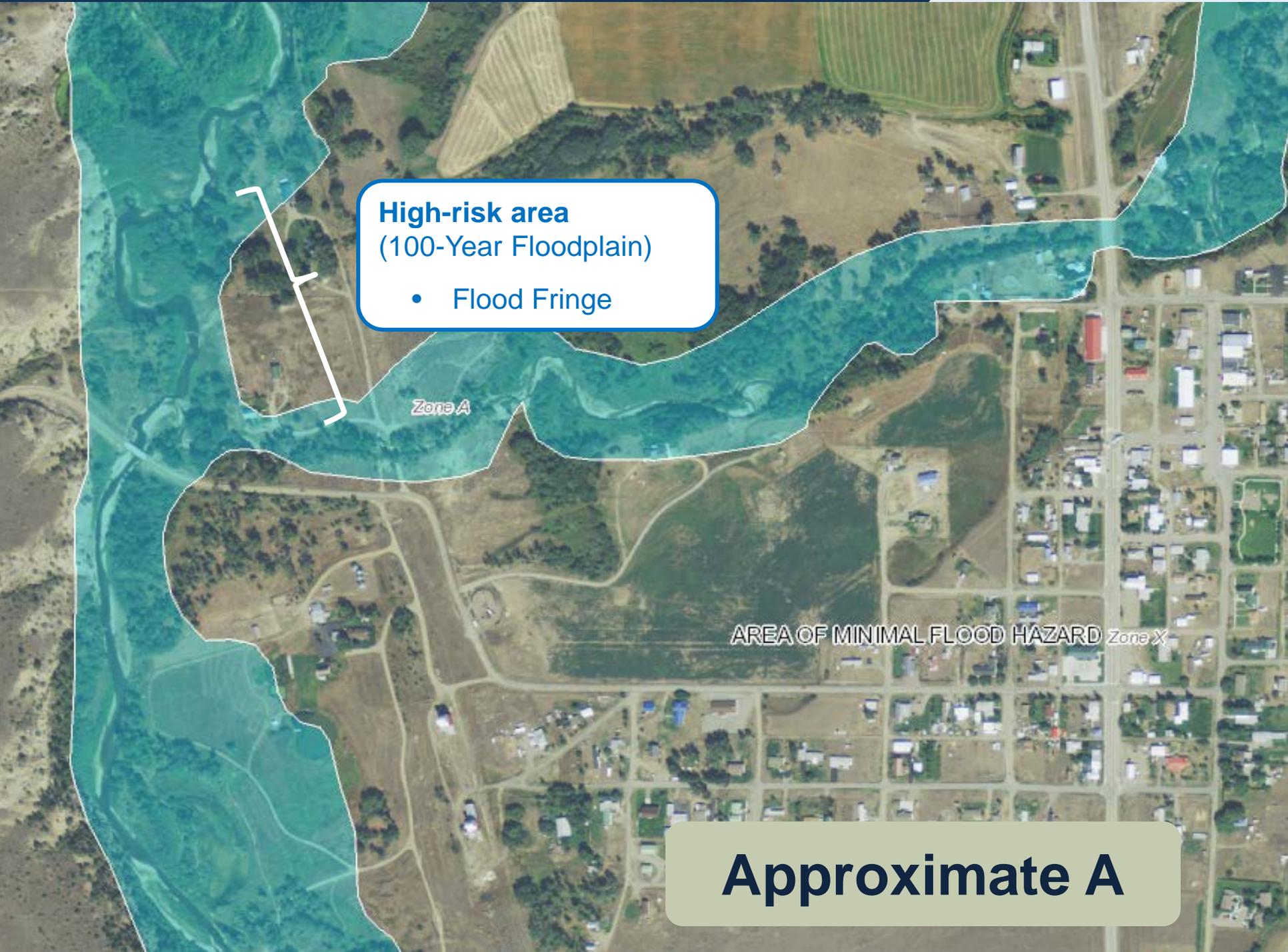
Moderate-risk area
(500-Year Floodplain)

FLOODWAY Zone AE

0.2 PCT ANNUAL CHANCE FLOOD HAZARD Zone X

AREA OF MINIMAL FLOOD HAZARD Zone X

Detailed Study



High-risk area
(100-Year Floodplain)

- Flood Fringe

Zone A

AREA OF MINIMAL FLOOD HAZARD Zone X

Approximate A

WHAT IS REGULATED?

High-risk areas

(100-Year Floodplain, Special Flood Hazard Area)

- ▶ 26% chance of flooding during a 30-year mortgage
- ▶ Flood insurance required on buildings with a federally backed mortgage
- ▶ Floodplain regulations apply, floodplain permits necessary
- ▶ Also referred to as:
 - 1%-Annual-Chance Floodplain
 - Regulated Flood Hazard Area

WHAT IS REGULATED?

Floodway (in detailed studies only)

- ▶ Sees fastest flows and the deepest depths of flood waters
- ▶ Kept clear from development so that flood waters may pass

How it's different

- ▶ Insurance requirement is the same as 100-Year Floodplain
- ▶ More restrictive floodplain regulations apply
- ▶ Projects must be reviewed by an engineer to determine if the project will increase flood heights

MONTANA'S FLOODPLAIN PROGRAM

MARCH 2017
DROUGHT & WATER
SUPPLY ADVISORY COMMITTEE

STATE OF MONTANA
Floodplain Program



WATER OPERATIONS BUREAU

**WATER OPERATIONS
BUREAU CHIEF**
Steve Story

ADMINISTRATIVE ASSISTANT
Bree Caldwell

**BOARD OF WATER
WELL CONTRACTORS**

**FLOODPLAIN
PROGRAM**

**DAM SAFETY
PROGRAM**

**MAPPING UNIT
MANAGER**
Walter Ludlow

**NFIP/CAP
COORDINATOR**
Traci Sears

**CIVIL ENGINEERING
SPECIALIST**
Nicole Decker

**OUTREACH
SPECIALIST**
Tiffany Lyden (0.75)

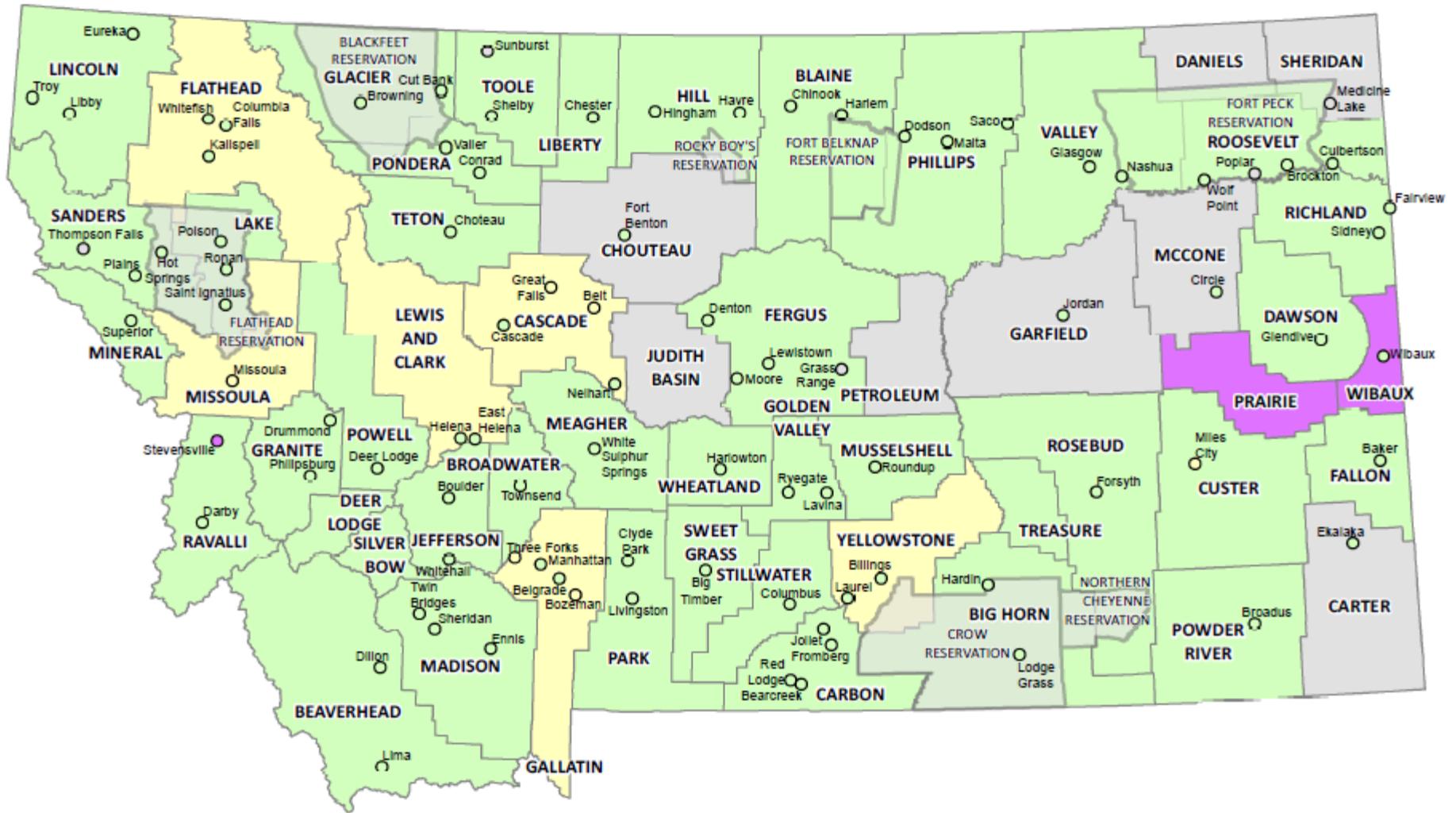
TRAINING SPECIALIST
Worby McNamee (0.5)

TRAINING SPECIALIST
Worby McNamee (0.5)

**OUTREACH
SPECIALIST**
Michelle Phillips

FLOODPLAIN MAPPING UNIT

COMMUNITY ASSISTANCE PROGRAM UNIT



NFIP Community Status

- Community Rating System Participant
- Participating Community
- Community Not Participating
- Suspended Community

* CRS communities receive discounted insurance premiums

Number of Participating Communities

Counties
Municipalities
Reservations
Joint Municipality and County (Butte, Anaconda)
Total

44
88
2
2
136



February 2017

MAPPING PROJECTS



Gallatin County Emergency Management
added 8 new photos.
April 1 at 10:10am · [Like Page](#)

#Floodplain maps are changing in Gallatin County!

On April 6 from 5-8pm at Monforton School Library, we will be discussing draft floodplain maps for the West Gallatin River. On April 7 from 5-8pm at Bozeman City Hall, we will be discussing draft floodplain maps for Bozeman Creek and its tributaries. Drop by either Open House between 5pm and 8pm to learn about areas that will be affected by the proposed map changes, the project timeline, and how the new maps can help create a #safergallatin. You can also have one-on-one meetings with staff to find out if your property will be affected by proposed floodplain map changes. Learn more at www.floodplain.mt.gov/gallatin



Bozeman gets look at new flood maps - 02:10



Why are floodplains mapped?

MORGAN MCKAY
mln NEWS

MONTANA
Fluoro Dentures

NEW APPROACH FOR TREATING FLU AND OTHER FAST-EVOLVING VIRUSES. ACCO



MARCH 2017
DROUGHT & WATER
SUPPLY ADVISORY COMMITTEE

STATE OF MONTANA
Floodplain Program



CURRENT MAPPING PROJECTS

Carbon County

- Yellowstone River

Richland County

- Yellowstone River

Gallatin County

- Bozeman Creek & tributaries
- West Gallatin River

Missoula County

- Swan River

Musselshell River

Beaverhead County

- Beaverhead River
- Blacktail-Deer Creek
- Junction Creek

Mineral County

- Clark Fork & tributaries
- St Regis & tributaries

COMMUNITY ASSISTANCE

COMMUNITY ASSISTANCE CONTACT(CAC) ANNUAL PHONE VISIT

Community Name:	CAC Date (mm-dd-yyyy):	Conducted by:	Community ID:
Floodplain Administrator:		County:	Last CAV:
CFM:	CRS Community:	Last Training Attended:	EMI Courses Attended:
Outreach projects conducted in last 12 months:		Are you on the Highground newsletter and email list?	
FIRM Date(mm-dd-yyyy):	FIRM Panel Numbers(s) - (Reference index for large areas):	FIS Date:	
Have a copy of FIRMs:	Have a copy of FIS:	Mapping Needs:	
Does the community regulate to other map studies?:		What are the study names? (Has DNRC approved them):	
How many LOMAs in the last 12 months:		How many LOMRs in the last 12 months:	
Ordinance Number:	Ordinance Date:	DNRC Review - (Yes or No):	FEMA Review - (Yes or No):
Proposed updates to ordinance: (Yes or No):		Sent to DNRC/FEMA:	Proposed Adoption date:
How many applications received in the last 12 months:		How many permits issued in the last 12 months:	
Any flood proof certificates in the last 12 months:		Was a copy of the FP permit and application sent to DNRC?	
How many insurance inquires in the last 12 months:		How many general fp questions in the last 12 months:	
Other visit information:			
Followup needed?:			

Updated 1/14/2014



FOR IMMEDIATE RELEASE

CONTACT

Michelle Phillips, Floodplain Specialist

(406) 444-1300

Traci Sears, Montana National Flood Insurance Program
Coordinator

(406) 444-6654



February 8, 2017

Rising temperatures offer important reminder to prepare for potential flooding

HELENA, Mont. – The National Weather Service has advised that temperatures around the state are expected to rise above freezing from Feb. 9 - 12, with rain also expected in lower elevations. Potential impacts from melting snow and rainfall include pooling of water in areas where storm drains or ditches are clogged with snow and ice, pooling of water in low-lying areas, and potential ice jams on small creeks and rivers. Such events may cause flooding that could put people and property in harm's way.

MONTANA HIGHGROUND

December 2016



CONTENTS

Official Montana 2016-17 Winter Weather Outlook	2
Farewell & Welcome	3
Musselshell floodplain Mapping Update	4
High Water Sign Project approved Around the Pond	5
Manufactured Home Installation Program Rolled out in Montana	6
Fishing Camps in Mississippi	7
Trainings and Meetings	8
Upcoming CFM Exam Dates	8
Grants Corner	9

NOW RECRUITING

Montana DNRC
Helena Regional Office

CIVIL ENGINEERING SPECIALIST

Read more on Page 6

CALL FOR PRESENTERS

Association of Montana Floodplain
Managers Annual Conference

March 6-9, 2017 | Missoula, MT

Read more on Page 6

Water Operations

Board of Water Well Contractors

Dam Safety

Floodplain Management

Training

Silver Jackets

Permitting and Regulations

Outreach

News

Mapping and Technical Resources

Disaster and Recovery

Community Rating System

Big Hole Floodplain Study

Products

Insurance

Property Owner Resources



Tracking weather

To track weather, go to www.weather.gov and click on the area of concern within the state of Montana on the map. On the top of that page, you can toggle through tabs ("Watches and Warnings", "Observations", etc.) or you can scroll down the page for more forecast information. You can also click on "Hydrology" on the menu on the left side of the page to see real time stream gauge data.

For additional local weather information, contact the service hydrologist or forecaster on duty in the following offices:

- > Billings Weather Service office, 406-652-0851
- > Glasgow Weather Service office, 406-228-4042
- > Great Falls Weather Service office, 406-453-2081
- > Missoula Weather Service office, 406-329-4840

Montana Department of Emergency Services (DES)

[Montana DES Directory](#)

[Flooding Section in 2016 DRAFT State PDM](#)

During a flood event, county Disaster and Emergency Services coordinators should be coordinating with your community's first responders—typically your fire and sheriff/police departments. Find out who the DES coordinator is for your county, if you don't already know. If you need additional disaster response information, you may also contact

[Marschal Rothe](#), Montana DES Response Branch Manager, 406-324-4776.

If you have a question, please first contact your County or Tribal DES Coordinator. For incidents and emergencies in which the DES Coordinator is not available or otherwise unreachable, you may contact the State DES Duty Officer at 406-324-4777 (24 hours a day, 365 days a year).

Contacts

[Steve Story](#), PE, CFM
Bureau Chief
Water Operations Bureau
(406) 444-6816

[Breanna Caldwell](#)
Administrative Support
(406) 444-0862

[Traci Sears](#), CFM
NFIP/CAP Coordinator
(406) 444-6654

[Walter Ludlow](#), PE
Floodplain Engineer
(406) 444-6664

[Tiffany Lyden](#), CFM
Outreach Specialist
(406) 444-0599

[Nicole Decker](#)
Civil Engineering Specialist

Contacts

Local Contacts

[Local Floodplain Administrators](#)

[NFIP Participating Communities Map](#)

County	Community	Floodplain Administrator (FPA)	FPA Email	FPA Phone	Address
Anaconda-Deer Lodge	Anaconda-Deer Lodge County	Hess, Steve	shess@adlc.us	(406) 563-4015	800 S Main Anaconda, MT 59711
Beaverhead	Beaverhead County	MacIoroski, Rob	rmacloroski@beaverheadcounty.org	(406) 683-3768	2 S Pacific, Suite #12 Dillon, MT 59725
	Dillon, City of	Hazelbaker, Todd	operations@dillonmt.org	(406) 683-4245	125 N Idaho St Dillon, MT 59725
	Lima, Town of	Weidinger, Carla	lima@3rivers.net	(406) 276-3521	PO Box 184 Lima, MT 59739
Big Horn	Big Horn County	Taft, Craig	ctaft@bighorncountymt.gov	(406) 665-8724	809 N Custer Hardin, MT 59034
	Hardin, City of	Connolly, Joe	publicworks@hardinmt.com	(406) 665-9292	406 N Cheyenne Ave Hardin, MT 59034
	Lodge Grass, Town of	Lovato, Joe	lgcityhall@yahoo.com	(406) 639-2362	PO Box 255 Lodge Grass, MT 59050
Blaine	Blaine County	Higley, Shawn	shigley@wwcengineering.com	(406) 443-3962	1275 Maple St, Suite F Helena, MT 59601
	Chinook, City of	Higley, Shawn	shigley@wwcengineering.com	(406) 443-3962	1275 Maple St, Suite F Helena, MT 59601
	Harlem, City of	Higley, Shawn	shigley@wwcengineering.com	(406) 443-3962	1275 Maple St, Suite F Helena, MT 59601
Broadwater	Broadwater County	Higley, Shawn	shigley@wwcengineering.com	(406) 443-3962	1275 Maple St, Suite F Helena, MT 59601
	Townsend, City of	Higley, Shawn	shigley@wwcengineering.com	(406) 443-3962	1275 Maple St, Suite F Helena, MT 59601
Butte-Silver Bow	Butte-Silver Bow County	Sesso, John	jsesso@bsb.mt.gov	(406) 497-6254	155 W Granite Butte, MT 59701

THANK YOU!

Michelle Phillips

mphillips2@mt.gov 444-1300

Traci Sears

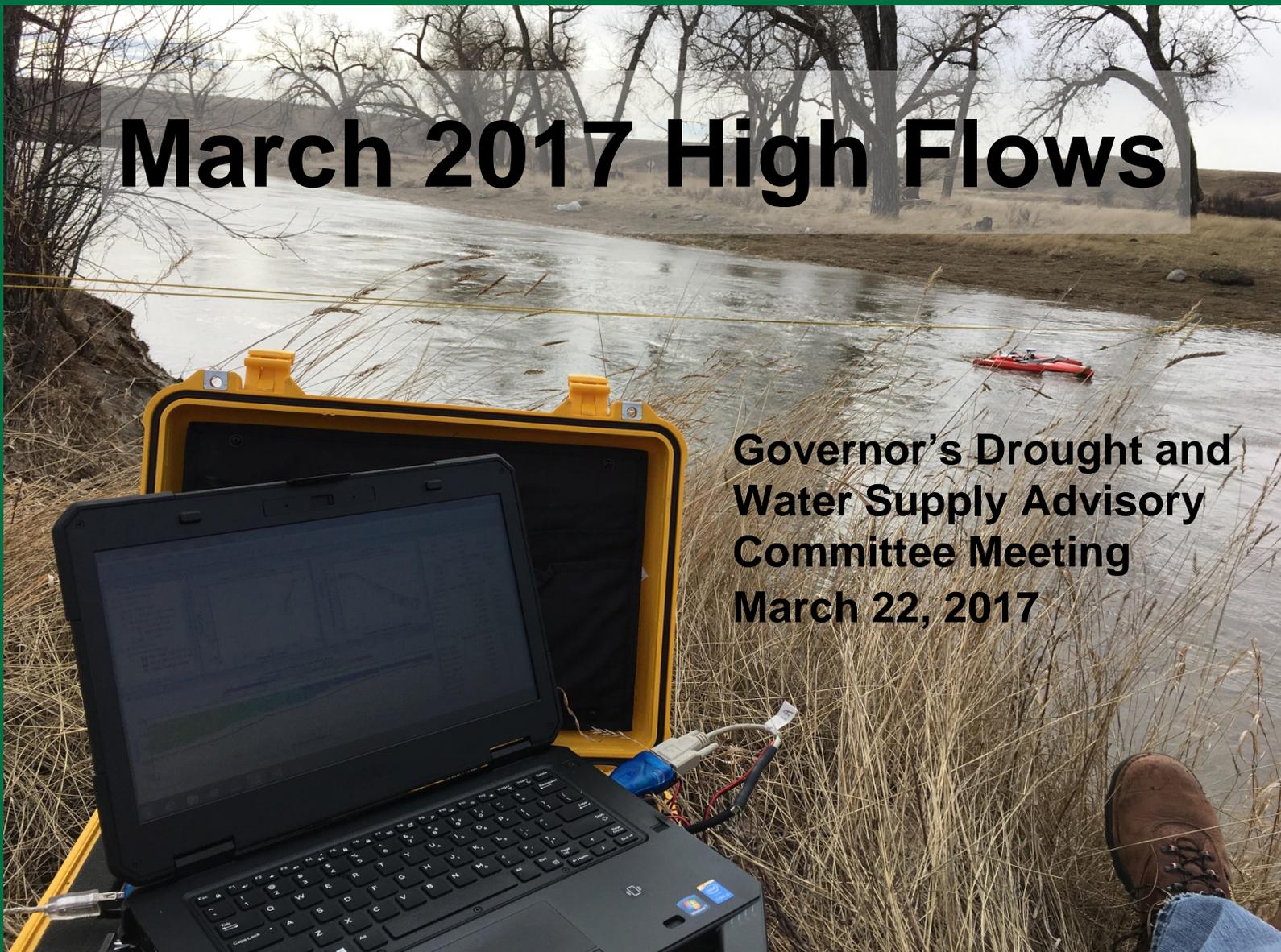
tsears@mt.gov 444-6654



March 2017 High Flows

**Governor's Drought and
Water Supply Advisory
Committee Meeting
March 22, 2017**

**Battle Creek
near
Chinook**

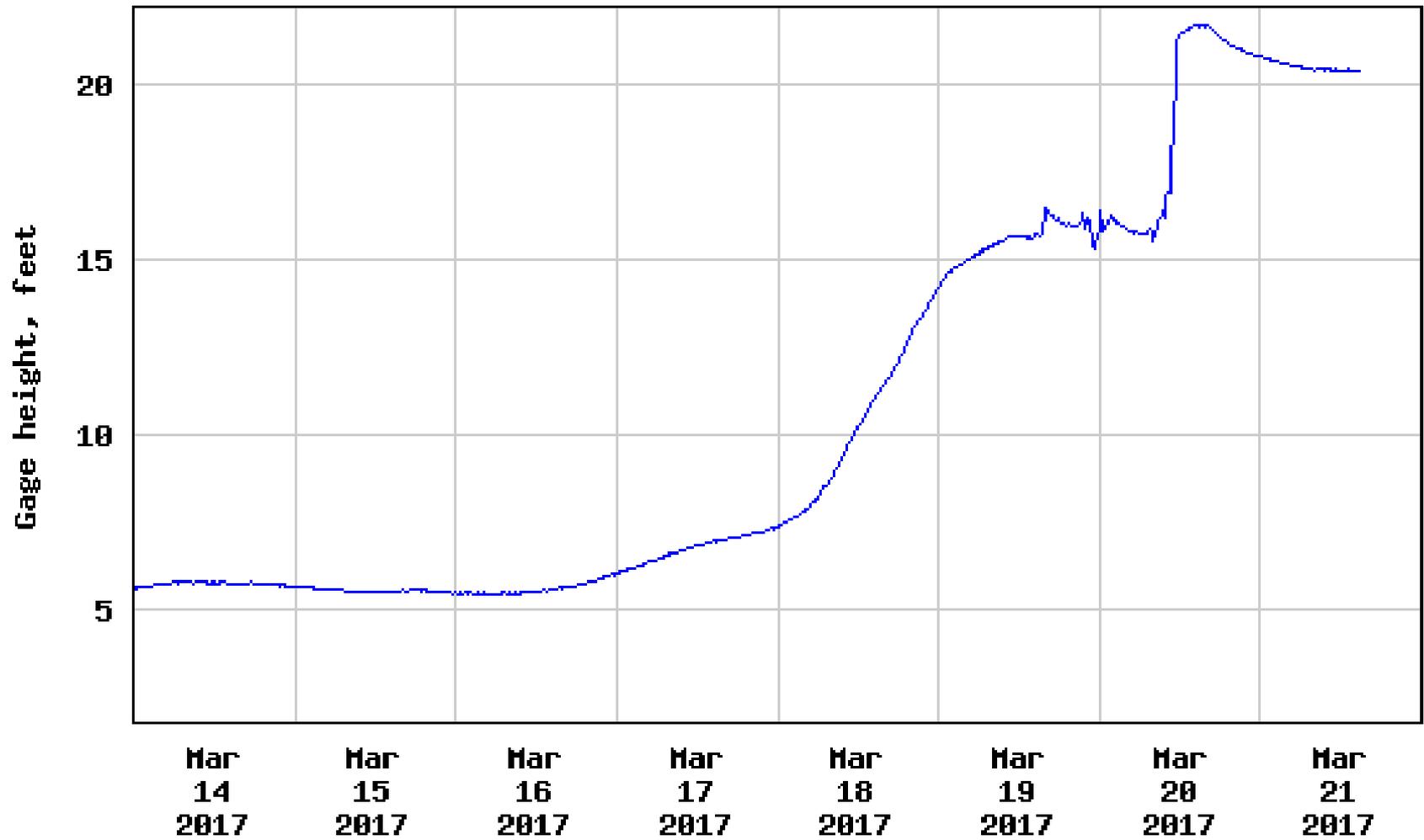




Mill Creek above Bassoo Creek near Niarada

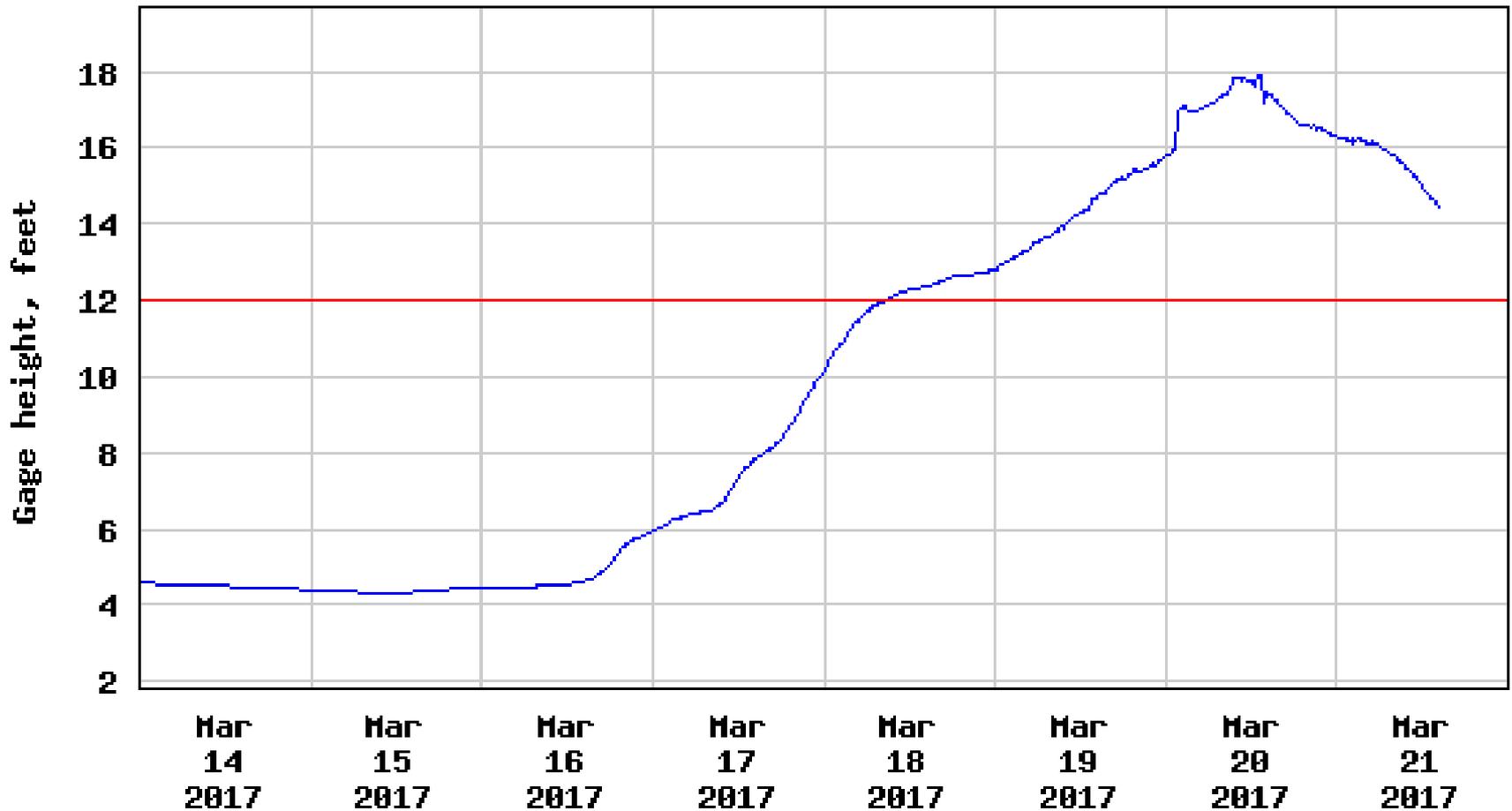


USGS 06154100 Milk River near Harlen MT



---- Provisional Data Subject to Revision ----

USGS 06183450 Big Muddy Creek near Antelope MT

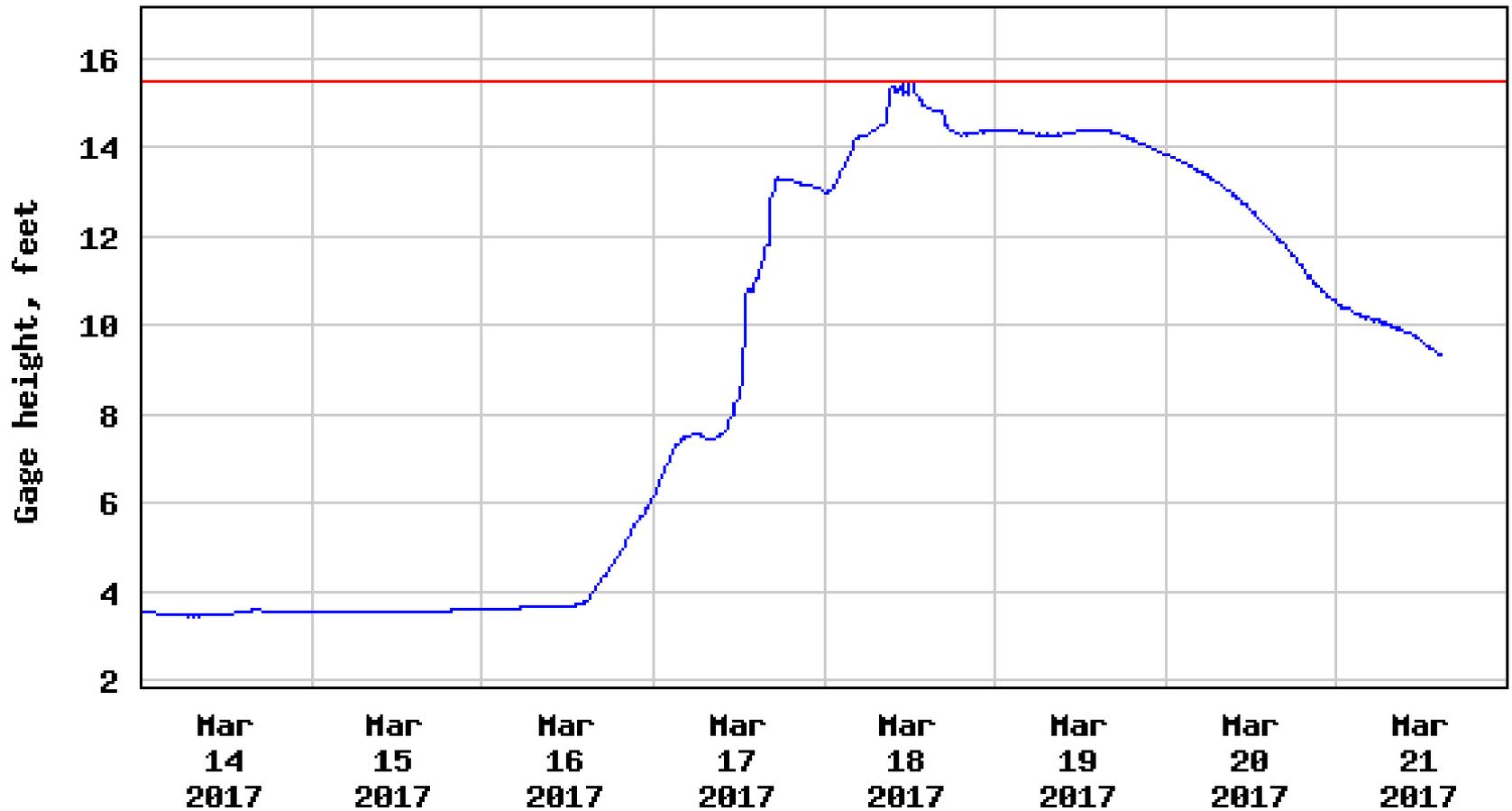


---- Provisional Data Subject to Revision ----

— Gage height

— NWS flood stage

USGS 06181000 Poplar River near Poplar MT

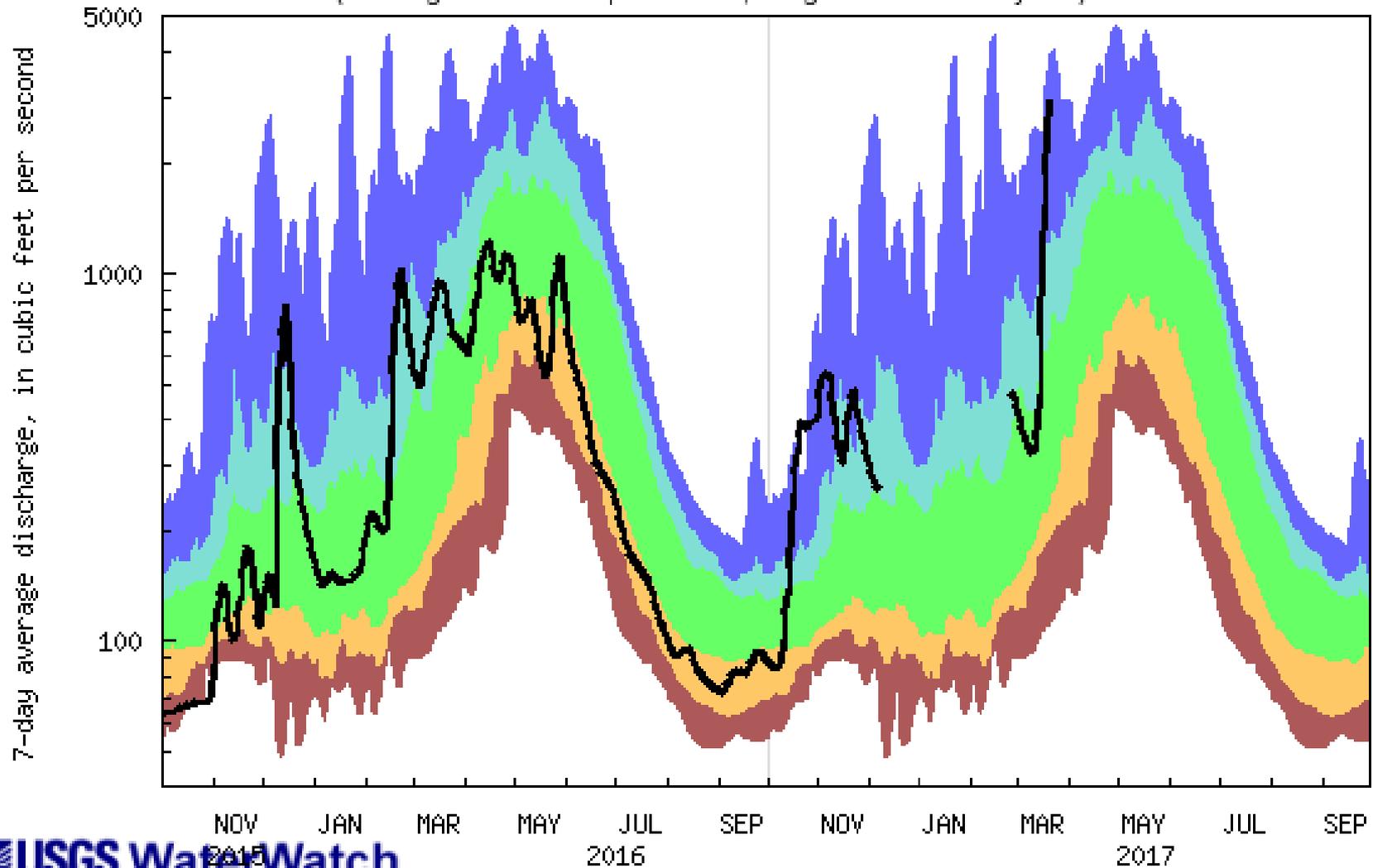


---- Provisional Data Subject to Revision ----

— Gage height

— NWS flood stage

USGS 12302055 Fisher River near Libby MT
 (Drainage Area: 842 square miles, Length of Record: 48 years)



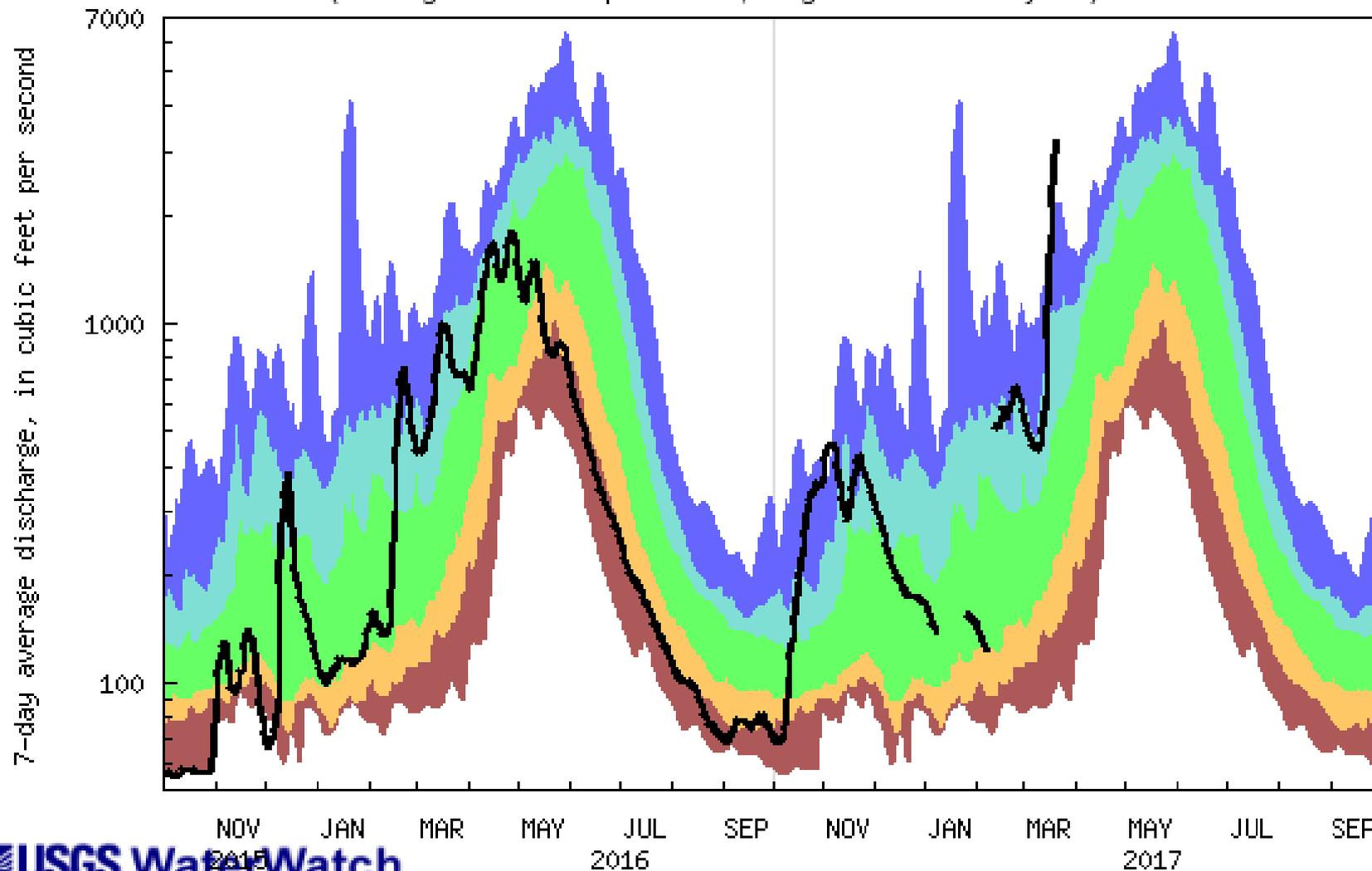
USGS WaterWatch

Last updated: 2017-03-21



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

USGS 12354000 St. Regis River near St. Regis, MT
 (Drainage Area: 304 square miles, Length of Record: 105 years)



USGS WaterWatch

Last updated: 2017-03-21



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



Lodge Creek near Chinook

Lolo Watershed Group

Established in 2003 with the mission:



“To understand and conserve the unique characteristics of the Lolo Creek watershed, including its wildlife and fisheries, scenic and rural character, local agriculture, and recreational opportunities while supporting private property and water rights.”

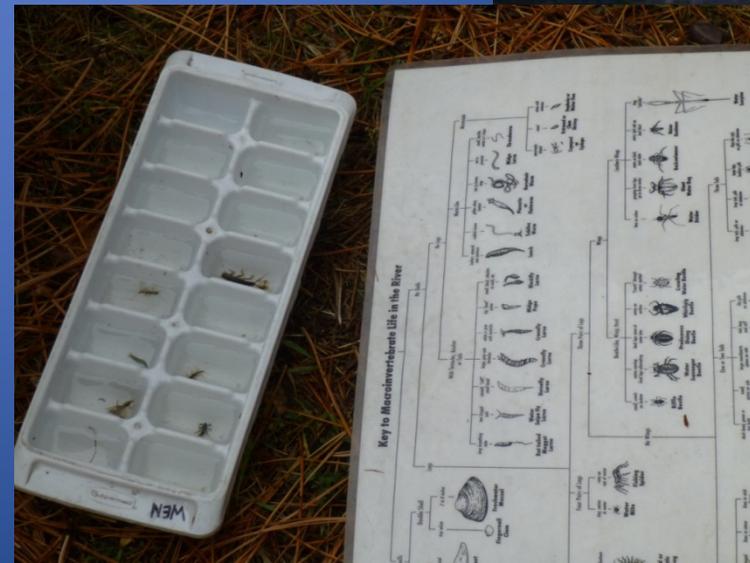
Monitoring, Education, Restoration

- Analyze our watershed through monitoring and information gathering
- Engage residents and interested stakeholders in joint fact finding
- Restore health and water quality to the creek based on our watershed restoration plan, EPA approved in 2012



Water Quality Monitoring

- Water quality limited by sediment. The non point source impairment qualifies us for 319 funding through DEQ for restoration work and monitoring efforts.
- Partner with Watershed Education Network to collect sediment data
- DEQ grant to investigate impacts of rip rap on sediment delivery



Purpose

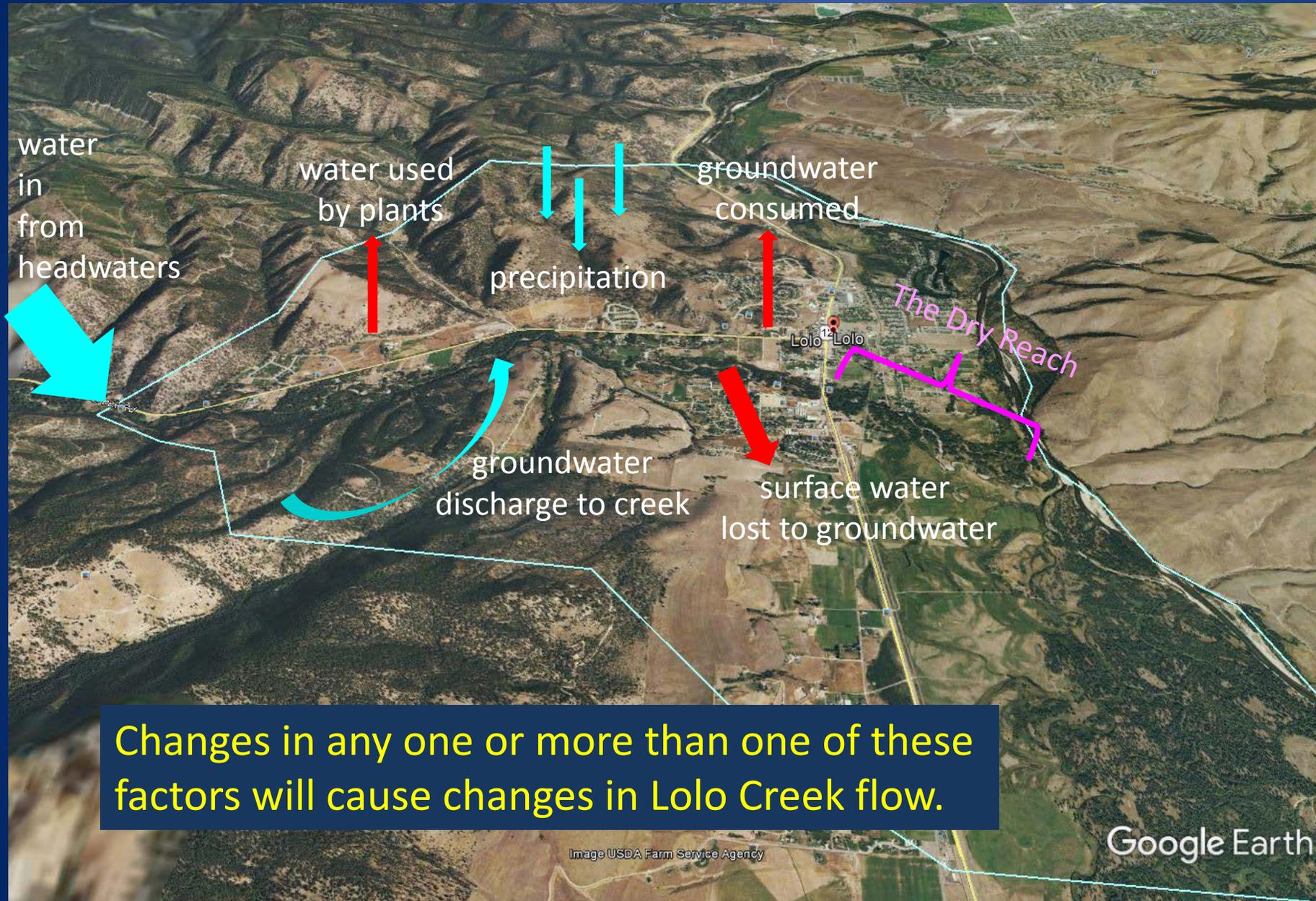
The purpose of this GWIP project is to determine the cause(s) of changes in streamflow that occur in Lolo Creek's lower reach.



Nominated: April, 2015
Approved for funding: October, 2015
Started: Spring, 2016



What determines the flow in Lower Lolo Creek?



The project will look at all of these possibilities and determine which creates the most significant stress

Changes in any one or more than one of these factors will cause changes in Lolo Creek flow.

How we approach the problem:

Establish monitoring program
drill monitor well
inventory wells
install stream gauging stations

Collect data

Analyze the data

Computer models of the data

Computer models of potential changes



Map of Monitoring Sites

- <http://goo.gl/obMiZi>



Lewis and Clark June 2016

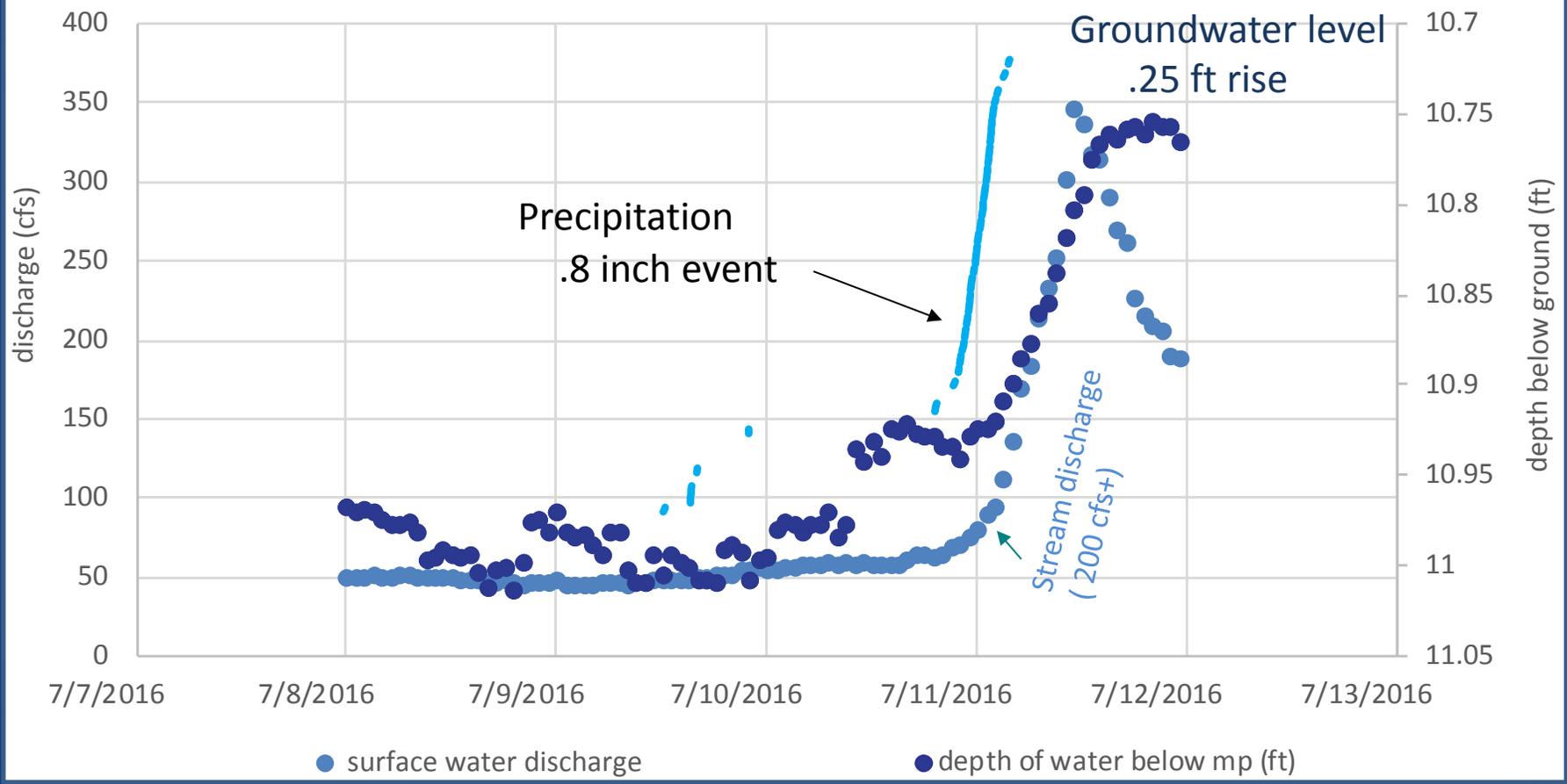


Lewis and Clark August 2016



Lewis and Clark March 2017, post ice jam

July Rain Event



Looking at data together through time

Products:

Finish the project by December, 2018.

Release an Interpretive Report that describes the system, the interactions between the components and how water management practices might play into streamflow.

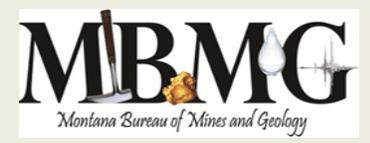
Computer models that will be available for future use to analyze new stresses.

Public presentations of the results.

A comprehensive data set, archived permanently for public access.



Lolo Watershed Study



What is it?

- A 3 to 4 year study of Lolo's water resources and uses

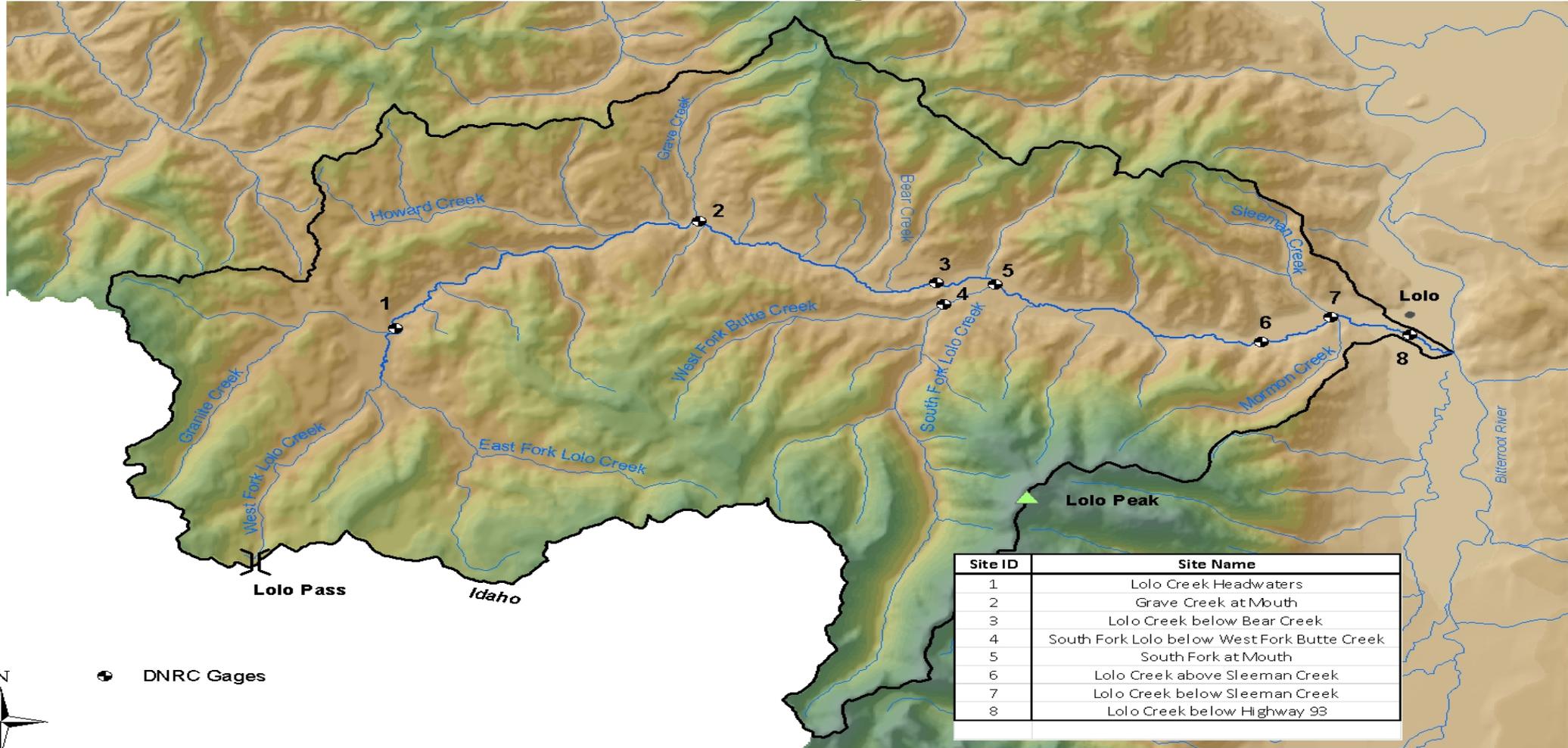
What are the benefits?

- A comprehensive report of the hydrology of the watershed
- Creation of a water budget
- Long-term real-time streamflow gaging
- Online data access

What's happening now?

- Collecting streamflow and water use data

Lolo Watershed Gages

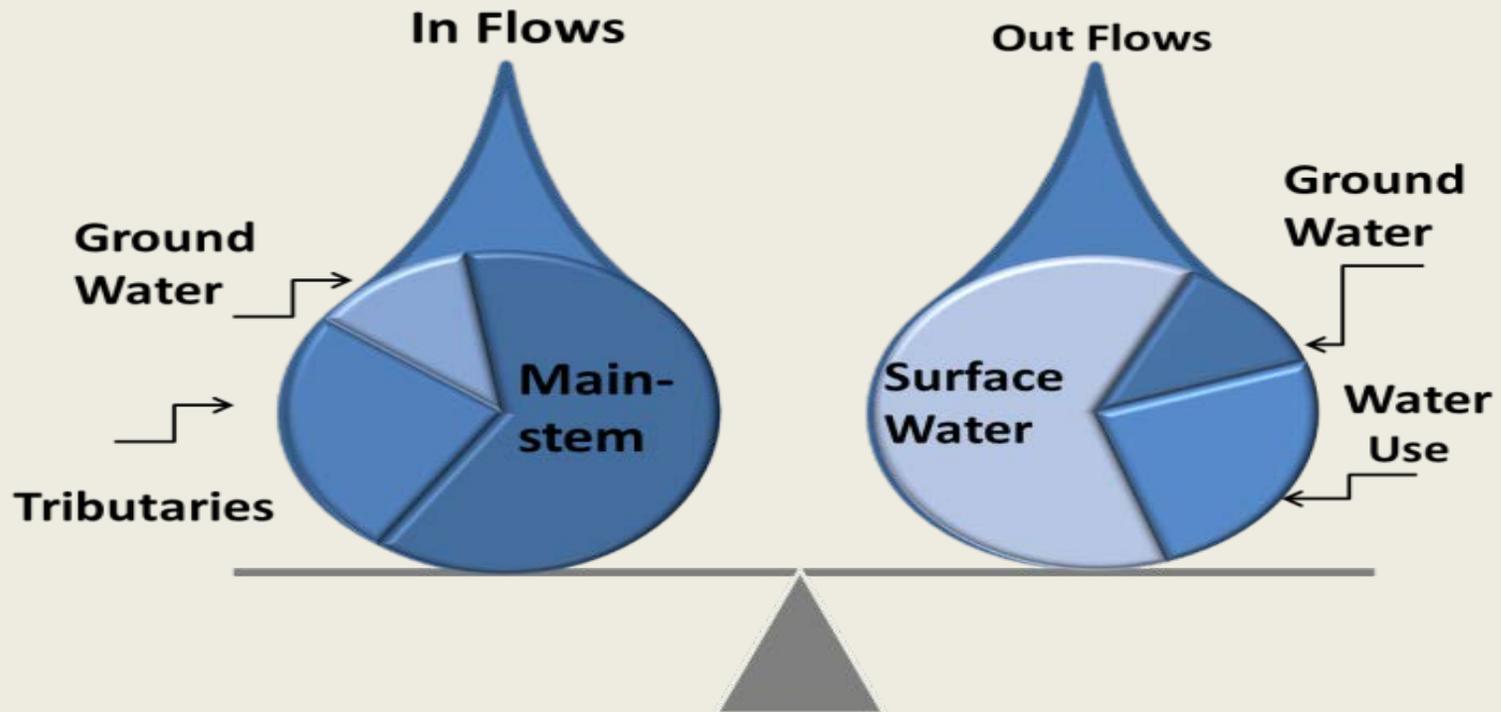


Site ID	Site Name
1	Lolo Creek Headwaters
2	Grave Creek at Mouth
3	Lolo Creek below Bear Creek
4	South Fork Lolo below West Fork Butte Creek
5	South Fork at Mouth
6	Lolo Creek above Sleeman Creek
7	Lolo Creek below Sleeman Creek
8	Lolo Creek below Highway 93

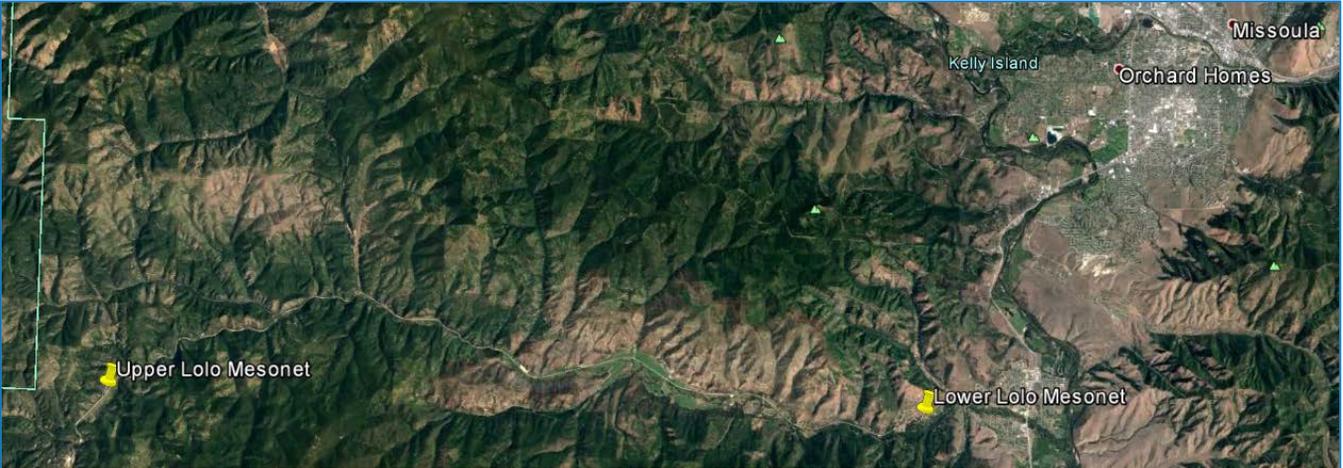
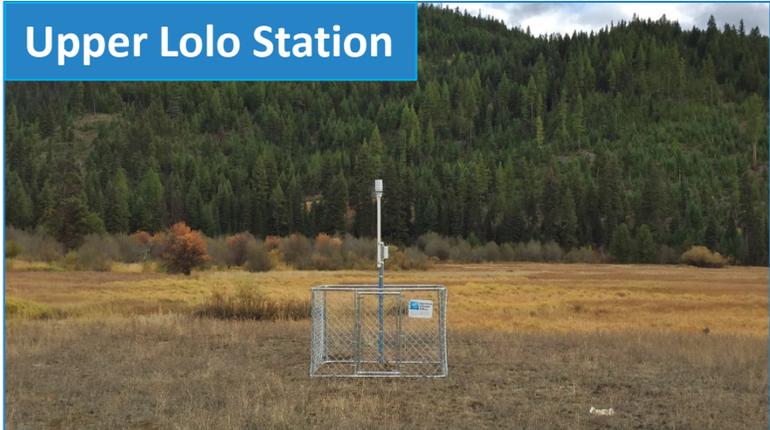


● DNRC Gages

Water Budget



Lolo Mesonet Stations



Mesonet Station Set-up

SOIL METRICS:

- Volumetric water
- Temperature
- Electrical conductivity

SENSOR DEPTHS:

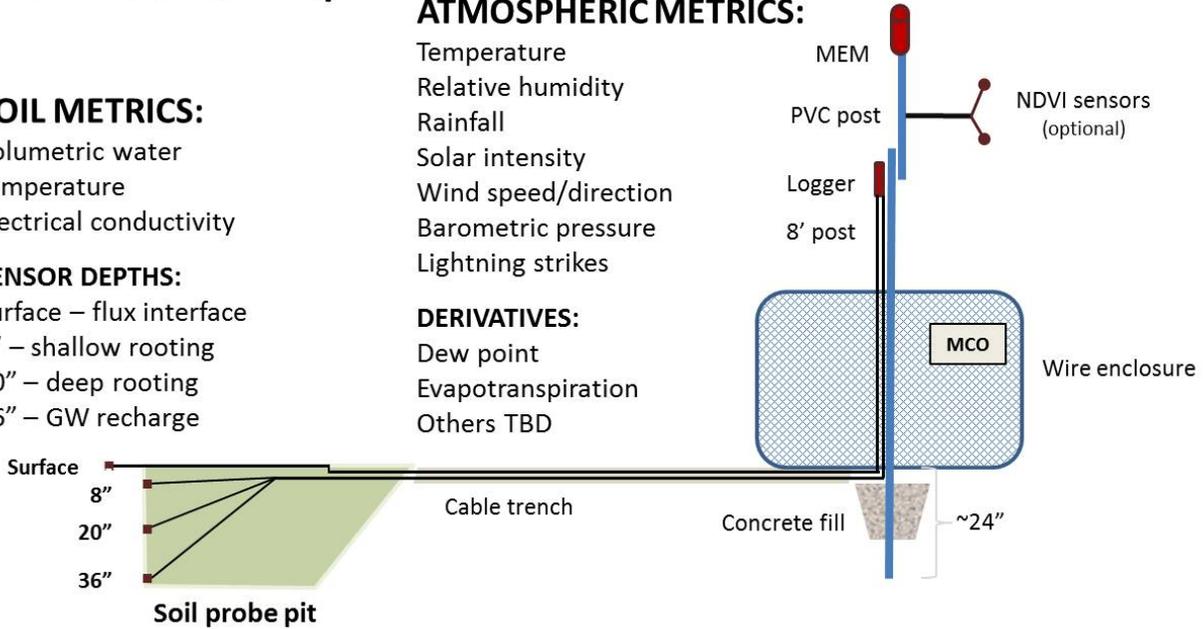
- Surface – flux interface
- 8” – shallow rooting
- 20” – deep rooting
- 36” – GW recharge

ATMOSPHERIC METRICS:

- Temperature
- Relative humidity
- Rainfall
- Solar intensity
- Wind speed/direction
- Barometric pressure
- Lightning strikes

DERIVATIVES:

- Dew point
- Evapotranspiration
- Others TBD



Educate Watershed Youth and Residents

- Lolo School Annual Field Trip – 60, 6th grade students
- Public meetings and presentations on relevant topics



Restoration Efforts

- Riparian Planting in 2016 of area badly burned by the Lolo Creek Fire in 2013.
- 75 volunteers over two days, planted 1,100 saplings, revegetating almost 1,000 feet of stream bank.



Annual Report 2016

Letter from the Director

The Lolo Watershed Group has seen an exciting year of learning about our watershed and sharing through outreach programs. We wish to thank all those who have granted funding for our work and who have taken interest in learning more about our water budget. We are excited to see reports and restoration work coming to completion



through a DEQ grant and look forward working on strategic plan development with a Watershed Coordinator through a DNRC grant and streambank stabilization planning with help of a Cinnabar Grant. We so appreciated our Big Sky Watershed Corp members and look forward to future funding partnerships to continue this program. I would like to especially thank the Ground Water Investigation Program, the DNRC 's Statewide Monitoring and Assessment Program, Montana Climate Office, and many others who are participating in studies in our watershed. Finally, I would especially like to thank the many landowners who have offered their time and property access to help us all understand the groundwater, surface water, and climate dynamics in the Lolo Creek Watershed and all of you who help encourage us to learn and share.

Board Members

Vacant, **President**

Vacant, **Vice President**

Bobbie Bartlette, **President Emeritus**

Kascie Herron, **Treasurer/Secretary**

Tom Morarre, **Agriculture Representative**

Michele Landquist, **Agriculture Representative**

Neva Larson, **Agriculture Representative**

Tana Doyle, **Community Representative**

Educate:

• WEN Sediment Monitoring

Watershed Education Network (WEN) has been helping to create a sample analysis plan (SAP) in order to guide sediment trend monitoring for project effectiveness in the Lolo Creek watershed. This information will help evaluate the long-term effects of efforts to reduce sediment loading, while concurrently exposing middle-high school aged students to the concerns and relevant scientific evaluations of Lolo Creek's health.

• Riprap Planting Investigation

Tess Scanlon, a Masters student at UM, has completed a project for the Department of Environmental Quality to perform a feasibility study for a riparian planting along Lolo Creek. She researched the feasibility of decreasing sediment loading into the creek by way of increasing the riparian habitat to create a buffer zone between the road and the creek. Tess focused her study primarily on sites lined with riprap, considering these areas are not vegetated and leave the creek unprotected from sedimentation due to traction sand. Her full report can be found on our website at lolowatershed.org/what-we-do.

• Lolo Watershed Study

The Department of Natural Resources and Conservation (DNRC) and Montana Bureau of Mines and Geology (MBMG) have come together to create a statewide program to install real-time stream gages, create an online database, and conduct watershed studies. The Lolo Watershed Group was successful in nominating the lower reaches of Lolo Creek to be studied by MBMG Groundwater Investigation Program (GWIP). Find the real-time data on our website at <http://lolowatershed.org/water-monitoring/>

Education Cont.

• Big Sky Watershed Corps (BSWC)

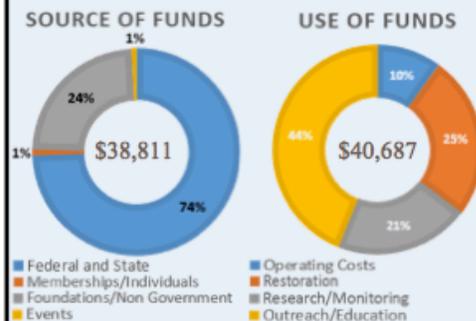
Lolo Watershed Group is in its second year of hiring a full time BSWC member. The BSWC member is responsible with planning and volunteer generation for our quarterly outreach events, creating quarterly newsletters, updating our social media, hosting education events, helping build our capacity through grant writing and volunteer generation, writing reports, among many other possibilities.

We have also secured a SWCDM Mini-grant to educate the Lolo middle school on stream health which will be led by our 2017 BSWC member this Spring!

Restore:

Through our funding from the Department of Environmental Quality (DEQ), LWG was able to team up with the Clark Fork Coalition to complete a revegetation project on a stretch of Lolo Creek, which was badly burned in the 2013 fire. Thanks to the help of over 75 volunteers, over two days, we were able to plant over 1,100 trees improving 840 feet of streambank! This project will help to stabilize the stream bank and prevent sedimentation into the creek.

Finance:



Building Organizational Capacity

- Hired Big Sky Watershed Corps Member 2015-2017
- Hired contractor to help with strategic planning
- Volunteer board helps guide organization's goals and work plan



2017 Goals

- Educate youth and local residents
- Collect information about watershed (sediment and water supply) and share with public through written communications, field trips and presentations
- Seek and apply for funding for riparian restoration
- Develop strategic plan for organization
- Begin drought resiliency planning





The Economic Risks & Opportunities of Increased Water Volatility



Presentation for the Governor's Drought &
Water Supply Advisory Committee

March 22, 2017
Helena, Montana

Presented by Sharon Brodie and Gary Gannon



Four Corners Community Foundation



Research. Educate. Empower.





- Grassroots Driven
 - Multiple Stakeholders
 - Reduces Redundancy
 - Promotes Collaboration
 - Provides Insight for Action
-
- Develops core technology for citizens, governments, businesses, and nonprofits around the world.
 - Wealth Accounting: A method for measuring social, environmental, economic, and human capital.



Four Corners Community Foundation

The Story of Water

H₂O Tools

Natural world

Environmental use of water:
Baseline stocks and flows





Four Corners Community Foundation

The Story of Water

H₂O Tools

Natural world

Environmental use of water:
Baseline stocks and flows



Human controlled world

Human use of water:
Requirements per purpose,
actual use per purpose





Four Corners Community Foundation

The Story of Water

H₂O Tools

Natural world

Environmental use of water:
Baseline stocks and flows



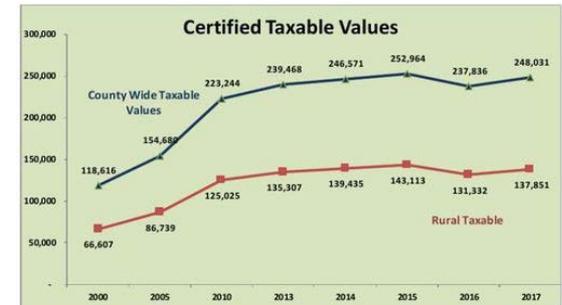
Human controlled world

Human use of water:
Requirements per purpose,
actual use per purpose



The Monetary Economy:
Revenue & Income;
Assets & Liabilities

FY 2017
Financial Trend Analysis and Financial Forecast



The Story of Water

H₂O Tools

Natural world

Environmental use of water:
Baseline stocks and flows



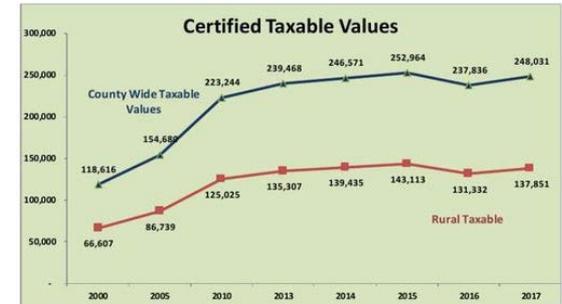
Human controlled world

Human use of water:
Requirements per purpose,
actual use per purpose



The Monetary Economy:
Revenue & Income;
Assets & Liabilities

FY 2017
Financial Trend Analysis and Financial Forecast



Challenges

Knowns:

- Increased volatility of precipitation patterns
- Population growth
- Conversion of agricultural to residential
- Agriculture & tourism affected by changing precipitation patterns

Unknowns:

- Economic volatility resulting from changing precipitation patterns
- Options for adapting infrastructure and markets to improve resiliency

Agenda

- Water-relevant information
- H₂O Tools
- Engaging stakeholders
- Enhancing efforts of water groups

Agenda

- Water-relevant information
- H₂O Tools
- Engaging stakeholders
- Enhancing efforts of water groups

Water Relevant Information: Many Sources



Water Relevant Information: Many kinds of data

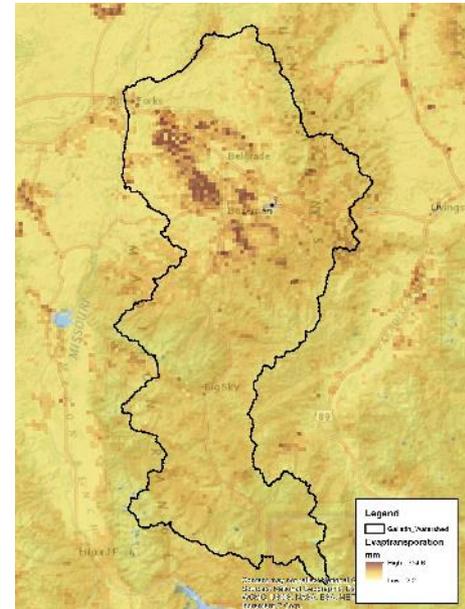
Evaporation

MONTANA														
MONTHLY AVERAGE PAN EVAPORATION (INCHES)														
PERIOD	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	
OF RECORD														
BABB 6 NE	1948-2005	0	0	0	0	5.23	5.91	6.87	5.9	4.06	0	0	0	27.97
BOZEMAN MONTANA ST UNIV	1892-2005	0	0	0	3.34	5.58	6.03	8.34	7.17	4.57	2.62	0	0	37.65
BOZEMAN 6 W EXP FARM	1966-2005	0	0	0	4.24	5.68	6.62	8.19	7.73	4.88	2.99	0	0	40.33
CANYON FERRY DAM	1948-1957	0	0	0	0	7.98	7.13	8.17	7.41	5.5	3.11	0	0	39.3
CANYON FERRY DAM	1907-1996	0	0	0	3.15	5.04	6.21	7.91	7.04	4.18	1.93	0	0	35.46
DILLON WMCE	1895-2005	0	0	0	3.05	4.72	5.32	6.41	5.45	3.48	2.84	0	0	31.27
FORT ASSINNIBOINE	1917-2005	0	0	0	4.54	6.43	7.3	8.86	8.12	5	0	0	0	40.25
FORT PECK	1948-1956	0	0	0	0	5.99	8.17	9.51	8.04	5.36	4.25	0	0	41.32
FORT PECK POWER PLANT	1956-2005	0	0	0	0	7.34	8.45	10.42	9.81	5.83	3.53	0	0	45.38
HUNGRY HORSE DAM	1948-2005	0	0	0	0	4.83	5.62	7.81	6.63	3.46	1.37	0	0	29.72
HUNTLEY EXPERIMENT STN	1911-2005	0	0	0	5.03	6.71	7.4	8.88	8.15	5.1	0	0	0	41.27
LONESOME LAKE	1948-1981	0	0	0	0	7.42	7.6	9.25	8.31	5.7	0	0	0	38.28
MALTA 7 E	1972-2005	0	0	0	4.67	6.5	6.51	7.61	6.84	4.17	1.34	0	0	37.64
MEDICINE LAKE 3 SE	1911-2005	0	0	0	0	7.44	7.69	9.62	9.19	5.36	0	0	0	39.3
MOCCASIN EXPERIMENT STN	1909-2005	0	0	0	4.35	6.59	7.72	9.66	9.21	6.39	0	0	0	43.92
SIDNEY	1910-2005	0	0	0	3.99	5.63	6.44	6.93	5.45	2.89	1.81	0	0	33.14
TIBER DAM	1952-2005	0	0	0	0	4.51	6.46	7.65	5.56	4.34	0	0	0	28.52
VALIER	1911-2005	0	0	0	0	5.37	6.49	7.33	5.62	4.72	0	0	0	29.53
WESTERN AG RESEARCH CNT	1965-2005	0	0	0	0	5.08	6.03	7.26	6.07	4.14	2.25	0	0	30.83
YELLOWTAIL DAM	1948-2005	0	0	0	0	6.94	8.84	10.6	9.74	6.58	4.86	0	0	47.56

Water Relevant Information: Many kinds of data

Evapotranspiration

MEAN	STD	SUM	Month_	acre-feet
7.011103099	4.32738751	38897.601		27,174.99
11.11584355	5.669284386	61670.7000202		43,084.94
19.6769106	5.705216056	109167.503		76,267.59
22.77092647	5.861678864	126333.100104		88,259.97
30.0441781	8.867635372	166685.100105		116,451.05
51.51870941	24.71594997	285825.799806		199,686.21
56.94336696	29.2675942	315921.799907		220,712.15
35.83312904	17.95027292	198802.199908		138,888.99
14.52189978	8.00312088	80567.4999709		56,286.80
10.53037131	4.762943745	58422.5000410		40,815.66
7.154361934	3.881523731	39692.4000111		27,730.26
6.076676276	3.792598517	33713.3999812		23,553.16
				1,058,911.78



Water Relevant Information: Many kinds of data

Ground Water

Center (GWIC) database shortly after measurements are made and are then easily retrievable by the citizens of Montana.

Gwic Id	Site Name	Lat	Lon	Geomethod	Datum	Ground Surface Altitude	Twn	Rng	Sec	Q Sec	Td	Date Completed	Aquifer	First Date	Last Date	Average Swl Grnd	Readings
9258	COOPER RANCH	45.816783027778	-111.642909647222	SUR-GPS	NAD83	4192.457	01N	01E	19	DDCB	60	6/15/1983	120SDMS	5/29/1991	2/1/2017	20.64	115
9271	KG RANCHLANE BROTHERS - STATE LANDS	45.808911630556	-111.566170375	SUR-GPS	NAD83	4413.406	01N	01E	26	BDDD	220	7/8/1970	120SDMS	11/20/1992	2/1/2017	140.69	118
32	WILLIAMS, CHARLES AND ROBERTA	45.81365165	-111.467824863889	SUR-GPS	NAD83	4226.709	01N	02E	27	BBDA	145	4/2/1980	120SNGR	10/30/1992	2/1/2017	63.91	123
199352	BOSWAY HOLSTIENS	45.848132236111	-111.392171994444	SUR-GPS	NAD83	4416.699	01N	03E	7	DDBD	620	9/16/2002	120SDMS	5/15/2008	2/2/2017	227.34	10322
226763	GLWQD MONITORING WELL * ALTENBRAND PARK DEEP COMPLETION	45.86031038	-111.32841768	SUR-GPS	NAD83	4241.13	01N	03E	10	AAAB	70	3/3/2006	120SNGR	6/7/2006	1/9/2017	25.9	41690
226764	GLWQD MONITORING WELL * ALTENBRAND PARK SHALLOW COMPLETION	45.86031001	-111.32841873	SUR-GPS	NAD83	4241.22	01N	03E	10	AAAB	29	3/3/2006	111SNGR	6/8/2006	1/9/2017	11.91	41722
148531	SCHUTTER, SID	45.79880067	-111.35773272	SUR-GPS	NAD83	4422.14	01N	03E	33	ABCC	300	6/17/1988	120SDMS	10/24/1989	1/9/2017	72.15	160
226766	GLWQD MONITORING WELL * DRY CREEK SCHOOL	45.87411	-111.2171	SUR-GPS	NAD83	4276.52	01N	04E	3	BABB	45	2/28/2006	111SNGR	3/1/2006	1/9/2017	19.85	42709
133162	USGS OBSERVATION WELL RICHARD MORGAN	45.835297097	-111.201461475	SUR-GPS	NAD83	4320.54	01N	04E	15	DADD	315	1/1/1953	120SNGR	5/20/1953	1/10/2017	3.99	181
133165	USGS OBSERVATION WELL HEEB ROAD	45.82155334	-111.28514722	SUR-GPS	NAD83	4300.35	01N	04E	19	CBCC	81	1/1/1953	111SNGR	6/11/1992	1/9/2017	4.39	171
135735	USGS OBSERVATION WELL - PENWELL BRIDGE RD.	45.802243368	-111.165269206	SUR-GPS	NAD83	4389.444	01N	04E	25	DCDD	101	1/1/1951	110SNGR	12/7/1951	1/10/2017	16.69	43339
135689	COOK RANCH	45.863380916	-111.097699989	SUR-GPS	NAD83	4507.132	01N	05E	4	DDAA	13.5		110SNGR	7/17/1992	1/9/2017	8.11	168
130172	BROWN RICHARD	45.83917	-111.06186	MAP	NAD83	4670	01N	05E	14	ACDD	109		120SDMS	7/31/1992	4/29/2000	90.19	31
183082	BROWN, RICHARD AND BARBARA	45.839188859	-111.061778029	SUR-GPS	NAD83	4671.968	01N	05E	14	ACDD	138.5	5/16/2000	120SNGR	7/29/2000	6/3/2014	93.01	101
234909	GLWQD MONITORING WELL * LUTZ	45.8025256	-111.0453876	SUR-GPS	NAD83	4618.19	01N	05E	25	CCCC	86.5	3/19/2007	120SNGR	4/25/2007	1/9/2017	51.01	41062
9771	THOMPSON, ALVIN	45.805541747	-111.13105238	SUR-GPS	NAD83	4394.21	01N	05E	29	CDBA	39	6/15/1981	111SNGR	7/8/1993	1/10/2017	6.71	150
9858	HARJES RICHARD AND KATY	45.832922683	-111.00776807	SUR-GPS	NAD83	5044.55	01N	06E	17	CDCB	60	10/10/1989	112SNGR	6/20/1991	1/9/2017	14.88	164
133172	US GEOLOGICAL SURVEY - KAMMERMAN	45.708284302	-111.30778394	SUR-GPS	NAD83	4652.408	01S	03E	36	BCCA	113	1/1/1952	120SDMS	9/29/1992	1/10/2017	40.55	169
133174	US GEOLOGICAL SURVEY - TORGERSON	45.77249142	-111.238008152	SUR-GPS	NAD83	4436.58	01S	04E	9	BAAA	97.5	1/1/1952	110SNGR	3/27/1953	1/10/2017	22.84	172
235475	GLWQD MONITORING WELL * YUKON	45.74846235	-111.169788636	SUR-GPS	NAD83	4526.74	01S	04E	13	DBDA	73	4/26/2007	112SNGR	4/26/2007	1/10/2017	35.28	41735

Agenda

- Water-relevant information
- **H₂O Tools**
- Engaging stakeholders
- Enhancing efforts of water groups

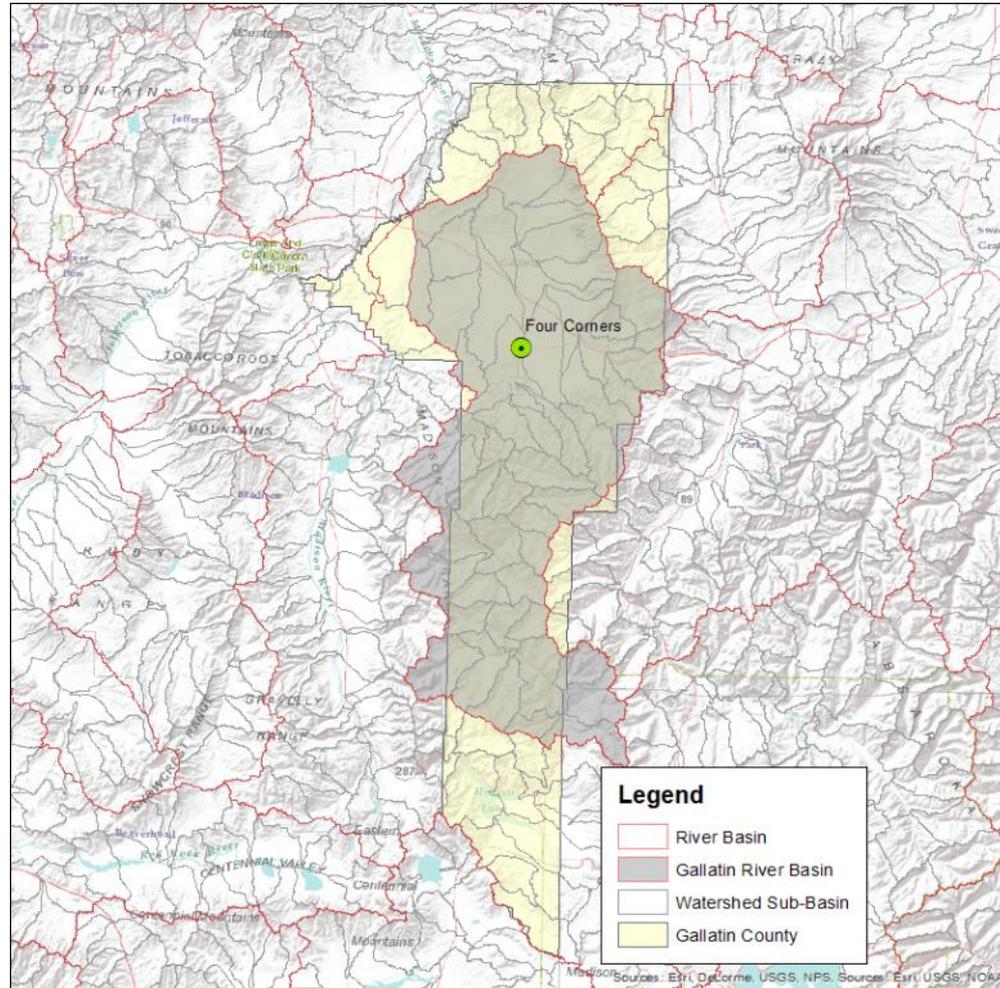
H₂O Tools

An online platform

- Representation and analysis of:
 - Hydrological properties, precipitation, stocks and flows
 - Water requirements, use and rights
 - Economic activity
- For a given region:
 - Analyze economic impacts accruing to changes in precipitation patterns
 - Analyze options for improving economic resiliency and opportunities
- For a given stakeholder:
 - Enable stakeholders to see how their actions affect each other

H₂O Tools : Gallatin

Overlapping physical and political boundaries

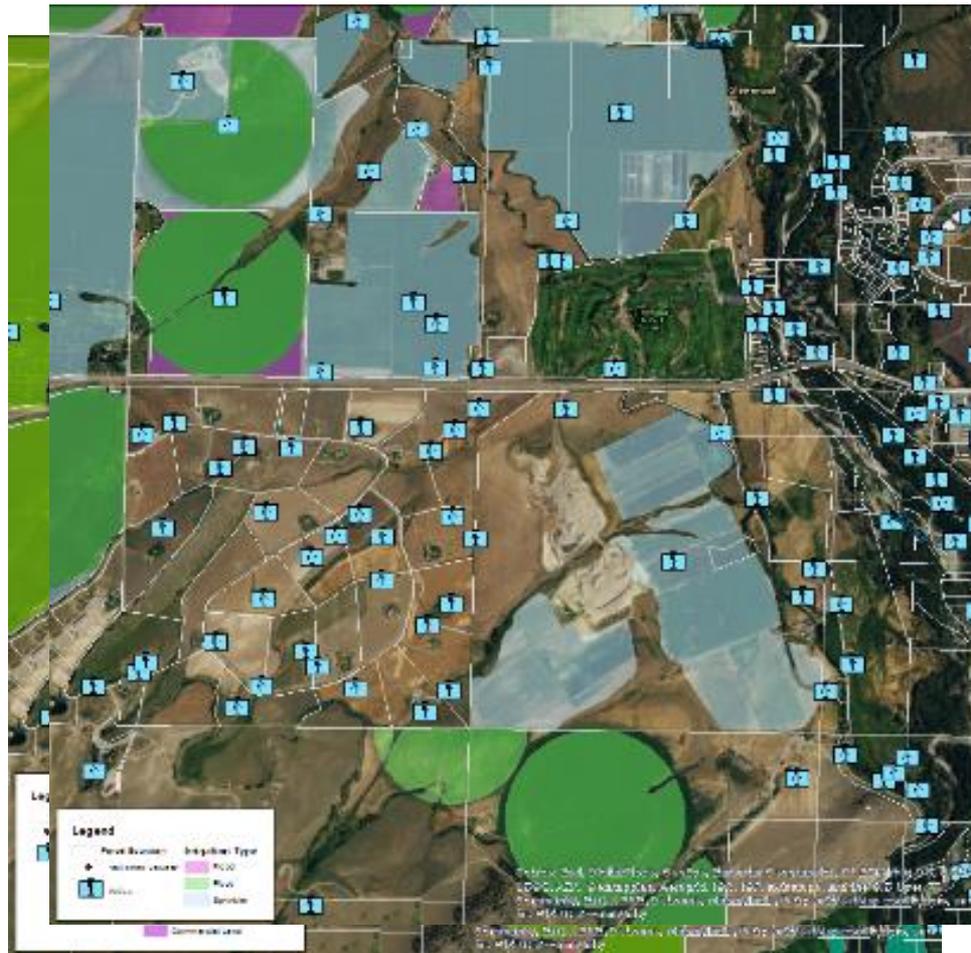


Water-Relevant Info: Many kinds of data



Parcel Outline View

Water-Relevant Info: Many kinds of data

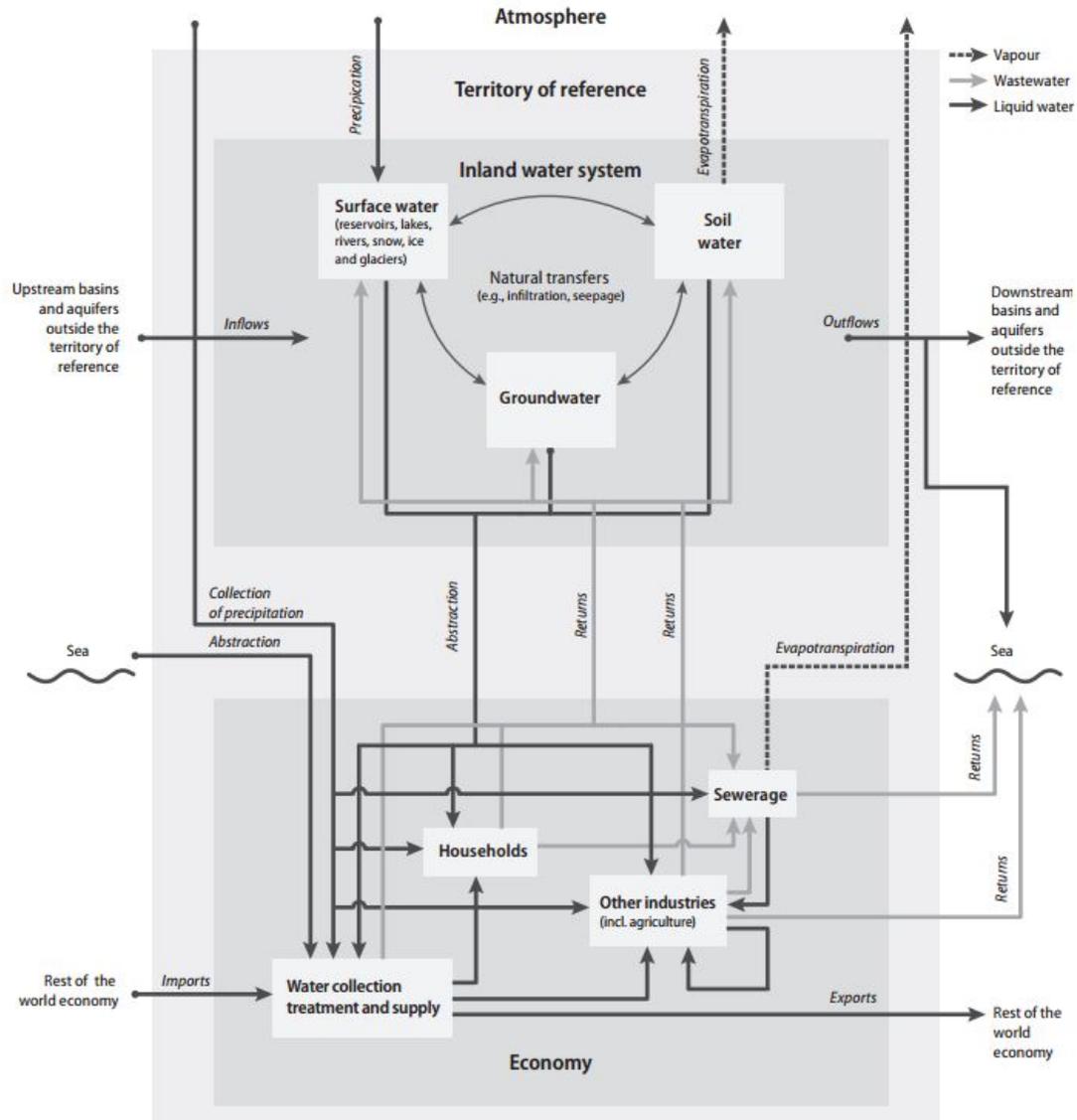


Land use, Irrigation by Parcel Outline View

H₂O Tools : Water Accounting

- Observations vs. Estimates
- Stock views vs. Flow views
- Actuals vs. Forecast
- Cash vs. Accruals
- Watershed vs. political region aggregation

H₂O Tools : Water Accounting Principles



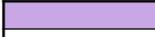
H₂O Tools : Physical Water Budgets

Time: 2015-July

Scenario:
Actual

Reporting Unit: Gallatin river basin

All units: Acre-feet	Opening stocks	Inflows			outflows			Unaccounted for	Closing stocks
		Precipitation	up-watershed	Economic discharge	evaporation over non irrigated surfaces	down-watershed	Economic abstraction		
All water Assets		283,328		0	88,285	42,259	132,427	0	20,356
<i>All Surface water</i>						42,259			
All lakes									
All rivers						42,259			
<i>All ground water</i>									
All Soil									
All Aquifers									
<i>All Urban systems</i>	3000								

Availability Legend					
	Not Applicable	Potential data gap	Partially available	Likely available	Available

Simple budget formula: $P + Q_{in} = ET + S + Q_{out}$

Expanded Formula: $P + Q_{in}^{sw} + Q_{in}^{gw} = ET^{sw} + ET^{gw} + ET^{uz} + \Delta S^{sw} + \Delta S^{snow} + \Delta S^{uz} + \Delta S^{gw} + Q_{out}^{gw} + RO + Q^{bf}$

H₂O Tools : Physical Water Budgets

Time: 2015-July

Scenario:
Actual

Reporting Unit: Gallatin river basin

All units: Acre-feet	Opening stocks	Inflows			outflows			Unaccounted for	Closing stocks
		Precipitation	up-watershed	Economic discharge	evaporation over non irrigated surfaces	down-watershed	Economic abstraction		
All water Assets		283,328		0	88,285	0	132,427	0	62,615
<i>All Surface water</i>									
All lakes									
All rivers									
<i>All ground water</i>									
All Soil									
All Aquifers									
<i>All Urban systems</i>									

Data Value Legend

 High value unknowns	 Not high value unknowns	 Not Applicable
--	--	---

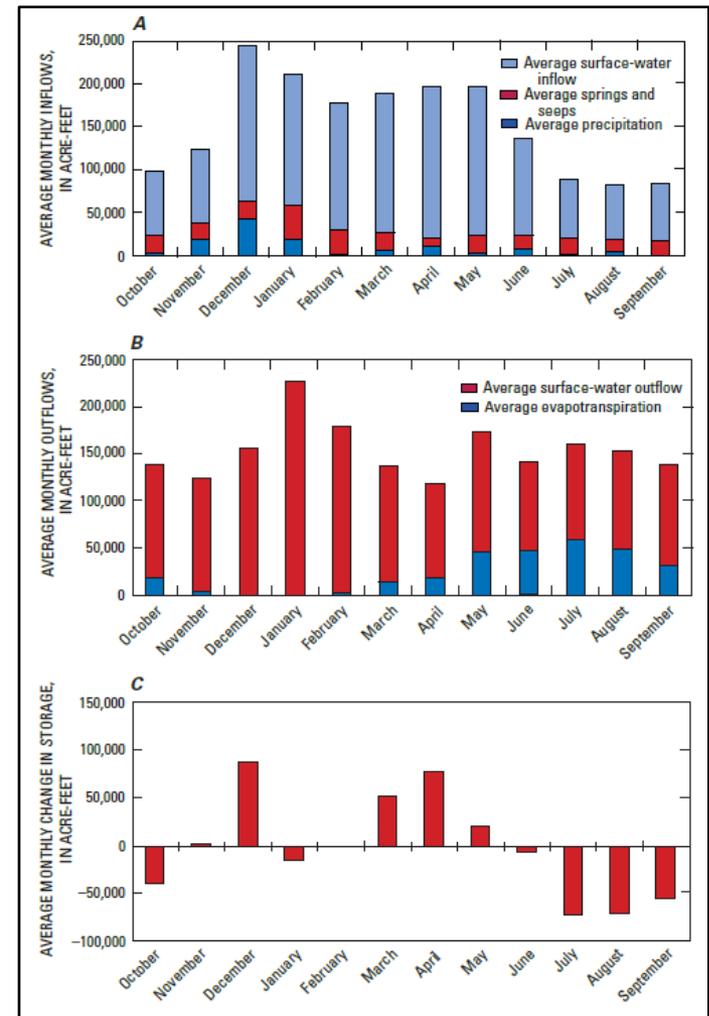
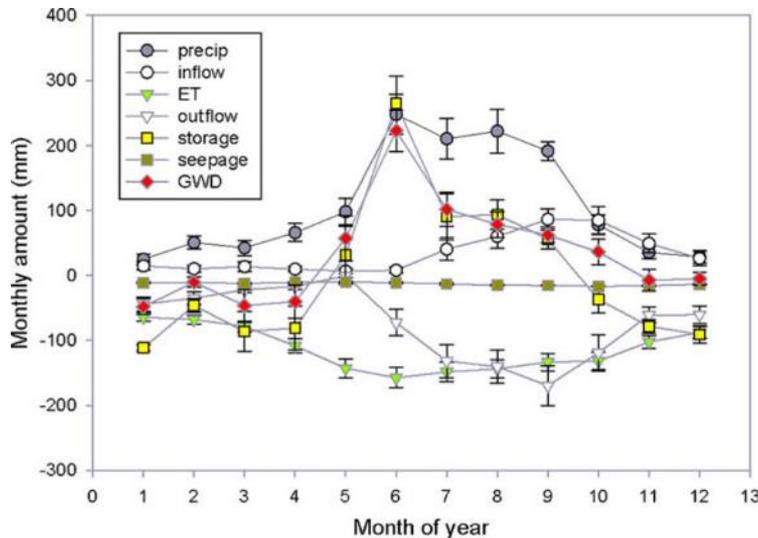
Simple budget formula: $P + Q_{in} = ET + S + Q_{out}$

Expanded Formula: $P + Q_{in}^{sw} + Q_{in}^{gw} = ET^{sw} + ET^{gw} + ET^{uz} + \Delta S^{sw} + \Delta S^{snow} + \Delta S^{uz} + \Delta S^{gw} + Q_{out}^{gw} + RO + Q^{bf}$

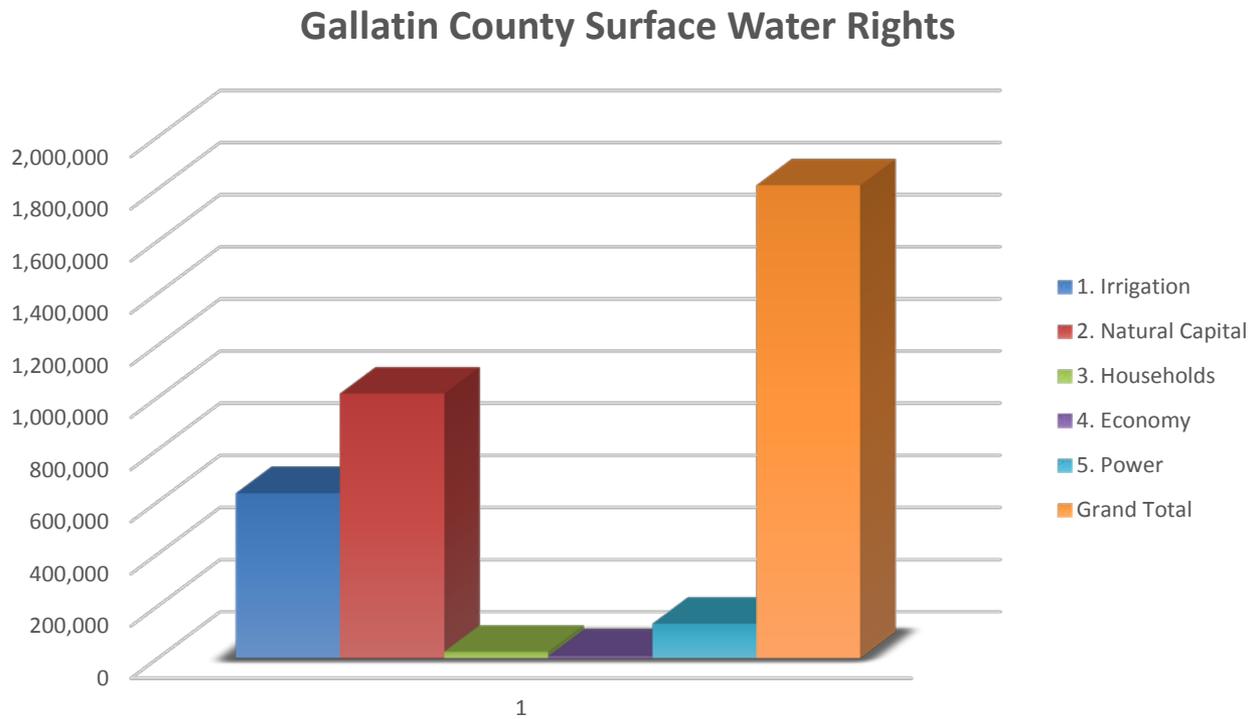
H₂O Tools : Water Budget Analyses

- Can take any reasonable form

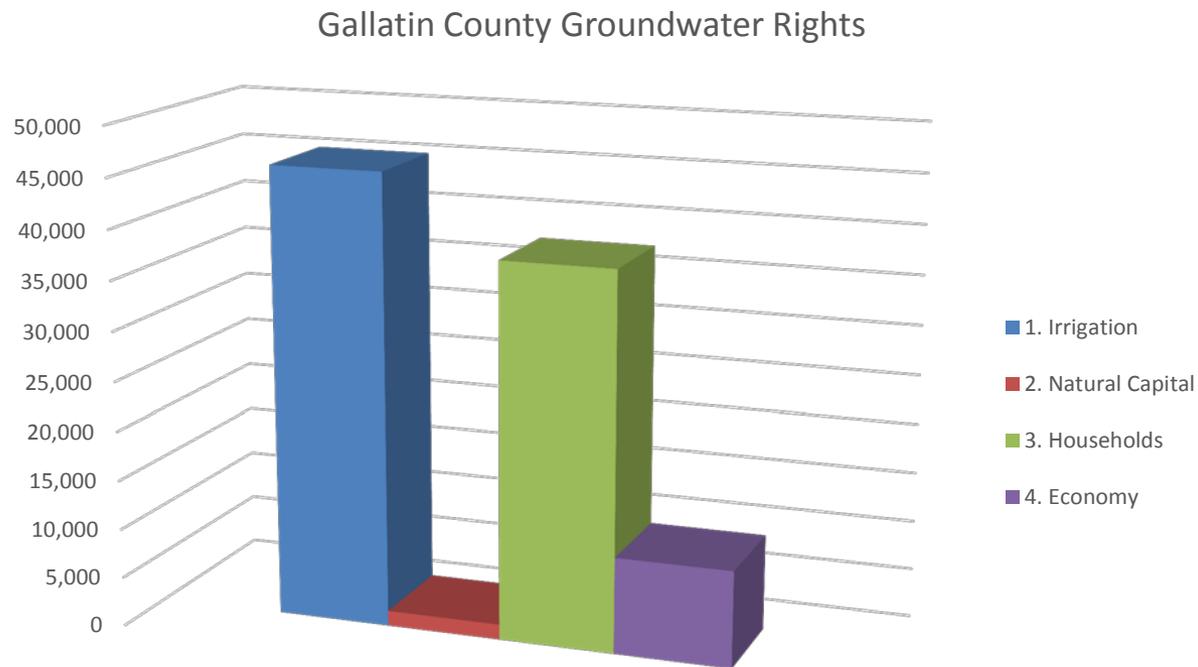
Conceptual water budget			
based on the data collected for this study and accepted hydraulic estimates.			
Input Component	Value (AF/y)	Output Component	Value (AF/y)
GW _{in}	100-900	GW _{out}	30,000
R _{in}	60,000	R _{out}	Variable
RIV _{in}	20,000-40,000	RIV _{out}	20,000-50,000
STR _{in}	200-500	STR _{out}	100-500
		±ΔS	



H₂O Tools : Water Budget Analyses

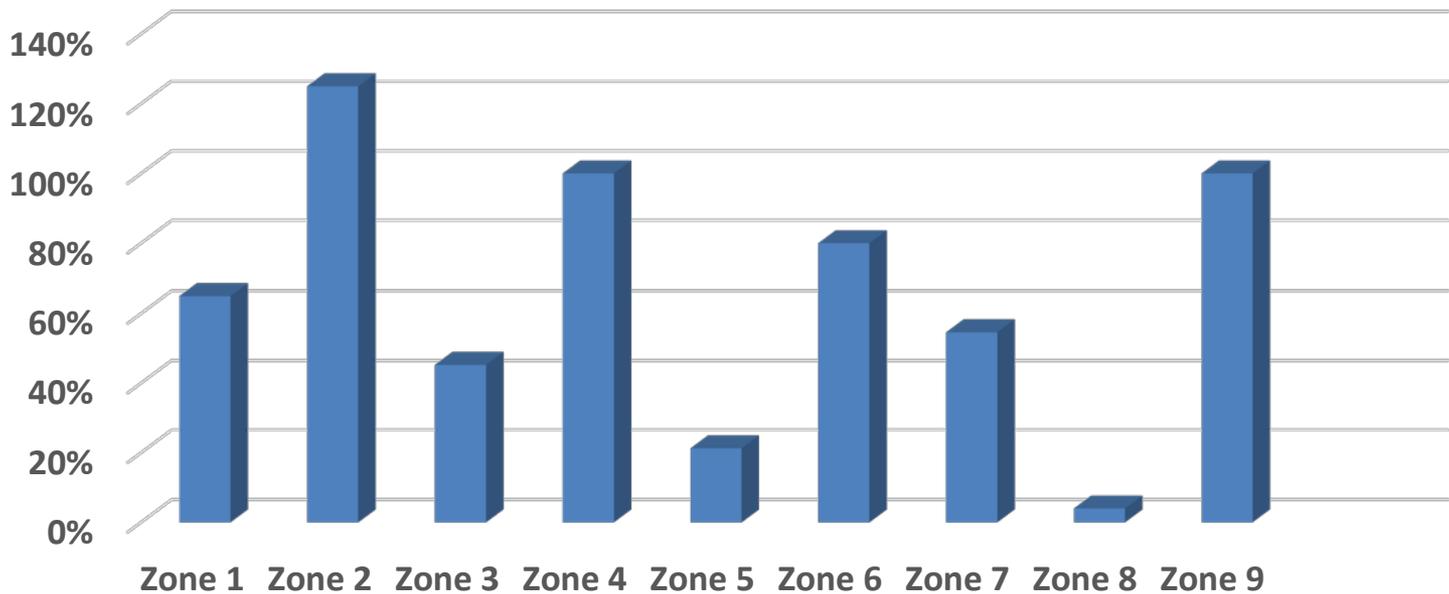


H₂O Tools : Water Budget Analyses



H₂O Tools : Water Budget Analyses

Economy water use as % Water Rights



H₂O Tools : Productive Use of Water

- Agriculture & Livestock
- Domestic & Municipal
- Commercial
- Fisheries and Wildlife
- Recreation & Tourism
- Hydro Power
- Industrial



H₂O Tools: Illustrative Vulnerability and Threat Assessment

NATURAL ASSETS		Natural Asset Assessments												
BASELINE SCENARIO	Category	Specific Risk	MA Jubel			SD Bangulegi			MA Wonolopo			SD Kemlagi		
			River	Spring	Well	River	Spring	Well	River	Spring	Well	River	Spring	Well
	Drought	Water Quantity/Quality Risks	na	2.40	na	na	na	2.00	na	0.80	na	na	na	3.20
	Flooding	Water Quantity/Quality Risks	na	0.20	na	na	na	1.20	na	0.60	na	na	na	0.20
	Landslides	Water Quality Risks	na	0.20	na	na	na	0.20	na	3.20	na	na	na	1.60
	Sea Level	Water Quality Risks	na	na	na	na	na	na	na	na	na	na	na	na
	Sub Total by Asset		na	0.93	na	na	na	1.13	na	1.53	na	na	na	na

BASELINE SCENARIO	Category	Specific Risk	MA Jubel			SD Bangulegi			MA Wonolopo			SD Kemlagi		
			River	Spring	Well	River	Spring	Well	River	Spring	Well	River	Spring	Well
	Drought	Water Quantity/Quality Risks	na	4.00	na	na	na	0.60	na	0.20	na	na	na	5.00
	Flooding	Water Quantity/Quality Risks	na	0.20	na	na	na	0.60	na	1.20	na	na	na	5.00
	Landslides	Water Quality Risks	na	1.80	na	na	na	1.00	na	3.20	na	na	na	2.40
	Sea Level	Water Quality Risks	na	na	na	na	na	na	na	na	na	na	na	na
	Sub Total by Asset		na	2.00	na	na	na	na	na	1.53	na	na	na	na

BUILT ASSETS		Built Asset Assessments																
BASELINE SCENARIO	Category	Specific Risk	MA Jubel				SD Bangulegi				MA Wonolopo				SD Kemlagi			
			Intake	Transmis sion	Water Treatme nt	Storage Facilities	Intake	Transmis sion	Water Treatme nt	Storage Facilities	Intake	Transmis sion	Water Treatme nt	Storage Facilities	Intake	Transmis sion	Water Treatme nt	Storage Facilities
	Drought	Physical Damages to Infrastructure	0.20	1.00	0.80	na	0.60	0.40	0.40	na	0.40	0.80	na	0.80	4.00	0.40	na	na
	Flooding	Physical Damages to Infrastructure	0.20	0.20	0.20	na	0.20	0.80	1.60	na	1.80	3.20	na	1.60	0.80	0.40	na	na
	Landslides	Physical Damages to Infrastructure	1.20	0.60	1.60	na	5.00	0.40	0.40	na	0.60	2.40	na	0.60	4.00	0.40	na	na
	Sea Level	Physical Damages to Infrastructure	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	Sub Total by Asset		0.53	0.60	0.87	na	1.93	0.53	0.80	na	0.93	2.13	na	1.00	2.93	0.40	na	na

BASELINE SCENARIO	Category	Specific Risk	MA Jubel				SD Bangulegi				MA Wonolopo				System 4			
			Intake	Transmis sion	Water Treatme nt	Storage Facilities	Intake	Transmis sion	Water Treatme nt	Storage Facilities	Intake	Transmis sion	Water Treatme nt	Storage Facilities	Intake	Transmis sion	Water Treatme nt	Storage Facilities
	Drought	Physical Damages to Infrastructure	0.20	0.40	0.60	na	3.20	0.20	0.20	na	0.80	0.80	na	0.80	4.00	0.80	na	na
	Flooding	Physical Damages to Infrastructure	0.40	0.20	0.20	na	1.00	0.20	1.20	na	1.20	2.40	na	0.80	4.00	0.80	na	na
	Landslides	Physical Damages to Infrastructure	1.80	1.80	2.40	na	5.00	0.20	1.60	na	0.80	3.20	na	0.80	4.00	4.00	na	na
	Sea Level	Physical Damages to Infrastructure	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na	na
	Sub Total by Asset		0.80	0.80	1.07	na	3.07	0.20	1.00	na	0.93	2.13	na	0.80	4.00	1.87	na	na

Gallatin County Budget

BUDGET for FY 2016 and FY 2017

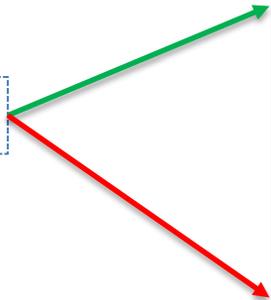
SUMMARY OF MAJOR REVENUES, EXPENDITURES, AND OTHER FINANCING

SOURCES/USES

Actual Revenue & Expenses FY 2010 - FY 2016 (Budget for FY 2017)

	Total All Funds	Total All Funds	Total All Funds	Total All Funds	Total All Funds	Total All Funds
	FY 2017 BUDGET	FY 2016 BUDGET	FY 2015 ACTUAL	FY 2014 ACTUAL	FY 2013 ACTUAL	FY 2010 ACTUAL
Beginning / Adjusted						
Fund Balance	\$ 80,476,364	\$ 70,362,988	\$ 60,054,519	\$ 54,396,972	\$ 45,239,555	\$ 75,111,644
REVENUES						
Taxes & Assessments	43,718,609	42,038,829	39,344,602	37,323,128	35,905,220	27,226,244
Licenses & Permits	3,834,400	4,249,126	3,310,500	3,491,658	3,419,871	244,025
Intergovernmental	15,191,793	12,131,009	15,688,079	12,149,754	16,119,264	11,366,707
Charges for Services	18,058,651	19,915,256	16,533,744	18,353,990	17,360,678	14,529,471
Fines & Forfeitures	580,000	632,063	507,500	514,474	474,086	409,118
Miscellaneous	470,853	5,240,863	203,749	1,656,161	258,753	9,543,195
Investment Earnings	431,333	445,449	479,391	509,673	650,749	993,924
Transfers	7,816,389	1,220,283	6,739,292	11,744,186	7,535,373	1,946,405
Total Revenues	90,102,028	85,872,878	82,806,857	85,743,024	81,723,994	66,259,089
EXPENSES						
General Government	15,367,281	11,884,167	13,065,268	12,608,620	11,837,108	8,778,433
Public Safety	36,078,102	19,522,794	30,412,637	26,434,816	18,955,080	12,717,007
Public Works	28,746,286	14,450,723	27,307,623	16,608,752	14,509,372	10,744,187
Public Health	13,724,127	11,969,590	12,925,267	9,578,870	10,739,235	13,203,518
Recreation & Other	5,651,028	3,428,472	5,180,476	4,239,634	5,008,885	7,516,522
Debt Service	9,448,298	7,344,038	8,421,130	4,670,515	6,981,798	4,275,917
Transfers (out)	-	-	-	-	-	1,946,404
Capital Outlay	36,248,127	5,135,815	30,289,165	5,912,684	4,535,098	24,783,969
Total Expenses	145,263,249	73,735,599	127,601,565	80,053,891	72,566,577	83,965,957
Projected Change in						
Fund Balance/Cash	(55,161,221)	12,137,279	(44,794,708)	5,689,133	9,157,417	(17,706,868)
Projected / Ending						
Fund Balance/Cash	\$ 25,315,143	\$ 82,500,267	\$ 15,260,028	\$ 60,054,519	\$ 54,396,972	\$ 57,404,776

Water impacts



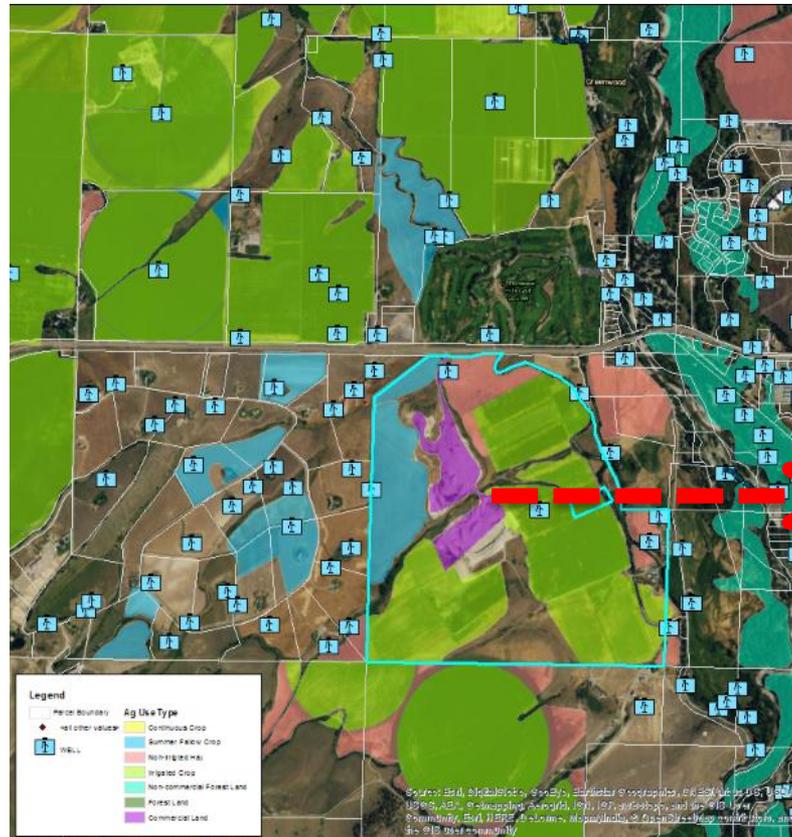
Agenda

- Water-relevant information
- H₂O tools
- **Engaging stakeholders**
- Enhancing efforts of water groups

Engaging Stakeholders

- Stakeholder-specific views / User Interface
- Run what-if scenarios
- All micro information accepted
- Competing water uses identified within groups
- Multi Stakeholder collaboration

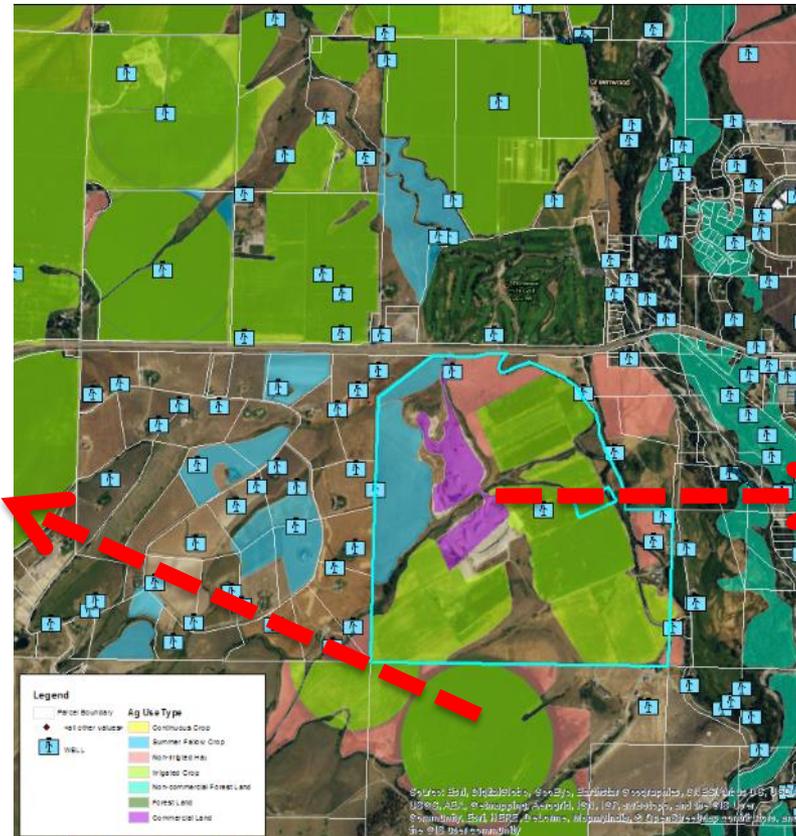
Engaging Stakeholders: to Resolve Conflicts



Parcel 236- July 2015	
Irrigated Acres	193.0 Acres
Sprinkler Irrigation Acres	193.0 Acres
Irrigation Efficiency	0.5
Water use	73 acre-ft
Ag use	71 acre-ft.
Water rights	acre-ft.
Optimal Ag requirements	90 acre-ft.
Ag production efficiency	0.7
Projected value of crop	\$2.3 mm
Value difference from prior projection	\$ - 0.5 mm
Water value	TBD

Engaging Stakeholders: to Resolve Conflicts

Parcel 341- July 2015	
Irrigated Acres	138.4 Acres
Pivot Irrigation Acres	138.4 Acres
Irrigation Efficiency	0.65
Water use	47 acre-ft.
Ag use	45 acre-ft.
Water rights	acre-ft.
Optimal Ag requirements	77 acre-ft.
Ag production efficiency	0.7
Projected value of crop	\$2.3 mm
Value difference from prior projection	\$ - 0.5 mm
Water value	TBD



Parcel 236- July 2015	
Irrigated Acres	193.0 Acres
Sprinkler Irrigation Acres	193.0 Acres
Irrigation Efficiency	0.5
Water use	73 acre-ft.
Ag use	71 acre-ft.
Water rights	acre-ft.
Optimal Ag requirements	90 acre-ft.
Ag production efficiency	0.7
Projected value of crop	\$2.3 mm
Value difference from prior projection	\$ - 0.5 mm
Water value	TBD

Agenda

- Water-relevant information
- H2O tools
- Engaging stakeholders
- **Enhancing efforts of water groups**

Enhancing Efforts of Water Groups

- As data providers:
 - All data accepted
 - Information value continually assessed
 - Even for data that's not there
 - Value of information that should be available

- As policy advocates:
 - Full transparency
 - Access
 - Quality

Enhancing Water Projects

- Observation
- Modeling
- Control



Supporting Mitigation Planning

- Water storage (slowing down water)
- Fisheries protections



Summary

- There appears to be enough water data to develop preliminary water budgets that highlight potential areas of water vulnerability
- Combining water budgets and water requirements enables H2O tools
 - To provide a multi-stakeholder platform for stakeholders to resolve water issues
 - To estimate the value of acquiring certain water information

Thank you!



Questions?

Please Contact Us



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Four Corners Community Foundation

The Story of Water

Natural world

Environmental use of water:
Baseline stocks and flows





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Environmental use of water:
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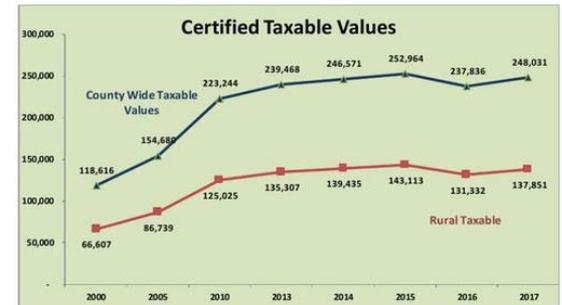


Human controlled world

The Monetary Economy:
Revenue & Income;
Assets & Liabilities

FY 2017

Financial Trend Analysis and Financial Forecast





Four Corners Community Foundation

The Story of Water

See H₂O

Natural world

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