

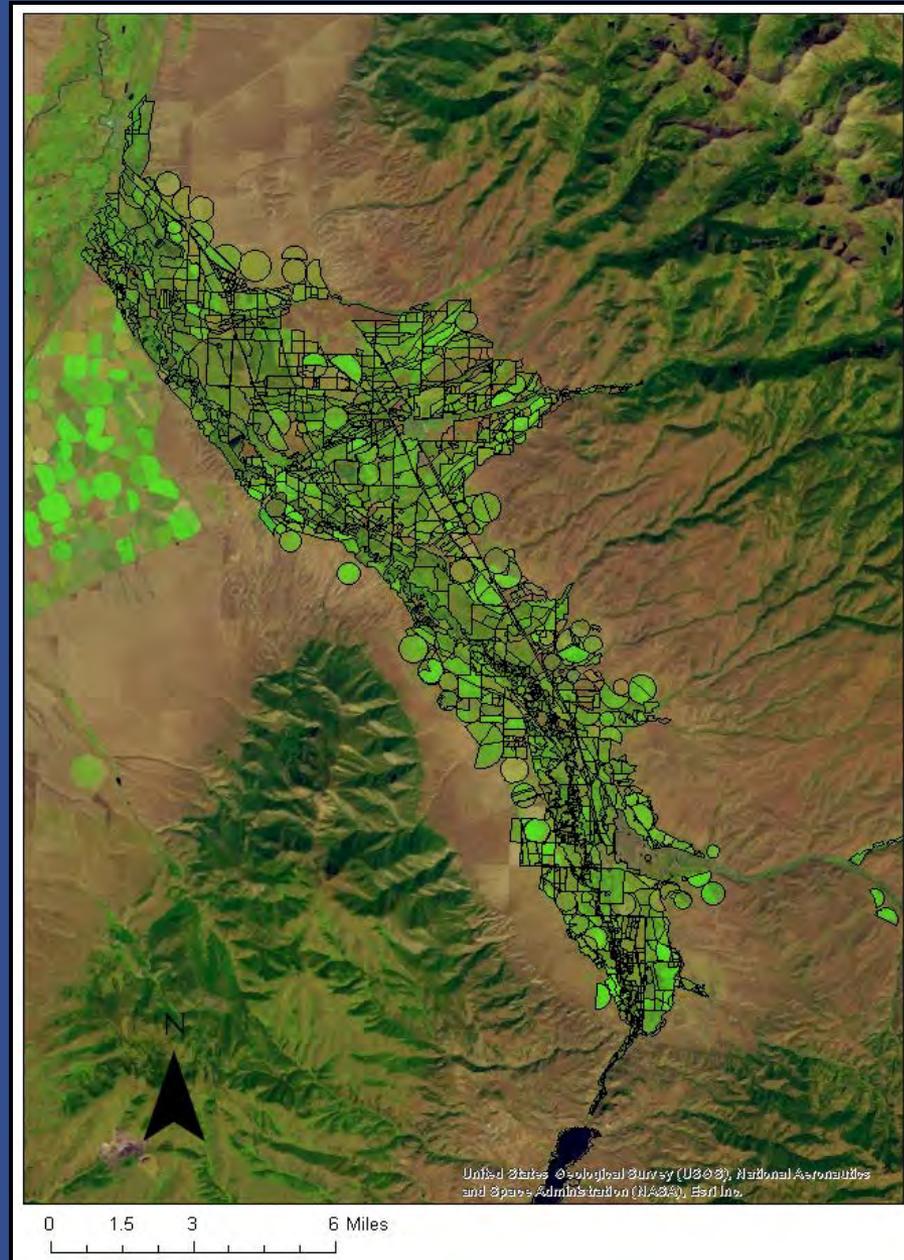
Missouri Headwaters Basin Study

Issues and Potential Adaptation Strategies

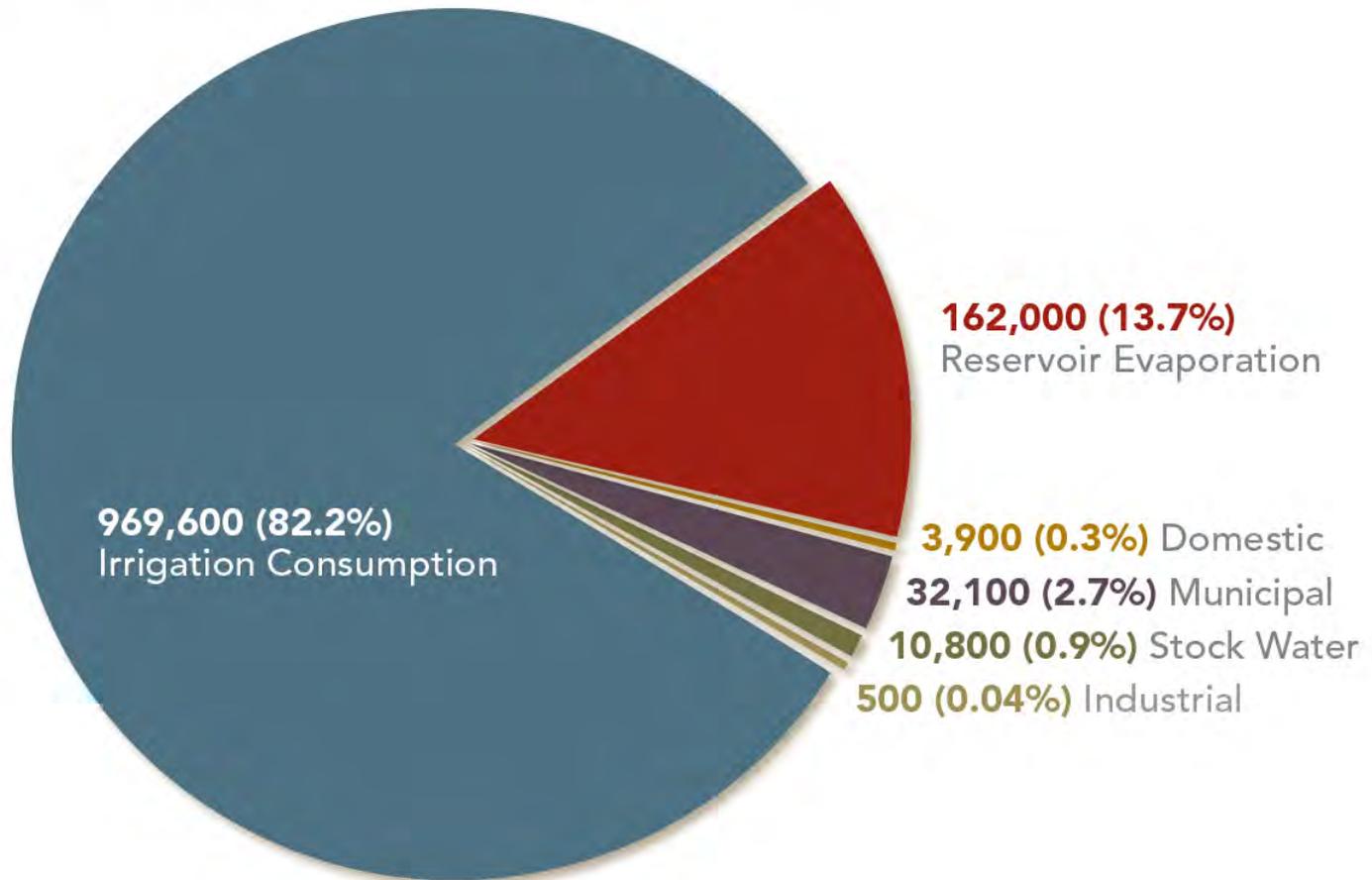


Irrigation in the Missouri Headwaters

Lower Ruby Valley
Landsat composite image
with irrigated lands delineated



UPPER MISSOURI RIVER BASIN CONSUMPTIVE WATER USE ANNUAL ACRE FEET



Irrigation Changes

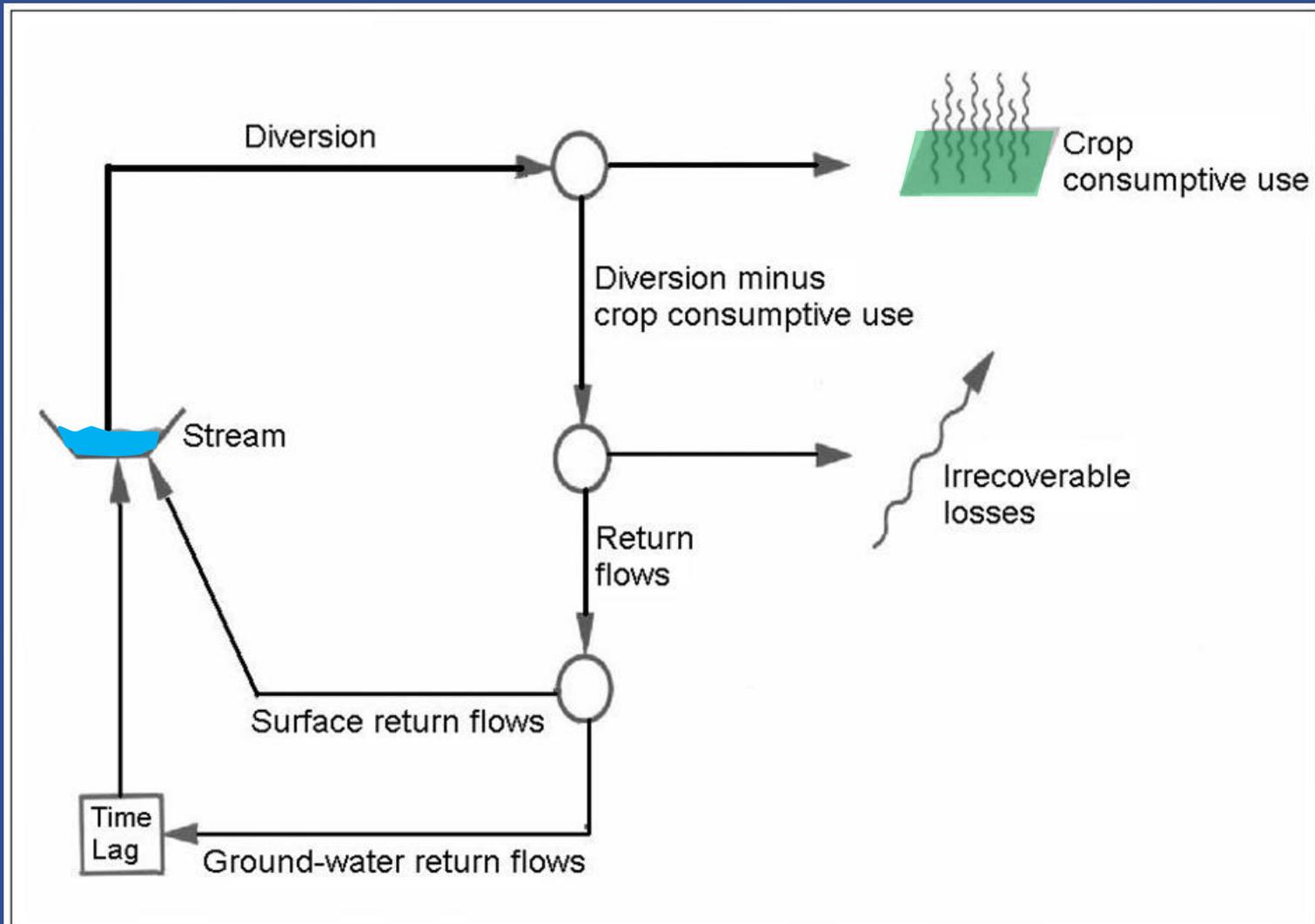


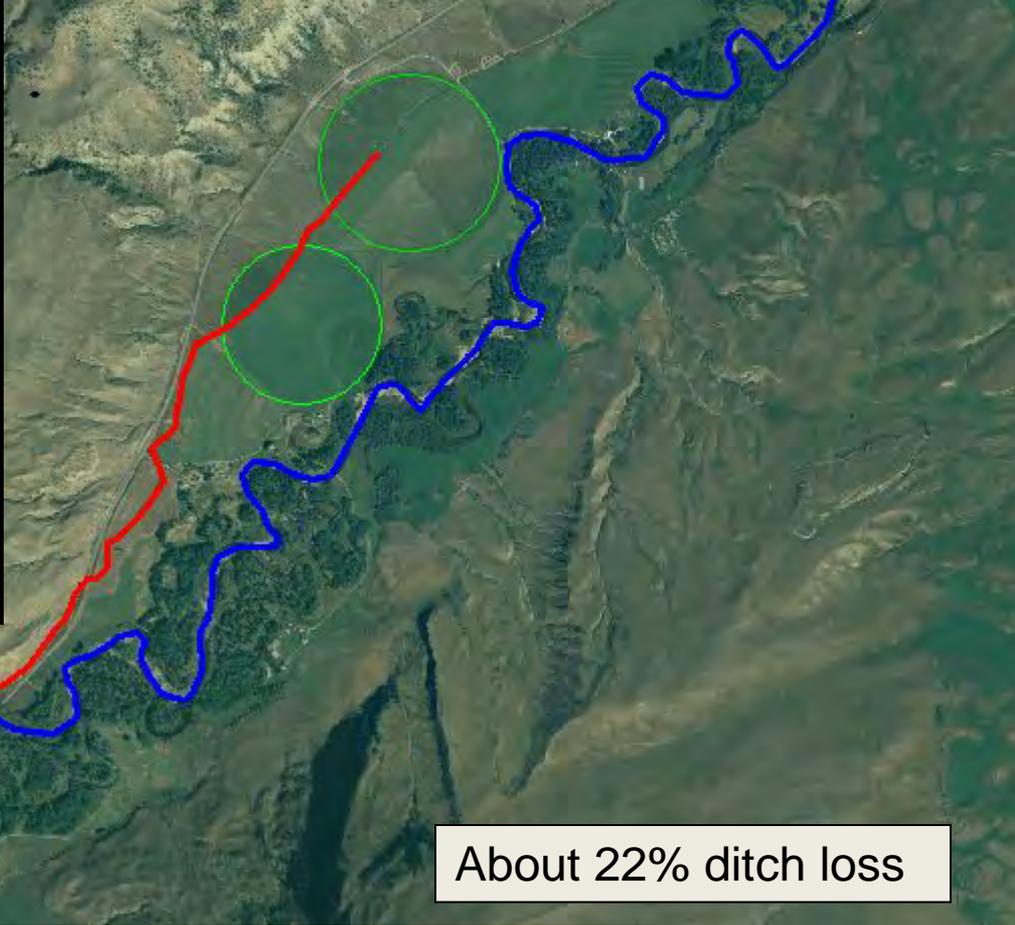
Flood Irrigation

Sprinkler Irrigation



Irrigation Water Use Schematic





About 22% ditch loss



Potential New Irrigation Development

- Basin Closures
 - Missouri Basin above Great Falls
 - Teton River Basin
- Water Contracting
 - Canyon Ferry Reservoir
 - Tiber Reservoir
- Water Reservations
 - Up to about 18,000 acres mostly below Great Falls

**WEST CHESTER IRRIGATION
PROJECT**

RECONNAISSANCE STUDY



**PREPARED FOR:
DNRC & USBR**

**PREPARED BY:
AQUONEERING
655-4460
JUNE 2005**

20,000 – 40,000 acres

Measures for Evaluating Impacts and Adaptation Strategies

- Irrigation deliveries
 - Average annual
 - Wet years
 - Dry years
- Irrigation shortages
- Irrigation consumptive use
- Irrigation allotments

Hydropower



Black Eagle Dam and Falls

UPPER MISSOURI RIVER BASIN WATER USE ANNUAL ACRE FEET

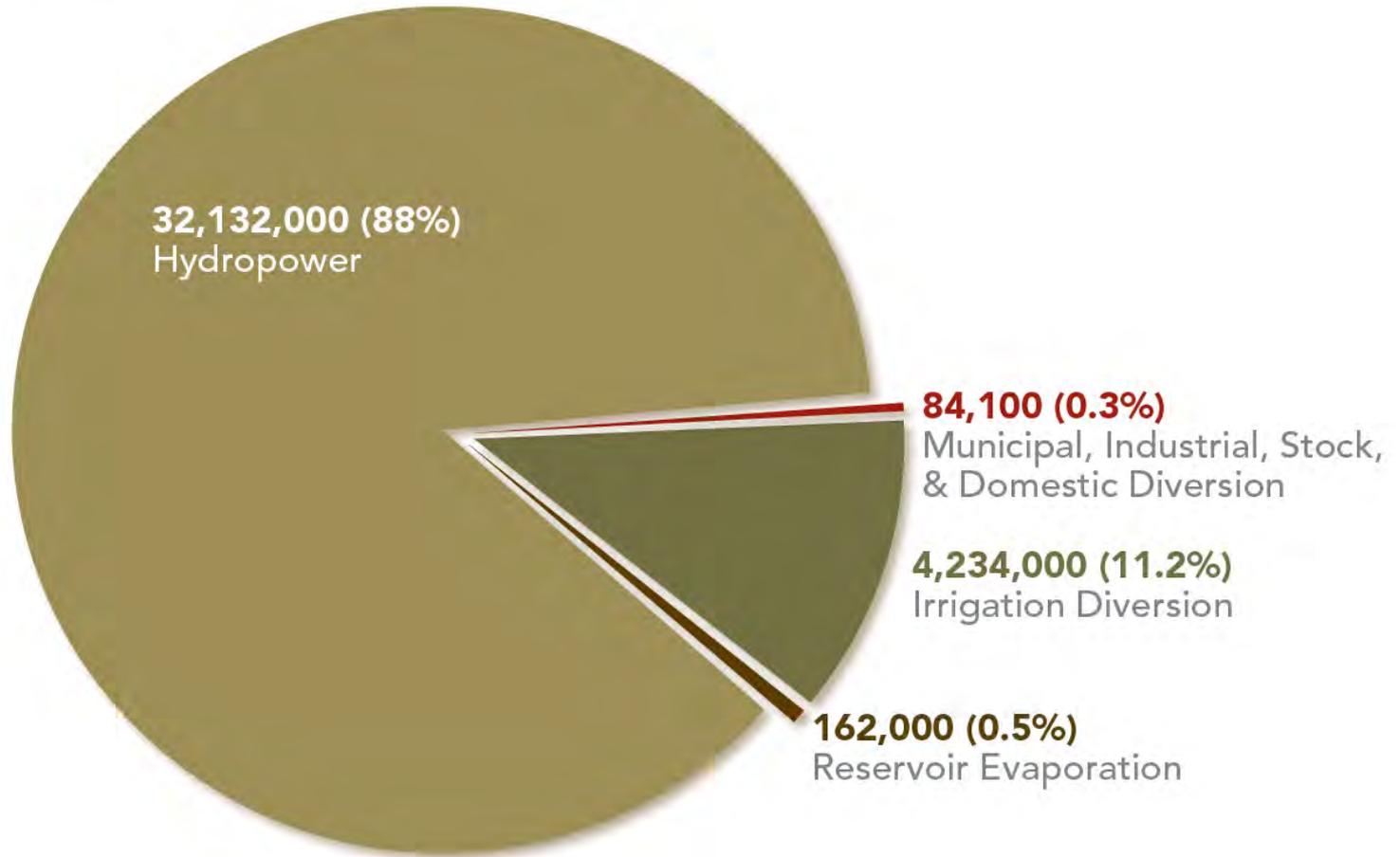


Table 3: *Hydroelectric generation facilities in the Upper Missouri planning basin above Morony Dam*

Owner/Operator	Facility	Water Right (cfs)	Generation Capacity (MW)
NorthWestern Energy	Morony Dam	8,280	48
NorthWestern Energy	Ryan Dam	5,900	60
NorthWestern Energy	Cochrane Dam	10,000	64
NorthWestern Energy	Rainbow Dam	8,000	60
NorthWestern Energy	Black Eagle Dam	5,040	21
NorthWestern Energy	Holter Dam	7,100	48
NorthWestern Energy	Hauser Dam	4,740	19
NorthWestern Energy	Madison Dam	1,650	9
U.S. Bureau of Reclamation	Canyon Ferry Dam	6,390	58
State of Montana/DNRC	Toston Dam	7,200	10

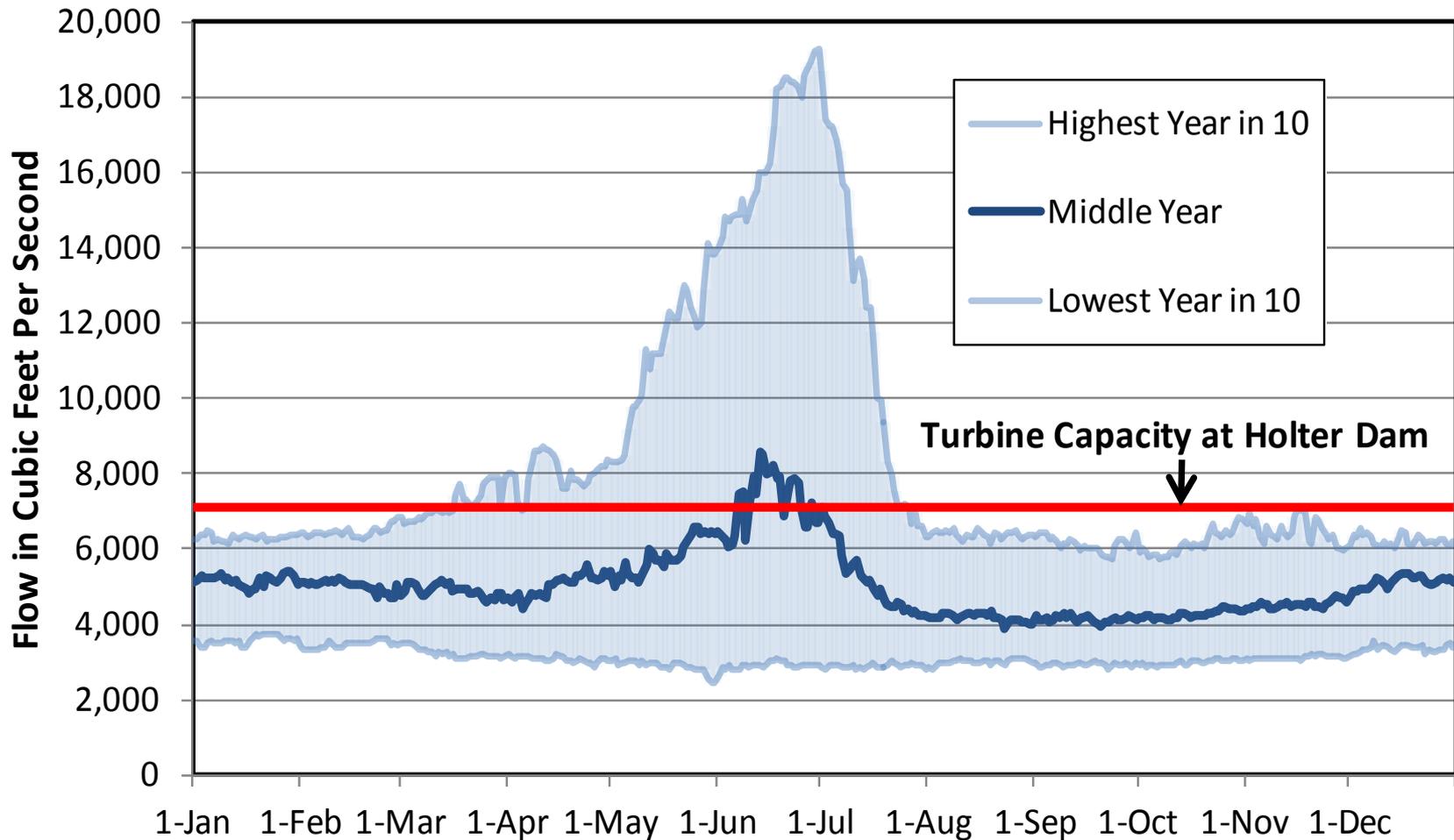
Turnbull Project GID: 13 MW

Tiber Dam: 7.5 MW

About 418 MW total

Missouri River below Holter Dam

Normal Range of Flow



Measures for Evaluating Impacts and Adaptation Strategies

- Total Hydropower Production
 - Average annual
 - Wet years
 - Dry years
- Headwaters Benefits Changes

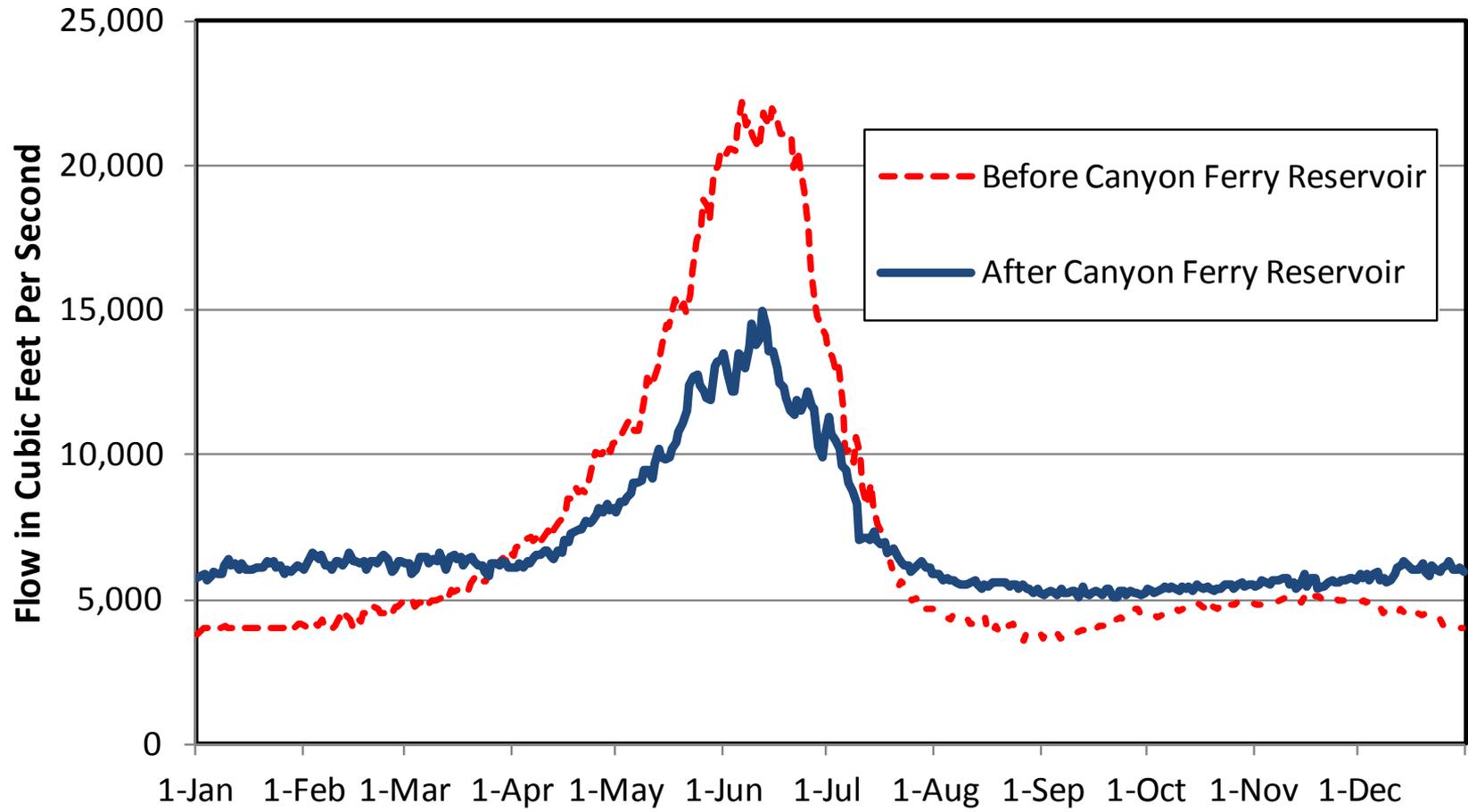
Ecological

Fish and Wildlife Habitat Endangered and Threatened Species



1 OF 120 FWP fisheries biologist Dave Fuller releases a wild adult pallid sturgeon, one of the rarest fish in North America.

Missouri River at Fort Benton Pre-Post Canyon Ferry Comparison



Big Hole River



Mike Roberts



Arctic grayling

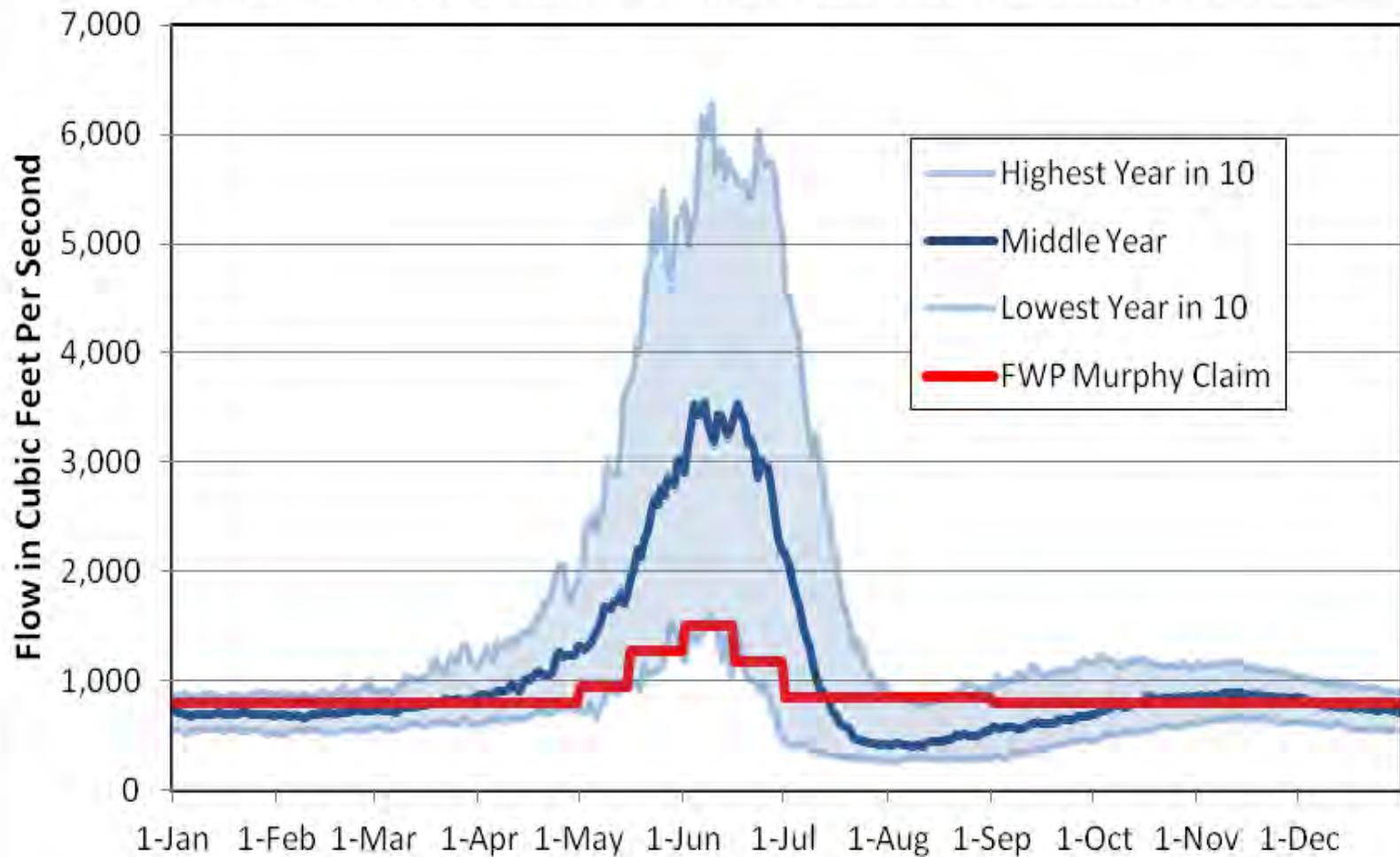


Photo credit: Emily Rens,
Montana Fish, Wildlife and Parks



Recreation

Gallatin River at Logan FWP Murphy Claim Compared to Normal Range of Flow



Riparian and Aquifer Recharge

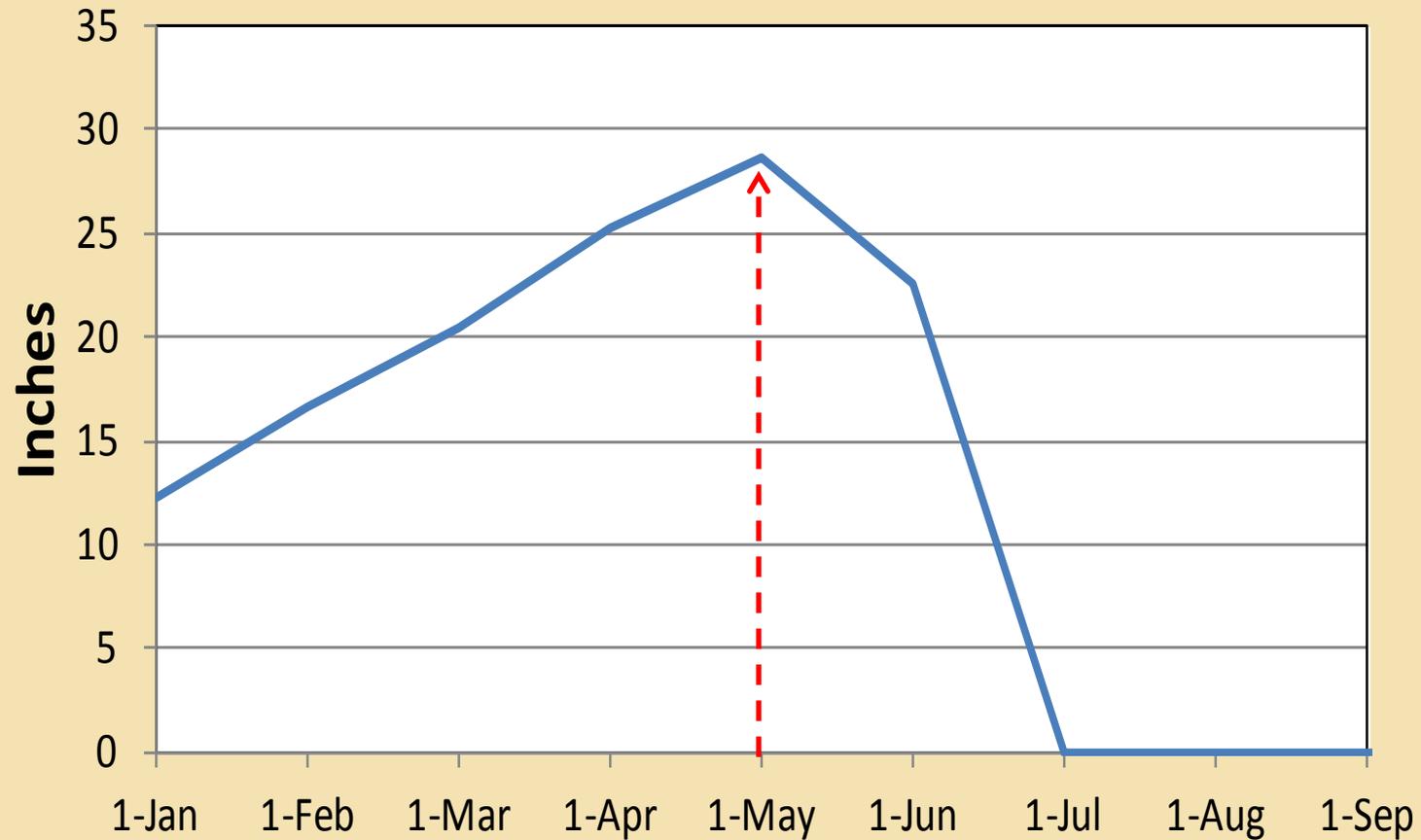


Snow



Carrot Basin SNOTEL Site

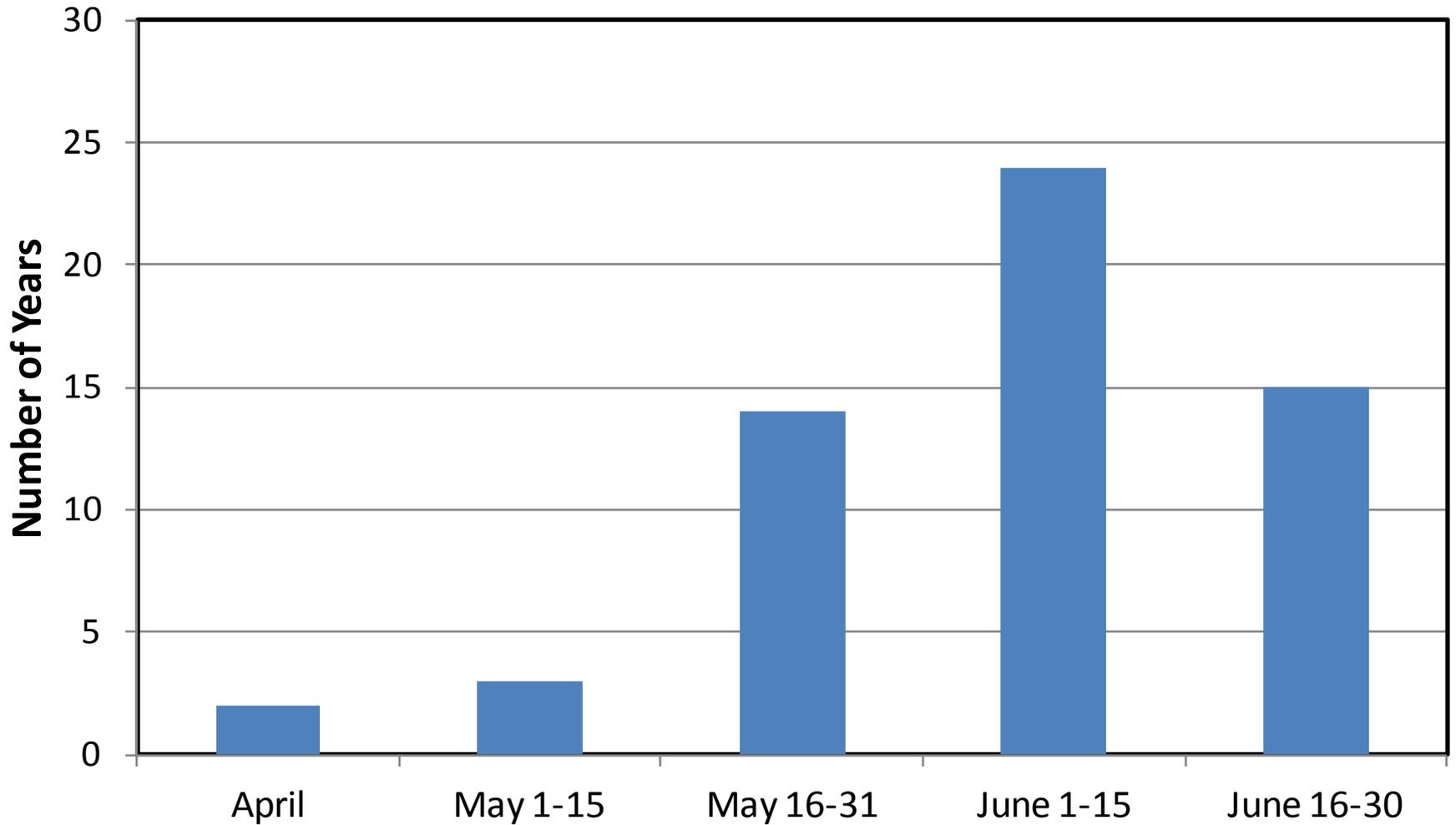
Normal Snow Water Equivalents (1981-2010 data)



Madison Range, Gallatin River Watershed: 9,000 feet
Average Annual Precipitation: 43 inches

Missouri River at Toston

Date of Peak Flow (1955-2012)



Measures for Evaluating Impacts and Adaptation Strategies

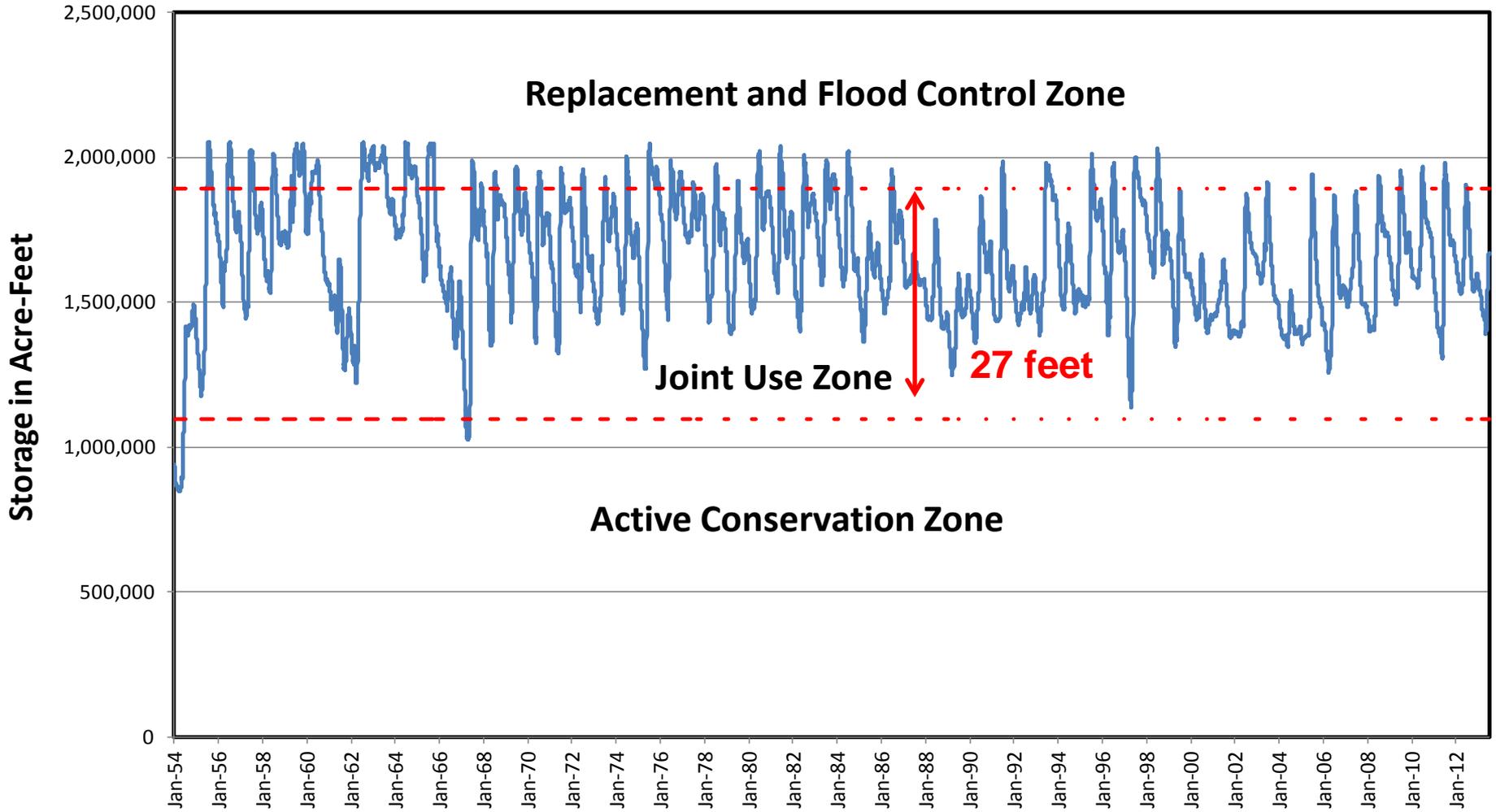
- Flow Distributions
 - Monthly
 - Daily
 - Percentile
- Date of flow peak or flow volume centroid
- Percent of time minimum instream flows are equaled or exceeded (Murphy Rights, Water Reservations)
- Percent exceedance of high and low flow conditions at various locations
 - 7-day minimum flow
 - 7-day maximum flow

Reservoirs

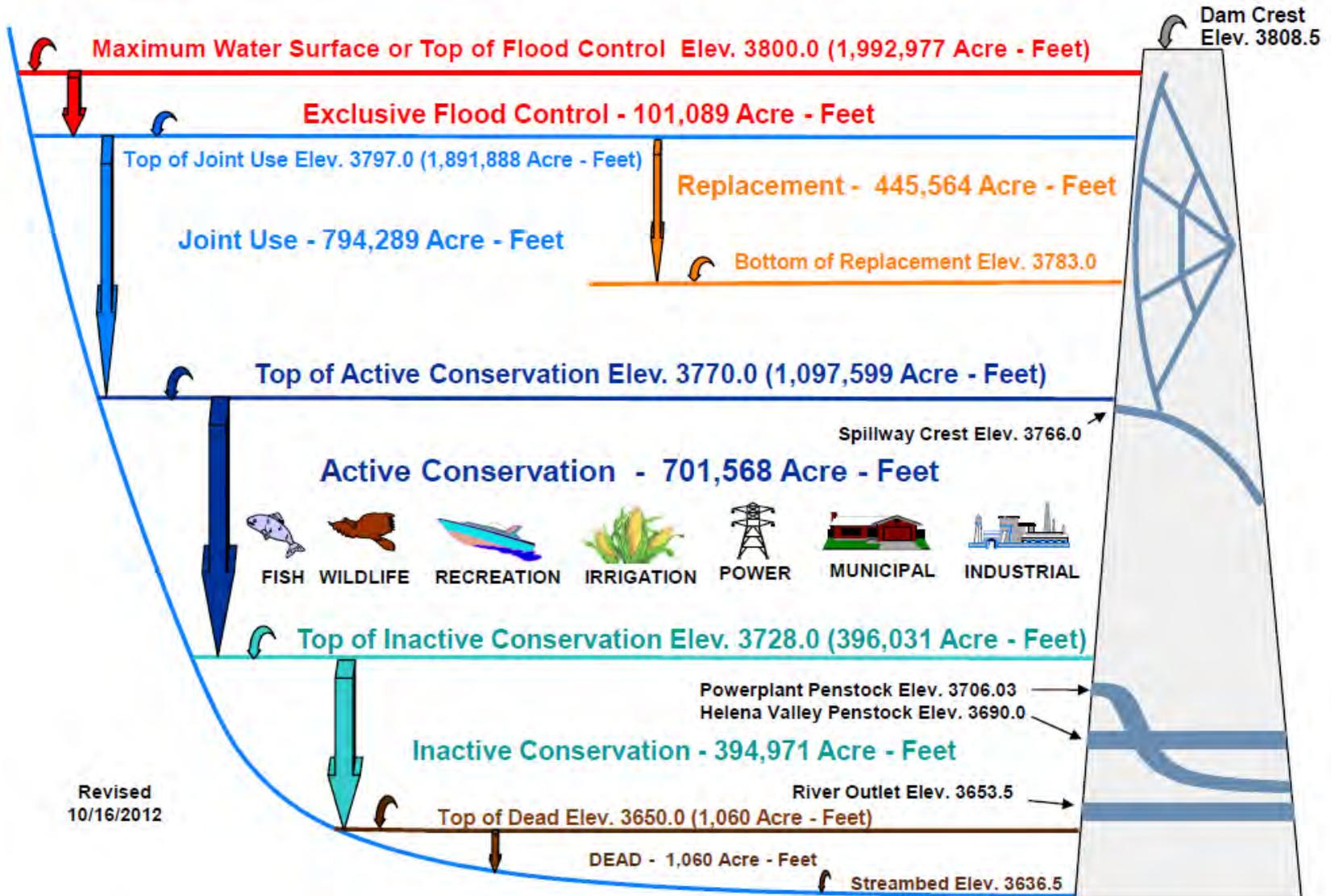
Canyon Ferry Reservoir



Canyon Ferry Reservoir Storage Through Time



CANYON FERRY RESERVOIR ALLOCATIONS



Revised
10/16/2012

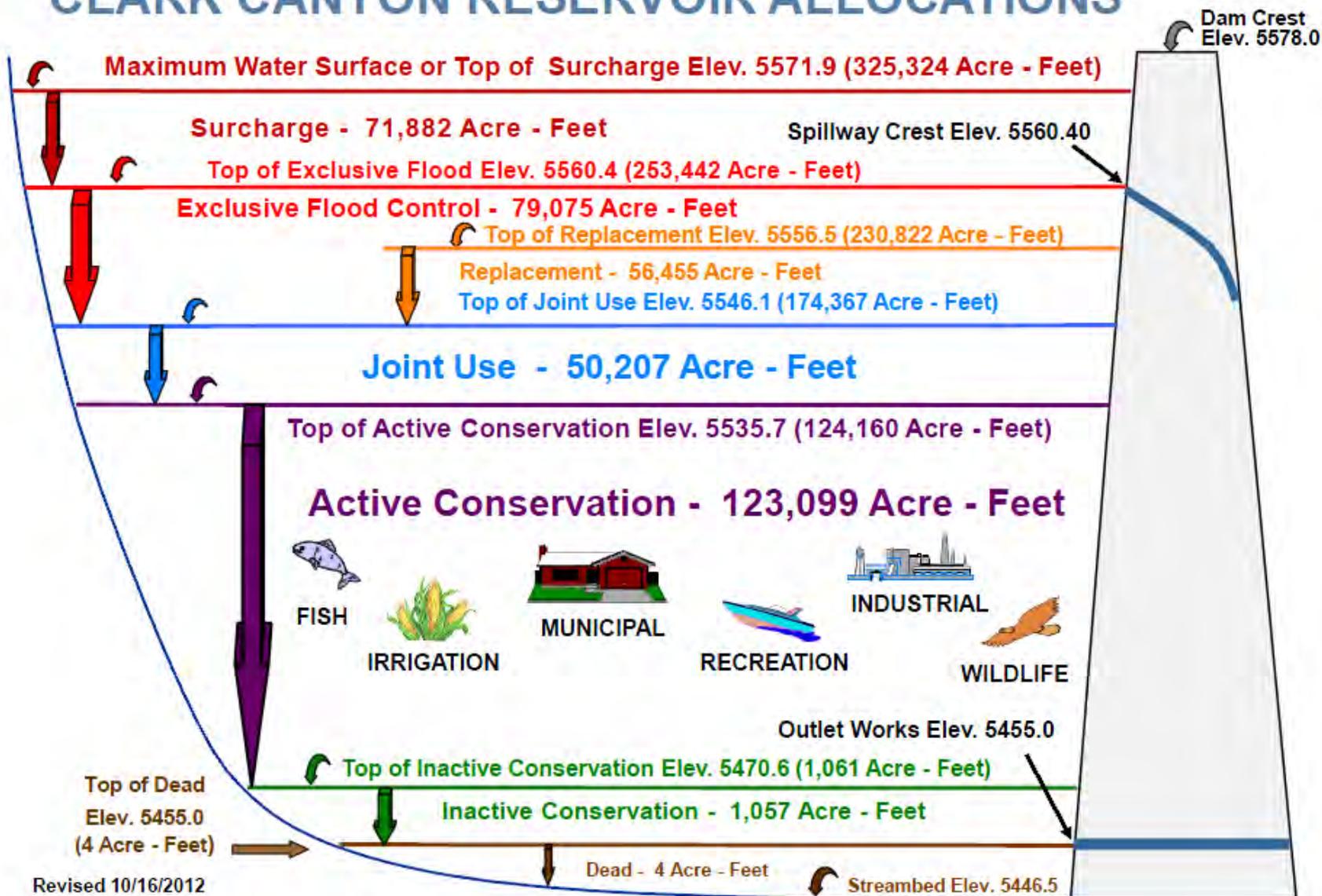
Gibson Reservoir Near the End of the Irrigation Season



Sun River



CLARK CANYON RESERVOIR ALLOCATIONS



Revised 10/16/2012

RECLAMATION

Managing Water in the West

FINAL ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT

CONVERSION OF LONG-TERM WATER SERVICE CONTRACTS TO REPAYMENT CONTRACTS

- CLARK CANYON WATER SUPPLY COMPANY
- EAST BENCH IRRIGATION DISTRICT



PICK-SLOAN MISSOURI BASIN PROGRAM
EAST BENCH UNIT



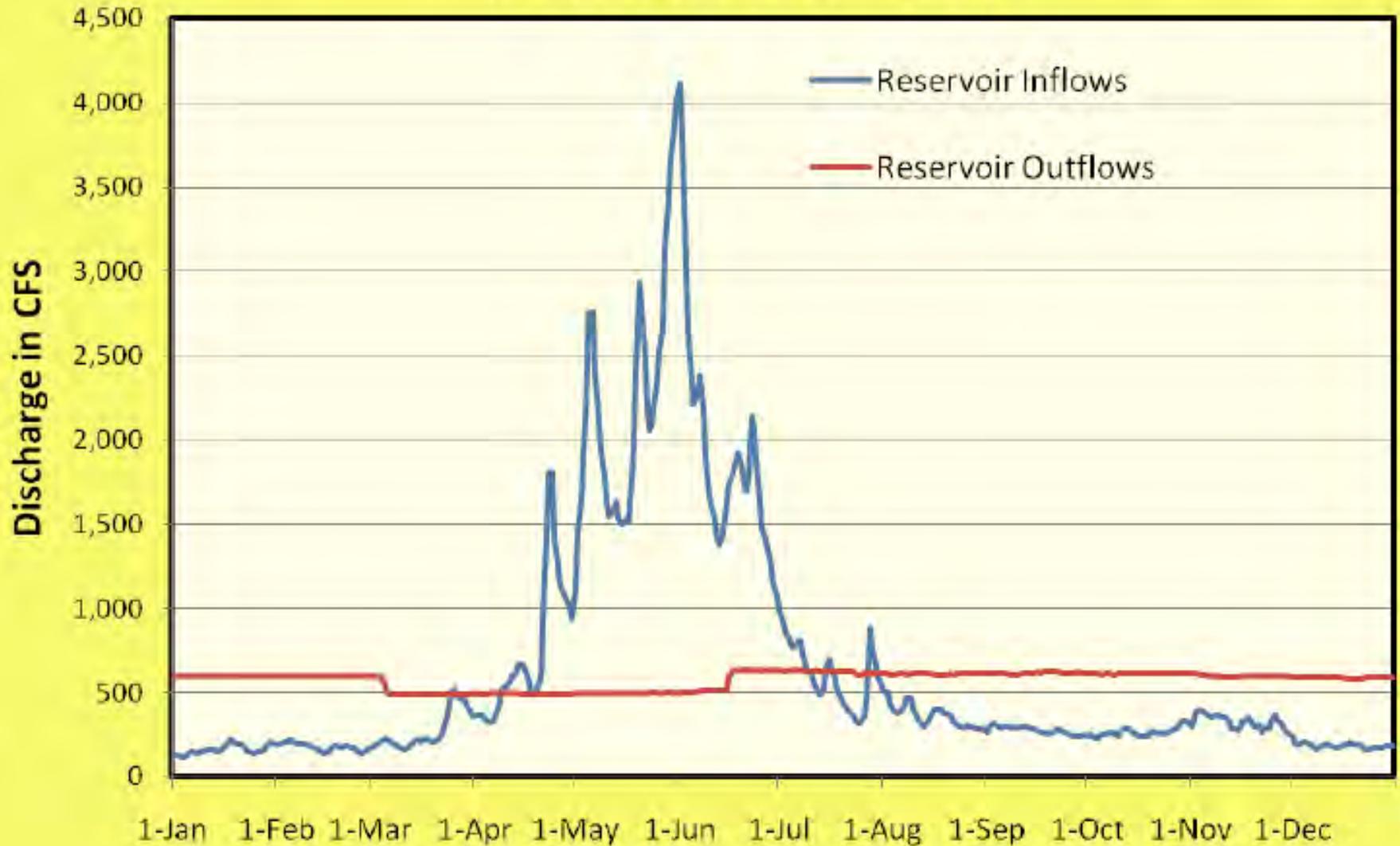
CLARK CANYON RESERVOIR, MONTANA



U.S. Department of the Interior
Bureau of Reclamation
Great Plains Region
Montana Area Office

November 2006

Marias River Inflow and Outflow To Tiber Reservoir 2009



Ruby Reservoir



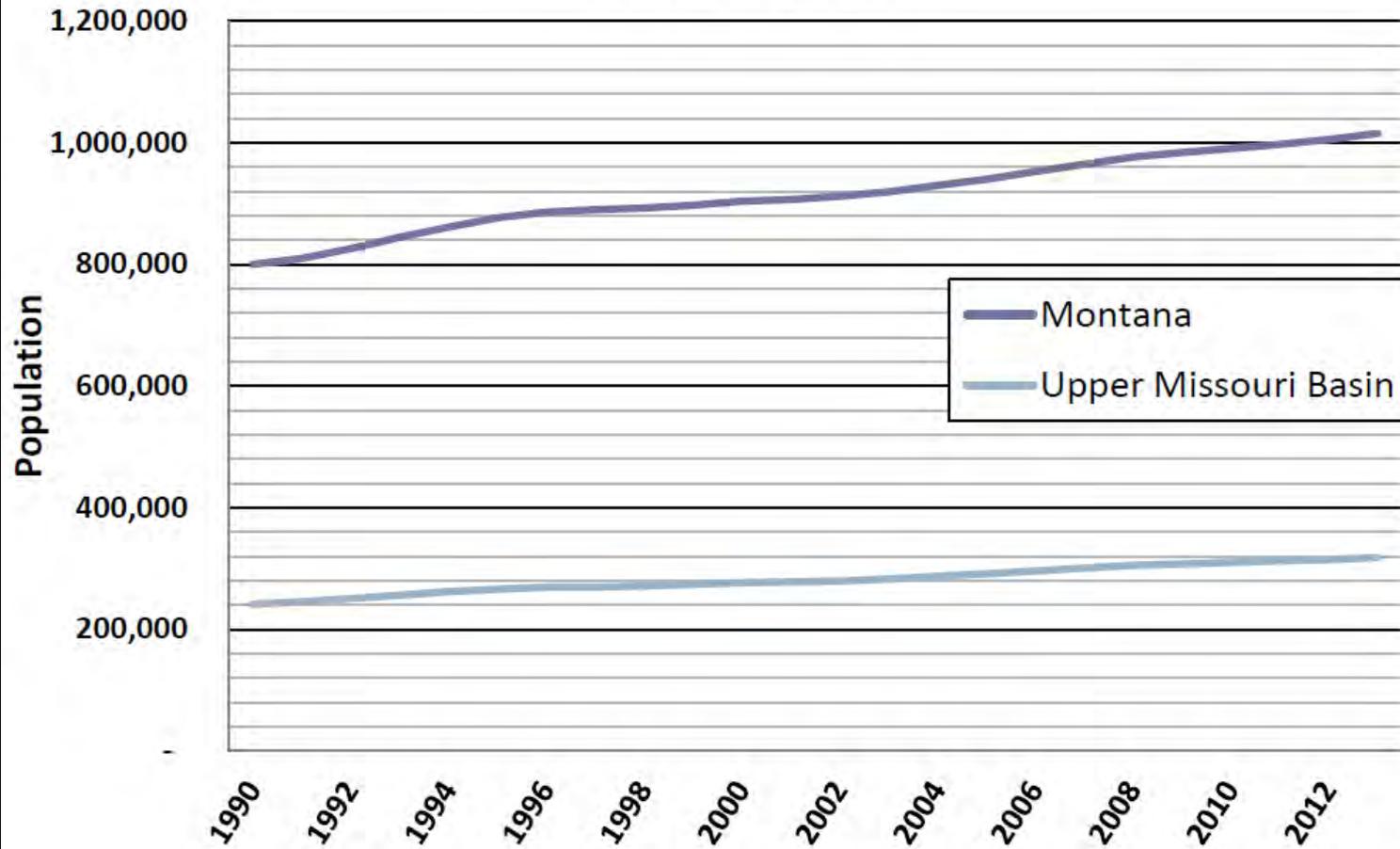
Measures for Evaluating Impacts and Adaptation Strategies

- Percent exceedance of identified reservoir elevations
 - Recreation targets
 - Flood control pool
 - Others
- End of September storage

Municipal, Domestic and Industrial Water Use



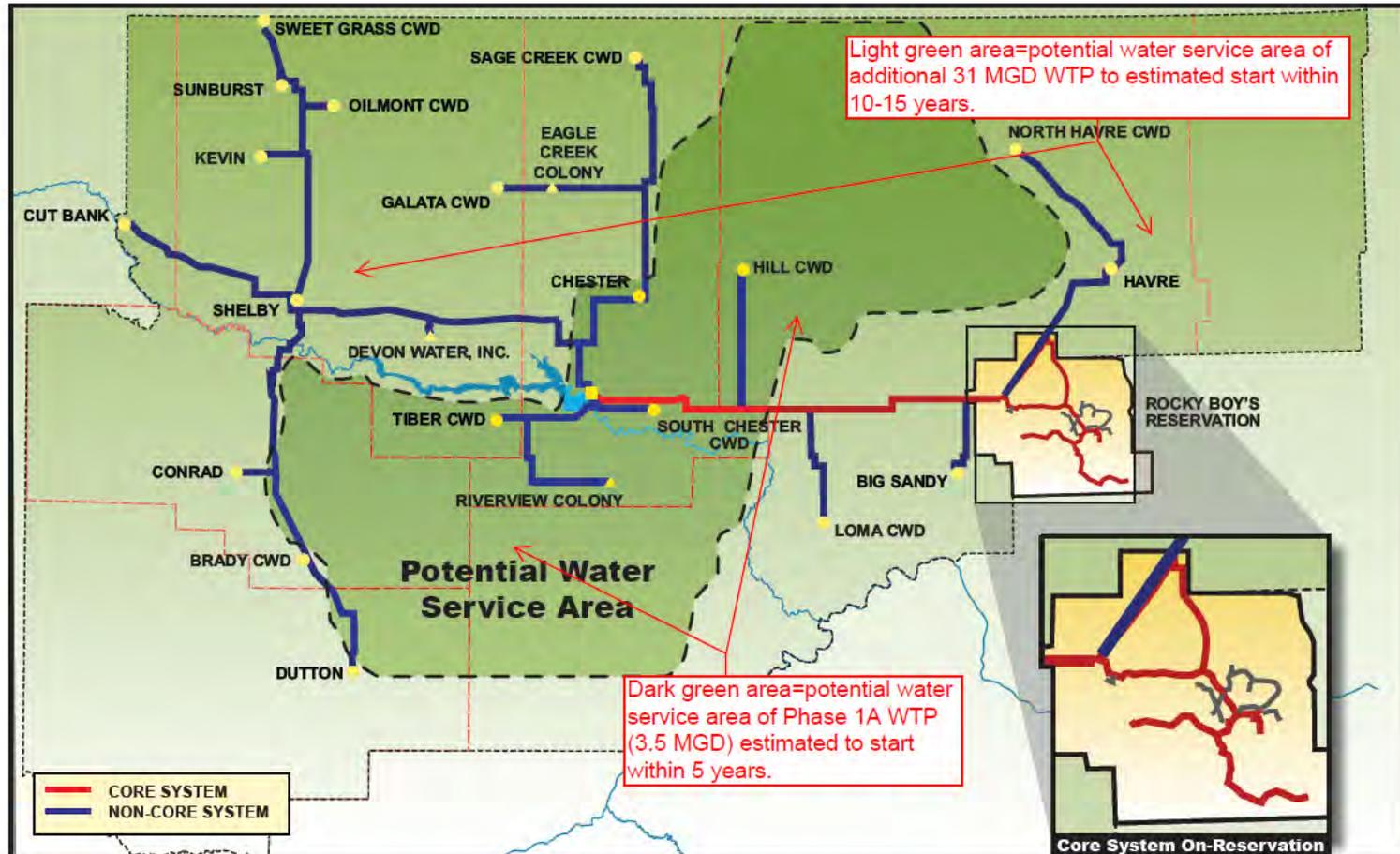
Population - Montana, Upper Missouri Basin 1990-2013



Rocky Boy's North Central Montana Regional Water Project Potential Service Areas

Project Map

January 2013



NOTE: The Chippewa Cree Tribe has use of up to 10,000 acre/feet of water from the Tiber Reservoir per their water settlement.

Federal Reserved Water Rights



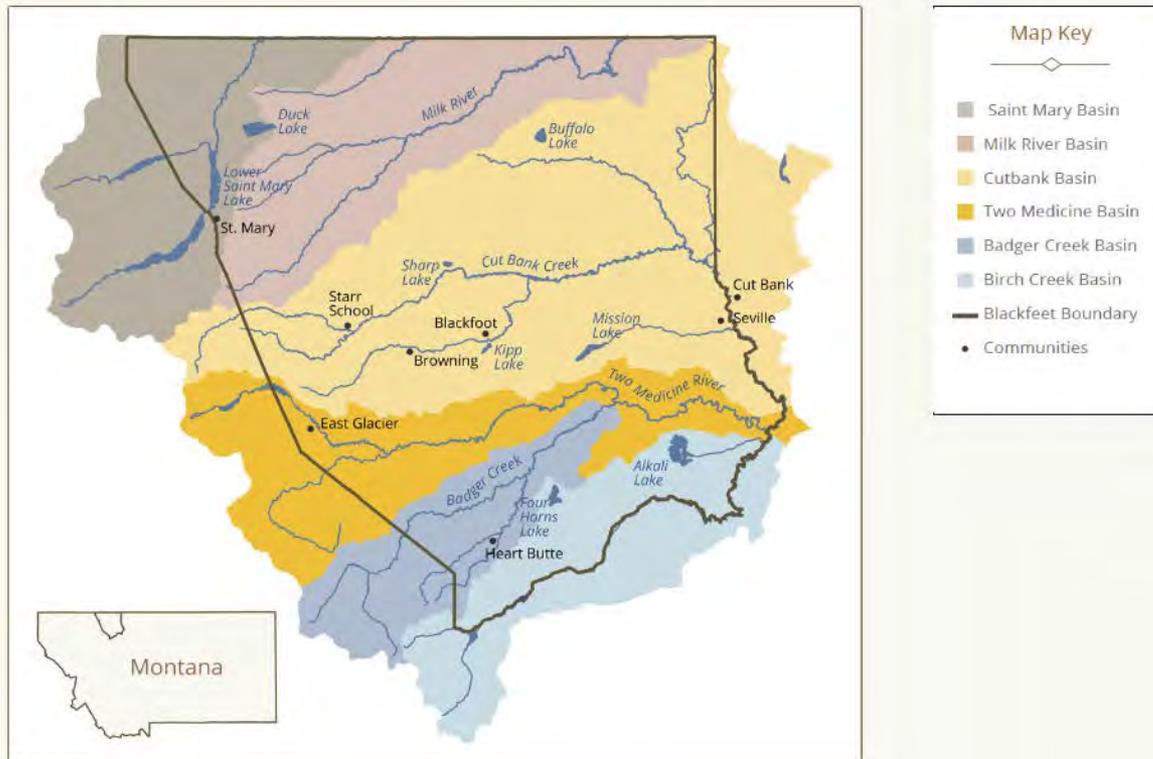
BLACKFEET NATION

WATER COMPACT
Learn more about Blackfeet
Nation's water compact.

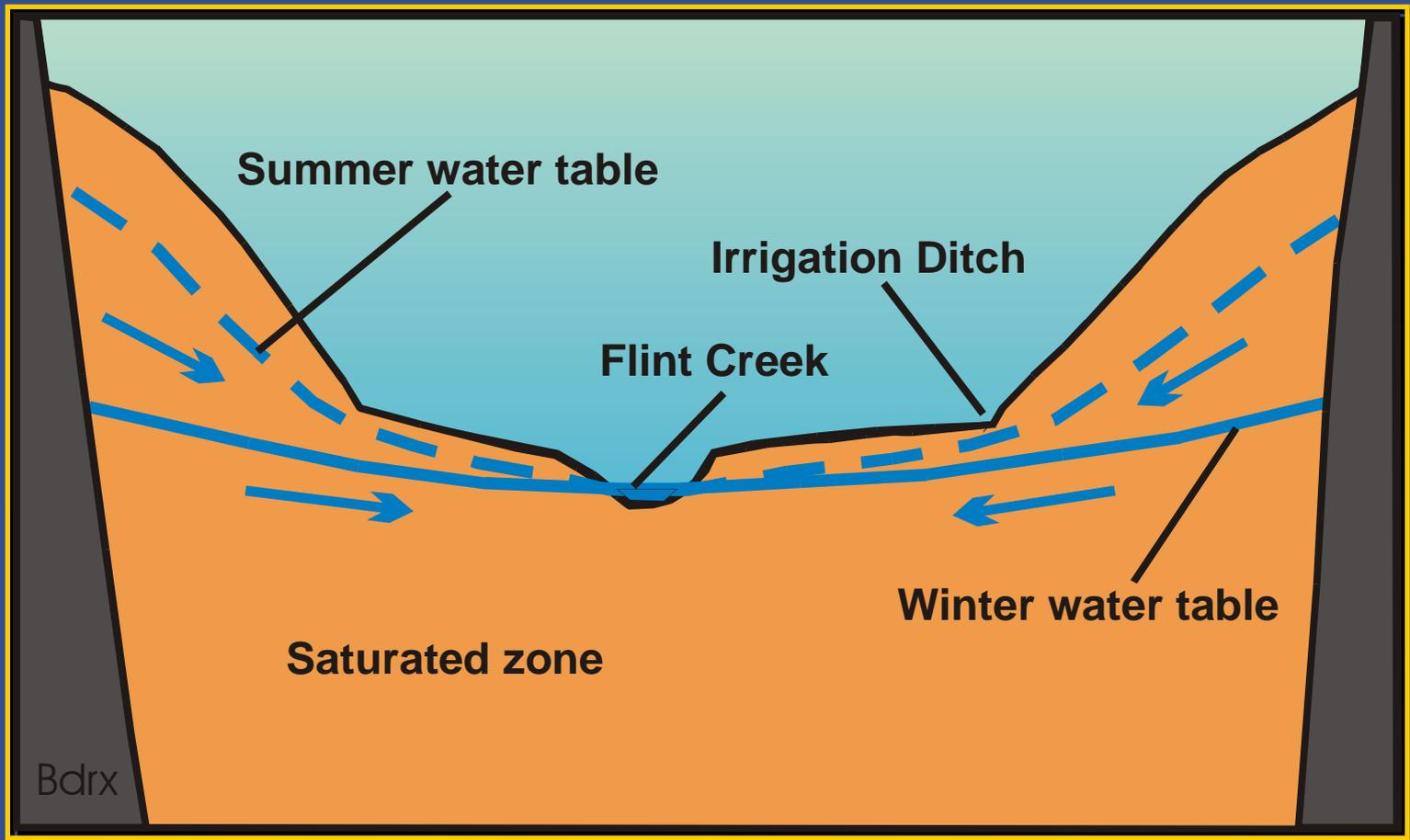
[Our Culture](#) [Our Lands](#) [Our Government](#) [Tribal Directory](#) [Water Compact](#)

PROPOSED PROJECTS

A finalized water rights agreement would provide more than \$450 million in federal funding for projects that would provide important improvements to watersheds, as well as jobs and benefits for members of the Blackfeet Nation. The projects in the settlement focus on improved water usage on the Reservation for community water supplies, irrigation, fisheries, recreational lakes, energy projects, resolution of environmental issues and other water related uses.



Groundwater Recharge Associated with Irrigation



Potential Effect to Streamflow Associated with Groundwater Pumping

