



— BUREAU OF —
RECLAMATION

Missouri Headwaters Basin Study

October 12, 2021

Canyon Ferry Reservoir



Agenda

- Upper Missouri River basin overview
- Study partners - State of Montana DNRC
- Structure and Objectives
- Study Approaches
- Adaptation Strategies and Key Findings
- Next steps
- Report materials





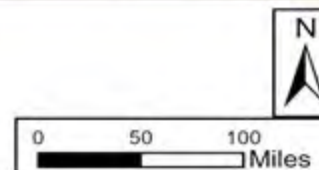
BUREAU OF
RECLAMATION

Missouri Headwaters Basin Study Area



Legend

- | | | | |
|--------------------------------------|---------------------------|------------------------------------|--------------|
| Missouri Headwaters Basin Study Area | Missouri Basin Reservoirs | Select Stream Gage Locations | Cities/Towns |
| Missouri River Hydrologic Basin | Select Reclamation Dams | Missouri Basin Indian Reservations | |
| Missouri Basin Rivers | National Parks | States | |



Study Area

- Location
 - Upper Missouri River basin upstream of Fort Peck Reservoir, including Musselshell River basin (50,000 square miles total)
 - Reclamation is the primary federal agency responsible for reservoir operations
- Major Reservoirs
 - Federal include Canyon Ferry, Tiber (Lake Elwell), Clark Canyon, Gibson Reservoirs
- Reclamation Projects
 - Pick-Sloan Missouri Basin Program (East Bench, Crow Creek, Canyon Ferry, Helena Valley, Lower Marias)
 - Sun River Project



Water Management Challenges



- Missouri River basin upstream of Great Falls closed to new water appropriations since 1993 by State of Montana, with minor exceptions for groundwater and water storage.
- Annual water demand in Gallatin County (City of Bozeman) is expected to at least double by 2080.
- Missouri River hydropower producing facilities have relatively senior water rights, leaving little flexibility for junior water rights holders to divert water in study area.
- Endangered Species Act (ESA) listed species - pallid sturgeon, and Montana Species of Concern - the fluvial Arctic grayling and west-slope cutthroat trout.
- Renowned trout fisheries of the Big Hole, Gallatin, Beaverhead, Jefferson, Madison, Smith, and Missouri Rivers.



Study Objectives

- Inform stakeholders of current and future water supply challenges
- Identify and evaluate strategies for improving resiliency to these challenges and for improving water supply reliability

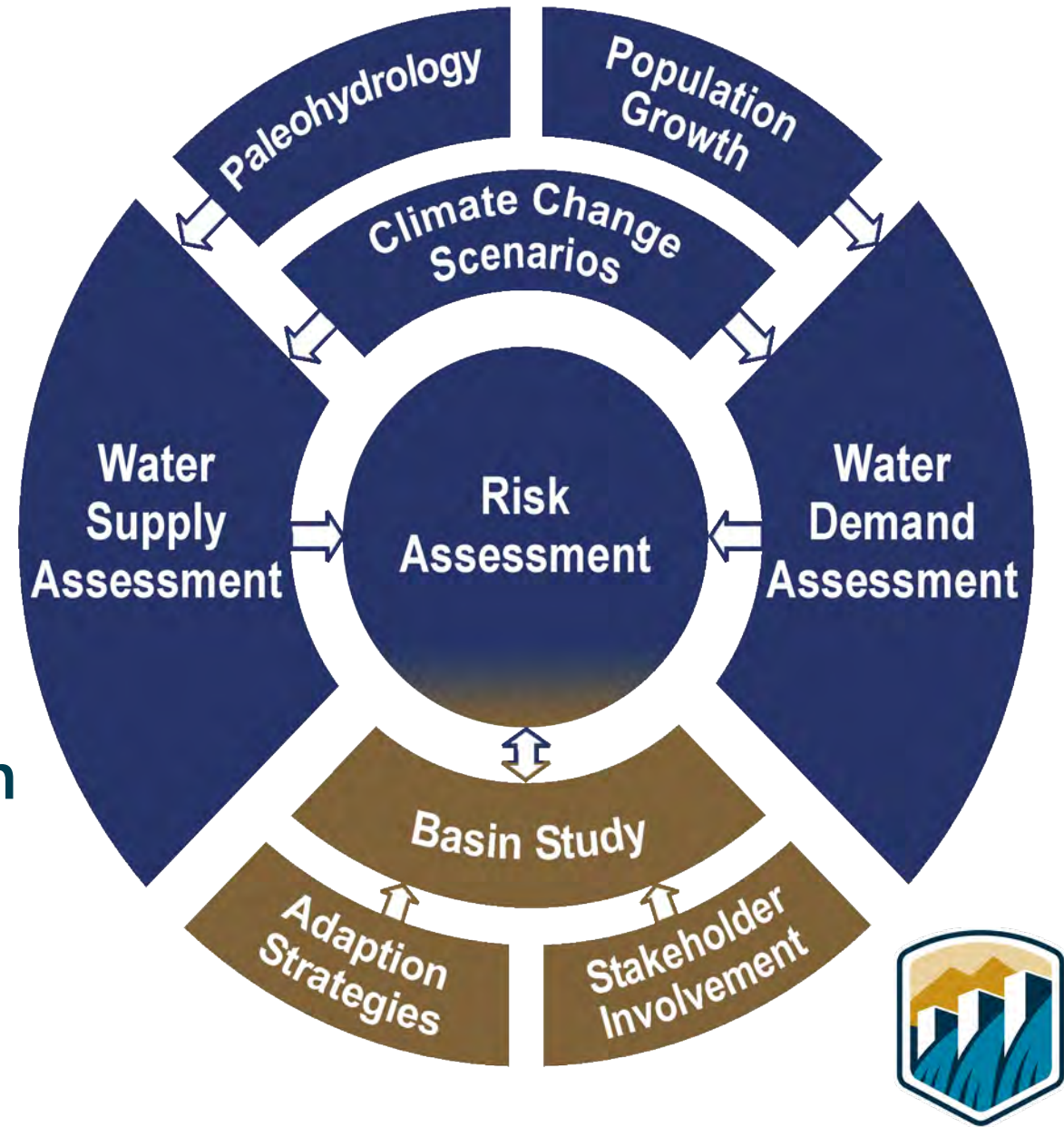


Clark Canyon Reservoir



Study Structure and Partners

- Upper Missouri Basin Impacts Assessment completed by Reclamation with support from MT DNRC (March 2019)
- Missouri Headwaters Basin Study involved cost-sharing by Reclamation and MT DNRC
- USGS Northern Rocky Mountain Science Center collaborated in both studies by providing expertise in paleohydrology



Collaboration and Outreach

- Local watershed groups & conservation districts
 - Sun River Watershed Group
 - Musselshell Watershed Coalition
 - Beaverhead Watershed Committee
 - Ruby Watershed Committee
 - Liberty County Conservation District
 - Montana DNRC State Water Projects Bureau
 - East Bench Irrigation District, Helena Valley Irrigation District
 - Great Northern Landscape Conservation Cooperative



- Blackfeet Tribe
- National Drought Resiliency Partnership Montana Pilot Project
- Missouri Headwaters WaterSMART drought contingency planning process



Study Approach

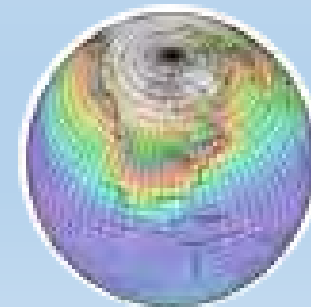
- Basin Study components
 - Assessment of historical and future water supply and demand
 - Assessment of water management impacts under current operations
 - Identification and evaluation of strategies for mitigating vulnerabilities
- Using a range of techniques provides a robust evaluation of potential future conditions
- Scenarios allow for stress testing the managed river system under current operations and proposed strategies



Distant past records



Observed stream gage records

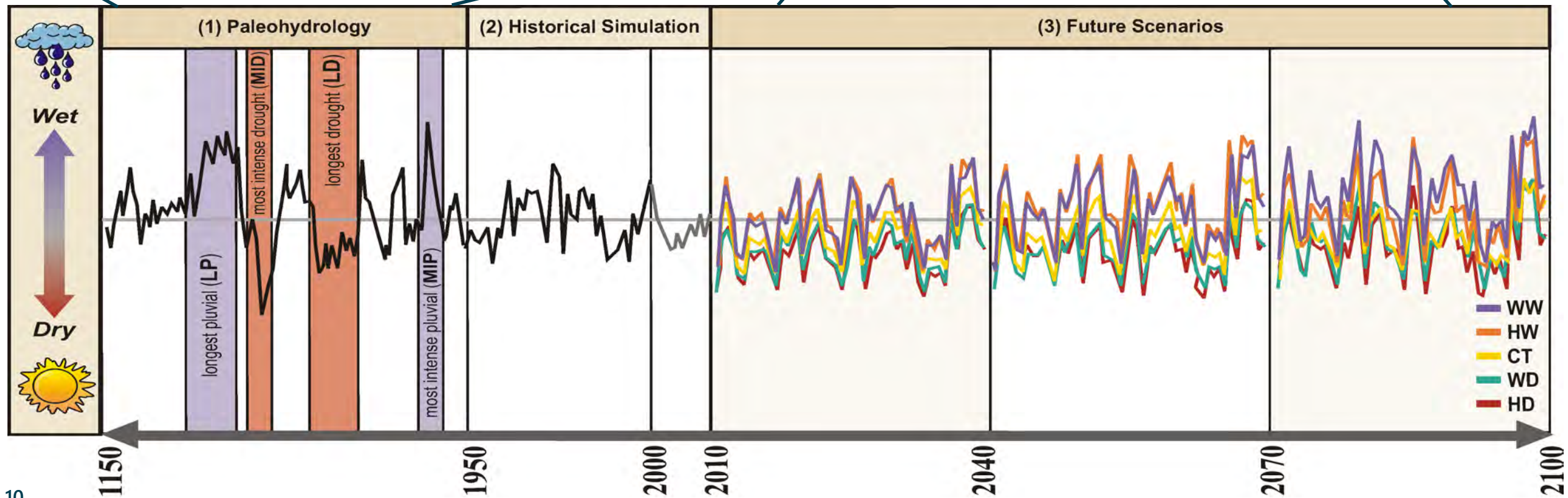


Future hydroclimate projections

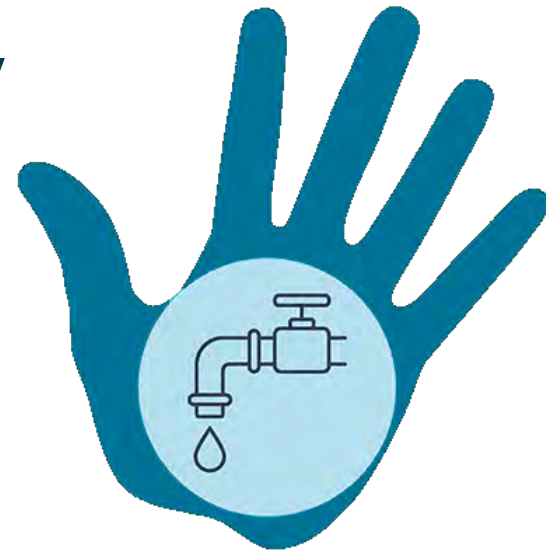
Study Approach

Paleohydrology involves use streamflow reconstructions based on tree-rings going back centuries before stream gages were installed

Future projections provide our best estimates of conditions to the end of the 21st century based on assumptions of socio-economic activity



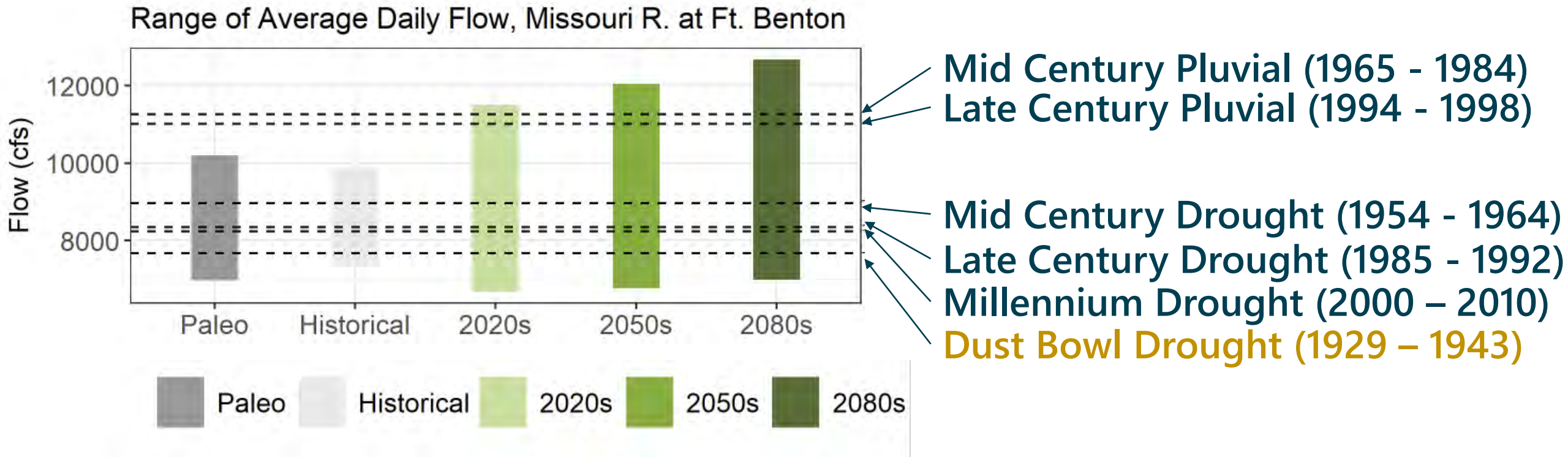
Projected Changes in Water Supply and Demand



- Warming in all months, increased cool season precipitation, and decreased summer precipitation
- Warming temperatures resulting in less snowpack, earlier peak runoff, and reduced summer streamflow
- Reclamation's Missouri River Reservoirs may experience roughly 10 percent more springtime days occupying flood control space
- Warming will result in increased evaporation and agricultural demands - projected precipitation increases will not entirely offset demands
- Decreases in end of the water year storage in most of the reservoirs
- Results are consistent with 2021 SECURE Water Act Report



Modeled Annual Streamflow



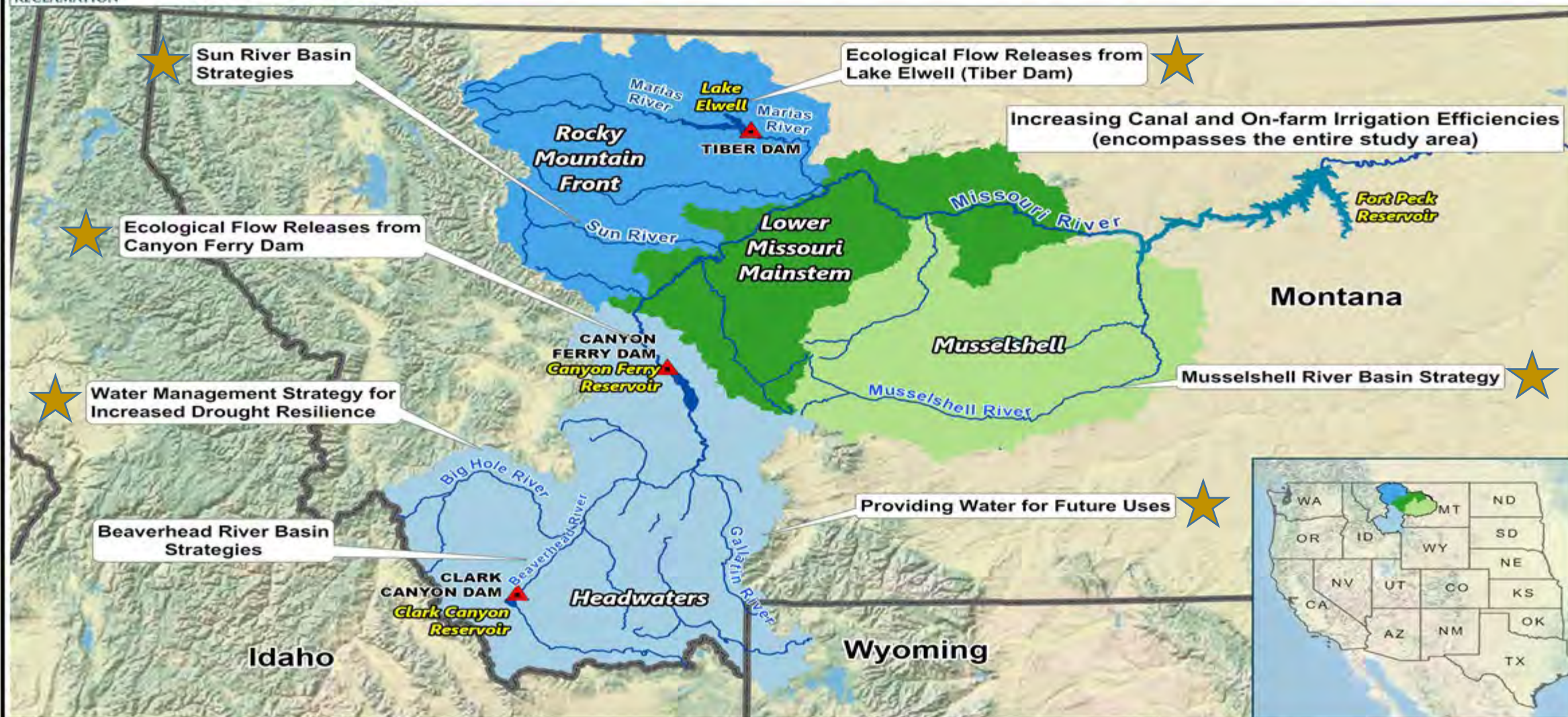
Main Takeaways

- Range of annual flow over last 900 years is greater than over the historical period
- The range of projected future annual flows is broader than over the historical and paleo periods
- Extended droughts are management challenges due to lack of multi-year storage
- Reservoirs may fill in individual years encompassed by droughts, reducing overall impact



BUREAU OF
RECLAMATION

Overview of Strategy Locations



Legend

- | | | | |
|-------------------------|-----------------------------|----------------------|-------------------------|
| Select Reclamation Dams | Other Missouri Basin Rivers | Regions | Lower Missouri Mainstem |
| Reservoirs | States | Rocky Mountain Front | Musselshell |
| Missouri River | | Headwaters | |



0 25 50
Miles

Potential Adaptation Strategies to Address Vulnerabilities



Strategy

- Providing Water for Future Uses (non-agricultural use in Gallatin Valley)
 1. High-capacity groundwater wells with groundwater recharge
 2. Conceptual pipeline from Canyon Ferry to the Gallatin Valley

Key Finding

- Additional Gallatin Valley domestic water through surface and groundwater conjunctive use or Canyon Ferry Reservoir pipeline could meet demands without impacting local water conditions



Potential Adaptation Strategies to Address Vulnerabilities



Strategy

- Ecological Flow pulse releases from Canyon Ferry and Lake Elwell – to benefit pallid sturgeon spawning above Ft. Peck Reservoir

Key Finding

- Wetter basin conditions maintain or increase opportunities for ecological flow releases benefiting fish and wildlife habitat



Potential Adaptation Strategies to Address Vulnerabilities



Strategy

- Increase Willow Creek and Pishkun Supply Canals to supply reservoirs and assist in meeting future demands

Key Finding

- Modest dry year benefit in the Sun basin, reducing irrigation shortages and increasing reservoir end of water year storage



Potential Adaptation Strategies to Address Vulnerabilities



Strategy

- Exploration of new off-stream reservoir in the Lower Musselshell River basin to increase late summer irrigation

Key Finding

- A new off-stream storage reservoir would generally increase flows in the Musselshell River during critical summer months



Potential Adaptation Strategies to Address Vulnerabilities



Strategy

- Build drought resilience capacity in upper Missouri River Basin and continue to work with stakeholders throughout basin to prepare for drought instead of reacting to drought

Key Finding

- Demonstration project for drought resilience in the Big Hole basin indicates that voluntary flexible instream flow targets provide multiple benefits without substantial impacts to irrigation



Key Benefits of Basin Study

- Development of **new tools**, data, and methods (i.e. paleohydrology)
- **Improved understanding** of water supply and demand in the basins, including distant past droughts
- **More effective communications** in the basin
- **Improved collaboration** with regional partners



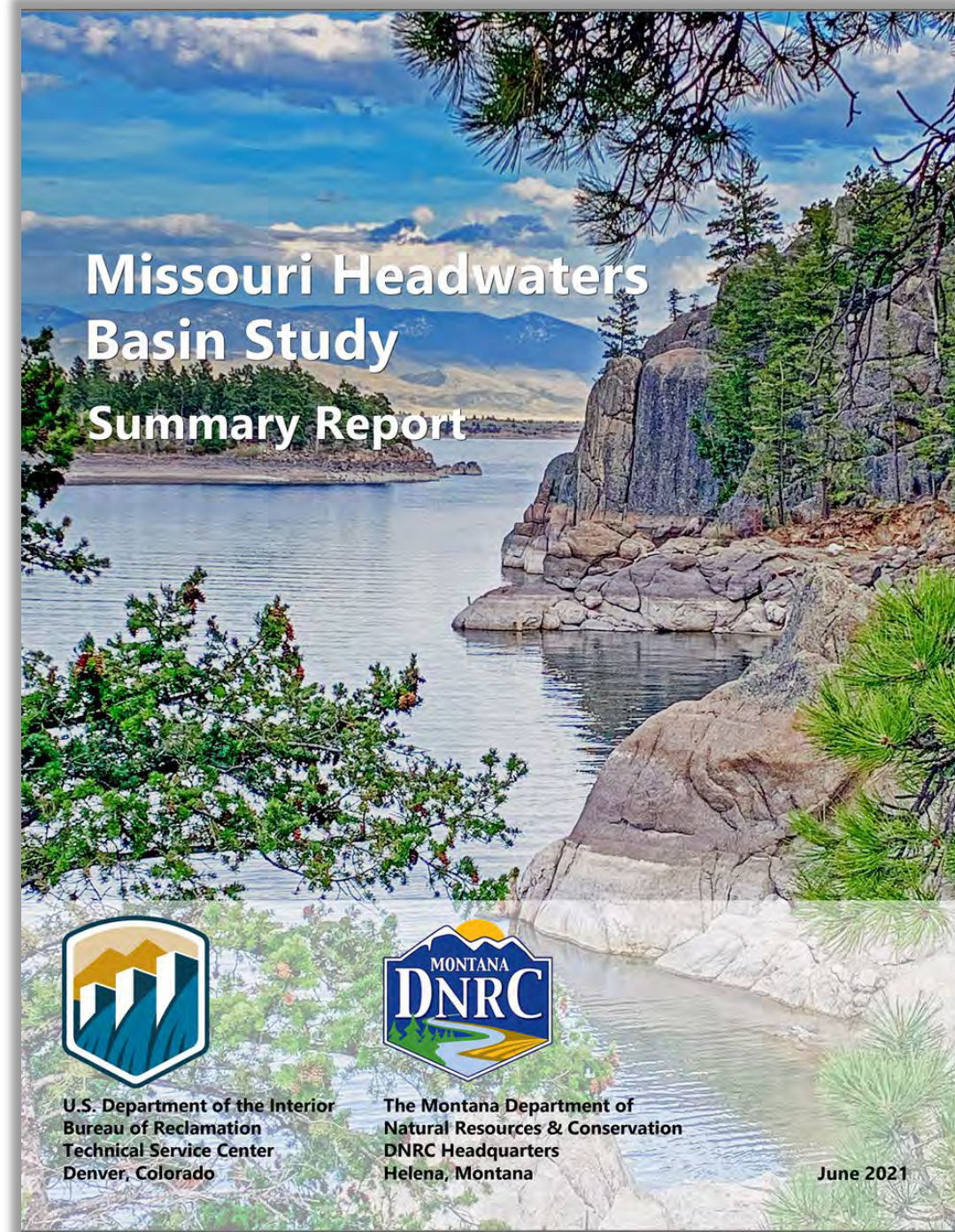
Next Steps

- The information developed in the Missouri Headwaters Basin Study was foundational for Reclamation's 2021 SECURE Water Act Report and may be used for further analysis in the Upper Missouri River basin and beyond
 - Approaches for developing and using paleohydrology information in the Basin Study are being further utilized in the St Mary and Milk Rivers Basin Study Update.
 - The Upper Missouri RiverWare planning model is already being used to inform and enhance current operational models for Reclamation reservoirs, such as Canyon Ferry Reservoir. This could be expanded to other parts of the study area such as Tiber reservoir/Lake Elwell.



Study Materials

- <https://www.usbr.gov/watersmart/bsp/completed.html>



Questions?

Contact:

Amanda Erath, Water Resources and Planning Office,
aerath@usbr.gov

Marketa McGuire P.E., Technical Service Center,
mmcguire@usbr.gov

Denis Kelsch P.E., Missouri Basin Region, dkelsch@usbr.gov

Lindy Johnson P.E., Montana Area Office, ljohnson@usbr.gov

