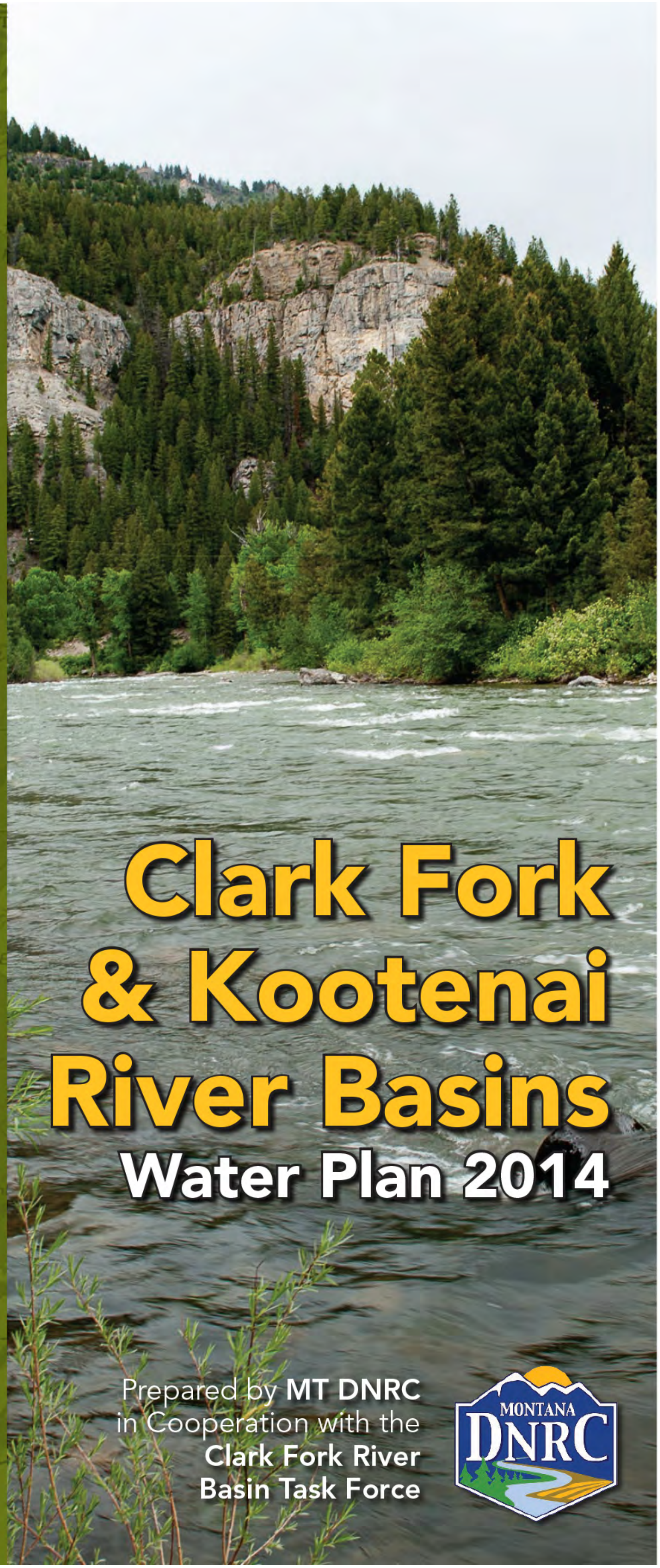


Clark Fork & Kootenai River Basins

Water Plan 2014

Prepared by **MT DNRC**
in Cooperation with the
Clark Fork River Basin Task Force

MONTANA DNRC


MONTANA WATER SUPPLY INITIATIVE
CLARK FORK & KOOTENAI RIVER BASINS WATER PLAN

Contents

I. Executive Summary

In 2013, under direction from the Montana Legislature, the DNRC launched the Montana Water Supply Initiative (MWSI) to work with citizens and community leaders to transform the current Montana State Water Plan into a dynamic guide to help residents and water managers in the state's major river basins: the Clark Fork and Kootenai, Yellowstone, Upper Missouri, and Lower Missouri. The Legislature directed DNRC to update the State Water Plan and submit the results to the 2015 Legislative Session. The state water plan is to include:

- An inventory of consumptive and nonconsumptive uses with existing water rights;
- An estimate of the amount of surface and ground water to satisfy new future demands;
- Analysis of the effects of frequent drought and new or increased depletions on the availability of future water supplies;
- Proposals for the best means, to satisfy existing water rights and new water demands;
- Possible sources of water to meet the needs of the state, and
- Any legislation necessary to address water resource concerns.

During the 18-month long planning process, DNRC worked with the Clark Fork Task Force on developing a basin specific response to each of the subject areas listed above. Results of this effort along with supporting data are contained in this report. The Clark Fork / Kootenai Basins Water Plan serves as a standalone document for guiding the development and management of the basins' water resources. This basin plan will continue to evolve to meet the planning needs of the two basins.

Water use in the Clark Fork and Kootenai River Basins totals approximately 35 million acre-feet annually. Water use in the basin exceeds the amount of water produced annually due to the re-use of water by several hydropower facilities. Hydroelectric power generation accounts for 33 million acre-feet or 94% of the water used in the basins. Approximately 668,782 acre-feet is consumed in the Clark Fork and Kootenai River Basins. Agriculture consumes approximately 448,700 on acre-feet, reservoir evaporation consumes 181,900 acre-feet, and municipal, industrial, domestic, and livestock watering consumes 38,212 acre-feet combined.

Demand for water is a function of many factors that are inherently uncertain. Population may grow or decline and agriculture and industry may demand more water or make do with less through greater efficiency. Changing and variable climatic conditions compound this uncertainty.

To forecast the potential effects of climate trends on future water supplies in Montana, DNRC modeled a range of climate scenarios following general procedures similar to those described in the U.S. Bureau of Reclamation (2011) West-Wide Climate Risk Assessments. Virtually all model simulations project warmer temperatures and most project modest precipitation increases. Although annual stream flow volumes are expected to stay the same or increase, Montanans are likely to see shift in the timing of runoff do to earlier snowmelt and an increase in the rain as a percentage of the precipitation during the later winter and early spring.

The availability of water for new appropriations varies across the state and is subject to both physical water availability and existing legal demands. Many of the watersheds west of the Continental Divide are generally closed to new surface water appropriations. Opportunities for new appropriations for surface water or hydraulically connected groundwater also may be limited outside of closed basins because of existing legal demands including irrigation claims, hydroelectric rights, or instream water rights for fisheries, wildlife, and recreational uses. Given the scarcity of legally available surface water, the reallocation of existing water rights to new uses will play a key role in meeting future demands...

Additionally, water storage is an important tool for meeting future demands and responding to a changing climate. The prospect of constructing storage projects in the Clark Fork or Kootenai river basins is limited by the availability of suitable locations, cost, public support, the need to mitigate environmental impacts, and limited legal and physical availability of water to store. The development of new storage projects is limited to basins where the volume of annual runoff exceeds downstream legal demands.

There may also be opportunities to retain high spring flows through the use of natural systems such as riparian areas, floodplains and wetlands which act to slow runoff and promote groundwater recharge; effectively storing water and releasing it slowly back to the surface water system. In this way, these natural systems fill a role similar to traditional reservoirs. Artificial recharge of alluvial aquifers may also provide additional opportunities to store water when the physical supply exceeds downstream legal demands.

Basin Advisory Councils and The Montana Water Supply Initiative (MWSI)

The 2009 Montana Legislature passed MCA 85-1-203 state water plan mandating that, " sections of the state water plan must be completed for the Missouri, Yellowstone, and Clark Fork River basins, submitted to the 2015 legislature, and updated at least every 20 years. The state water plan must set out a progressive program for the conservation, development, utilization, and sustainability of the state's water resources and propose the most effective means by which these water resources may be applied for the benefit of the people, with due consideration of alternative uses and combinations of uses." The legislation specifically directed DNRC to appoint a 20-member Basin Advisory Council (BAC) in each of the four major river basins in the state for the purpose of conducting public scoping sessions and developing recommendations for the state water plan. In the Clark Fork / Kootenai basins the legislation identified the Clark Fork Task Force (CFTF) to serve as the BAC for that drainage. Figure I-1 shows the make-up of the planning basins for the state water planning effort.

Figure I-1 State Water Planning Boundaries

PURPOSES OF THE BASIN ADVISORY COUNCILS

The BACs are to:

- Provide input and recommendations to DNRC as required by 85-1-203(3);
- Serve as advisors to DNRC and provide an avenue of communication and discourse between the various interests within the basin;
- Evaluate strategies, studies, and proposed actions for improving the understanding management and conservation of water resources in the basin and,
- Act in an advisory capacity to the DNRC for purposes of the basin planning process.

ROLE OF DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

Ground rules were established that specified the roles of the CFTF and DNRC. See: http://www.dnrc.mt.gov/wrd/water_mgmt/state_water_plan/bac_guidelines.pdf. The CFTF took the DNRC provided template and crafted their own ground rules to best suit the needs of the group. DNRC also provided technical information and advice and acted as the project fiscal agent. DNRC contracted with the Center for Natural Resources and Environmental Policy at the University of Montana (CNREP) for coordination and meeting facilitation during the scoping and recommendation development phases of the project. In addition to the specific recommendations contained in Chapter X of this document, detailed descriptions of the methods and

results of the scoping and recommendation development processes are contained in reports available at: http://www.dnrc.mt.gov/mwsi.

THE CLARK FORK AND KOOTENAI BASIN ADVISORY COUNCIL (BAC) 2013-2015

Pursuant to MCA 85-2-203 the CFTF was identified to serve as a BAC for purposes of the Montana Water Supply Initiative (MWSI): "For the Clark Fork River basin, the department shall continue to utilize the Clark Fork River Basin Task Force established pursuant to MCA 85-2-350." The CFTF was joined by representatives of the Kootenai River basin of Western Montana, also a major tributary of the Columbia River Basin of Montana. The CFTF consists of 20 representatives assembled from key water interests with the basins: agriculture, conservation, industry, municipal, recreation and tribal. Moreover, the CFTF is charged with coordinating various entities in order to achieve long-term sustainable water management.

The work of the CFTF culminating in the recommendations for the SWP was carried out in three phases:

Phase 1 – Public Scoping: CFTF member selection, public scoping, and determination of priority issues;

Phase 2 – Information Transfer: presentations by practitioners and subject matter experts on topics related to the priority issues;

Phase 3 – Recommendation Development: draft recommendations, conduct public review process, prepare and publish final recommendation report.

Major Findings of the Clark Fork/Kootenai Scoping Process

6 public meetings were held across the Clark Fork/Kootenai River Basins (CFKRB) to gather public input on the water resource issues of most concern to the citizens of the basin. In sum, participants engaged in the public scoping efforts identified 308 individual water management issues and concerns in the Clark Fork and Kootenai River basins. Staff from CNREP organized the 308 issues into 21 issue categories, including categories such as "gauges and monitoring" and "water rights enforcement." Staff from CNREP created a detailed report on the process in the *Clark Fork and Kootenai River Basins Water Resources Issues Scoping Report* (http://www.dnrc.mt.gov/mwsi). In order to develop a realistic scope of work, the CFTF deliberated and discussed the 21 issue categories and themes from the scoping efforts, built off the public's input, and prioritized issues to address with recommendations in the next phases of the MWSI. The 21 issue categories appear below.

Aquatic Invasive Species
Climatic Changes
Drought Readiness
Federal Regulation of Water
Fisheries and Instream Flow
Gages and Monitoring
Groundwater Wells
Growth and Development
Indian and Federal Reserve Water Rights
Infrastructure and Irrigation
Recreation
Riparian Areas
Water Availability
Water Conservation and Efficiency
Water Marketing
Water Planning
Water Quality
Water Rights Change Process
Water Rights Enforcement
Water Storage

Of the issues listed above, the CFTF selected the following categories to focus their efforts upon:

- Meeting Future Water Demand, which includes future growth and development (industrial, municipal, and agricultural), water storage, and groundwater wells;
- Ensuring Natural Systems Health, which includes fisheries, instream flow, riparian areas, and water quality;
- Maintaining Water Availability, which includes water conservation and efficiency and drought readiness, and
- Administering Water Rights, which includes the water rights change process, water rights enforcement, water allocation, and adjudication.

Recommendations from the Clark Fork and Kootenai BAC

The issues identified above were discussed, refined and re-categorized through a series of face to face meetings and conference calls throughout the fall, winter, and spring of 2013-2014. Phase 2 of the MWSI process entailed presentations from a variety of water resource experts that provided important technical information and background on issues like water policy, water rights, water quality, among others. The CFTF and DNRC staff worked to develop Issue Statements to describe the main issue areas for which they developed concrete recommendations. Abbreviated issue statements, specific goals and objectives followed by concrete recommendations are detailed in Section X of this report. For brevity's sake each issue area the associated goals and objectives are set forth below. A complete presentation of issue statements, goals, objectives, and final recommendations are detailed in Chapter X of this report. A presentation of the topics considered and changes made through the course of public meetings and final deliberations is available online in the *Final Recommendations Development Report* and as Appendix I-1 to this report (Appendix I-1).

MAINTAINING WATER AVAILABILITY

Occurrence of water in the Clark Fork and Kootenai Basins is limited by climatic conditions, precipitation, and snowpack. Water availability varies among years and dramatically between seasons of a given year. Recent data suggest changing trends in water availability, with earlier onset of spring snowmelt and runoff.

Looking ahead, we must focus on finding innovative strategies to use water more wisely and educate water users about their role in conservation. Water regulations and management should be modified to recognize the limited nature of the resource. With proper regulatory and physical measures in place, we can maintain water availability for existing uses and help accommodate future growth.

Goal #1: Implement measures that improve the ways in which we manage and conserve water resources.

Objective: Encourage existing programs that implement and support conservation measures from all types of water users at the watershed, subbasin and basin levels.

Goal #2: Better understand surface and ground water resources and the potential for future natural and human changes to those resources.

Objective: The State of Montana, in coordination with local and federal agencies, should continue to participate in, improve and expand efforts to gather the best scientific information available to better understand physical water availability.

Goal #3: Facilitate collaborative responses to issues of water availability

Objective: In recognizing that water availability depends on conditions that vary locally at the watershed level, pursue opportunities to increase interaction among water users and develop collaborative stakeholder approaches to maintaining water availability.

Objective: Montana should be fully represented and engaged in trans-boundary water management planning efforts that affect federal dam operations in the state.

Goal #5: Better understand surface and ground water resources and the potential for future natural and human changes to those resources.

Objective: The State of Montana, in coordination with local and federal agencies, should continue to participate in, improve and expand efforts to gather the best scientific information available to better understand physical water availability.

Goal #6: Facilitate collaborative responses to issues of water availability

Objective: In recognizing that water availability depends on conditions that vary locally at the watershed level, pursue opportunities to increase interaction among water users and develop collaborative stakeholder approaches to maintaining water availability.

ENSURING NATURAL SYSTEMS HEALTH

Western Montana's natural water bodies and watersheds and associated biological resources support our recreational opportunities, quality of life and economy. The availability of water in the appropriate quantity, quality, timing and duration is necessary to ensure the health of water-dependent natural systems. Challenges and threats associated with water availability have resulted in natural systems impacts. Population growth, associated development, and increasingly uncertain weather patterns will increase risks to these systems in the future. Proactive policies and management practices which balance natural systems health with other important priorities must be pursued to support the health of these valuable systems.

Goal #1: Restore and/or maintain surface water flows and groundwater levels needed to protect natural systems health over seasonal and long-term climate cycles.

Objective: Establish a more effective partnership between DNRC, DEQ and FWP to proactively identify and address current flow-related impairments of waterways, and to effectively address associated future threats to these systems.

Objective: More effectively manage (i.e., restore and/or maintain) natural storage systems to promote retention and infiltration of surface runoff resulting in beneficial release during low flows.

Objective: Establish a more effective coordination mechanism between DNRC (and appropriate sister agencies) and citizen watershed restoration groups to implement flow restoration projects and programs throughout the basin.

Objective: Establish a more effective partnership between DNRC, DEQ, FWP, the Montana Department of Transportation (DOT), and the U.S. Department of Agriculture (USDA) to pro-actively manage and reduce risk of introduction and spread of Aquatic Invasive Species (AIS).

WATER RIGHTS ADMINISTRATION, PROTECTION, AND ENFORCEMENT

Montana water users of both surface and groundwater sources rely on a clear expectation of their rights to water. There is an opportunity to improve complex issues through modified procedures.

These complex issues include:

- Protection of water rights through enforcement of existing rights.
- Consistent, transparent, and streamlined administration of water rights and adjudication processes; measurement and monitoring; and planning.

Goal#1: Maintain a system and process for changing existing water rights and allowing new water rights that both protects existing water rights while providing a transparent, coherent, and expeditious process for reviewing proposed water rights changes and new uses.

Objective: Currently, DNRC requires change applicants to provide detailed explanations of how water rights were used prior to July, 1973. At times, this evidence is difficult to produce. DNRC should review its pre-1973 historic use criteria to ensure that it accurately assesses the effect of a change of use on other water rights. If the historic use criteria is modified, DNRC should assure that any modifications not sanction any post-1973 illegal expansions of use.

Objective: Review of change and new use applications from one region to another continues to vary as to the standards applied and as to the level of documentation expected of applicants. DNRC should work to assure consistency and clarity in DNRC's review process from one region to another and from one application to another.

Goal#2: Protect water rights through enforcement of existing rights.

Objective: Increase the DNRC's role in enforcement as it relates to illegal water use under the Montana Water Use Act.

Objective: Explore and adopt additional strategies in advance and in lieu of litigation for the resolution of water rights disputes.

MEETING FUTURE WATER DEMAND

Montana needs to address future demands for water while meeting existing water rights and uses. The economies of our communities are dependent upon water availability. This requires projecting where and when demand will occur and what type of supply will be required to meet that demand. Ascertaining future demand for water is a precursor to planning for and anticipating opportunities within the Clark Fork and Kootenai basins, and assessing those opportunities against potentially competing demands within the larger Columbia Basin.

Goal #1: The availability of water in Montana to meet future demands is supported by a concise, predictable, and defensible legal framework.

Objective: Montana's existing laws regarding the availability of water should be complete, concise, and defensible.

Objective: Encourage the development of water use plans, including drought and conservation plans, while protecting water rights.

Objective: Determine if existing laws need to be modified to address concerns regarding water availability.

Goal#2: Montana actively pursues the development of water resources to meet future water demands with specific attention given to the spatial and temporal (seasonality) of those resources and the associated demand.

Objective: The quantification of water resources and water demand should be advanced to support the prioritization of opportunities that can improve the physical availability of water to meet anticipated demand.

Goal#3: Montana meets future demand through education, outreach, and a shared understanding of the importance of water to the economic, social, and environmental well-being of the citizens of Montana.

Objective: Agencies and relevant NGOs should continue to invest in an outreach program to engage existing water users.

Objective: Invest in a program to educate individuals and communities on water use and availability in Montana.

USE OF WATER USER COUNCILS FOR IMPLEMENTATION OF THE STATE WATER PLAN AND MANAGEMENT OF THE STATE'S WATER RESOURCES

The CFTF was created in 2001 with passage of House Bill 397 (MCA 85-2-350). The CFTF's work in developing a water management plan for the Clark Fork Basin and in the implementation of that plan serves as a model for similar organizations in the other major Montana river basins. Given that water in the Clark Fork and Kootenai Basins is a limited resource, carefully structured allocation and management is necessary to sustain and improve the economic health of the basin communities while meeting the needs of various competing uses.

Moreover, the CFTF is charged with coordinating various entities in order to achieve long-term sustainable water management. Per MCA 85-2-350, the CFTF is mandated to coordinate local basin watershed groups, water user organizations, and individual water users and provide a forum for all interests to communicate about water issues. The CFTF must also advise government agencies about water management and permitting activities in the Clark Fork Basin and consult with local and tribal governments within the Clark Fork River basin. The CFTF's role, which has expanded in the last six months to include the Kootenai River basin, is of great importance.

There were no goals and objectives developed for this issue area. Please see Chapter X for the specific recommendations associated with this issue.

STATE WATER-USER PROFILE

BETTY POTTER
PROMISES TO KEEP

WRITTEN BY AL KESSELHEIM, PHOTOS BY THOMAS LEE

Water comes ribboning down the meadow, bank-full in the neat ditch. It is early morning, barely sunrise, still cool. A glittering sheet of flood irrigation spreads across the field. A pair of sandhill cranes circle in to land, their loud guttural calls filling the pale day. Curlews probe in the shallows.

Betty Potter straightens up from her work, cleaning old hay and horse manure out of the ditch where it has backed up behind a gate. Mornings are her favorite time, and May is a good month. Everything is sparkling green. The little biting gnats that get behind your ears later in the summer aren't around. The days are cool and fresh. She leans on her pitchfork, looks toward the sunrise where water from the Clearwater River pools in the low spot.

She is 72 years old, just over 5 feet tall, maybe 100 pounds after a big breakfast. She wears work overalls, a bandana on her head. Her eyes are shy, but her laugh quick and infectious. Her 4-wheeler sits near the gate while she walks the ditch, managing the flow and keeping things tidy. Her husband, Bill, died last year at the age of 96.

"I made Bill two promises," she says. "That I would never put him in a nursing home, and that I would take care of this land."

What that means is that much of her summer is spent rotating water on hay fields, keeping the ditches clear and maintained, cutting hay. She is in the fields by 6 am and would have it no other way. During the winter she logs beetle-kill timber on the property. Last winter she single-handedly logged 34,000 board feet.

"I'm not much of an inside person," she says. "I like to work."

Potter says that she puts 3,000 miles a year on her four-wheeler, between irrigating and logging. She probably walks a couple thousand, too, checking ditches.

Potter grew up in Spokane. She went to college for a semester before she came to the Blackfoot Valley, near Clearwater Junction, in 1962. "I wanted to work in Glacier National Park," she remembers, "but they were already done with hiring, so I took a two-week job here at the dude ranch cleaning cabins."

That was 50 years ago. Cabin cleaning led to cooking and other jobs. Her personality and work ethic made her a valued employee. One thing led to the next, years passed. In 1984 she married Bill, one of the partners on the ranch, and she also married this landscape.

"I made Bill two promises...That I would never put him in a nursing home, **and that I would take care of this land."** *—Betty Potter*

"The only time we left the ranch was to go hiking in the Mission Mountains for a week in the fall," Potter says. "I wish we'd done more of that."

"When I came here I didn't know anything," she laughs. "I couldn't even drive a stick shift. I've learned a lot, especially after Bill got sick."

She sloshes through the wet field in rubber boots. Potter scrutinizes the banks, looking for places where horses broke down the edge or where the water release is uneven. She walks to the next gate, where she bends down to pull boards out with a hook made of rebar, and releases water lower down.

"I've fallen in a few times," she admits. "And I can't swim! Once I fell trying to cross on a board. I had to have sixteen stitches in my knee.

"I've got a bad back, a bad knee, sore shoulder. I take a lot of Ibuprofen," she shrugs and starts back toward the 4-wheeler at a brisk walk.

Potter is not a fan of center pivot irrigation. "Over my dead body," she says. "They just make a mess in the fields, and they miss too much. Flood irrigation is labor intensive, but that's exactly what I like about it."

"It takes me about two weeks to really get the acreage covered," she says. "Then I start over again. I keep irrigating until the day we cut hay." Between what she calls the Upper and Lower Rocking Chair, she manages about 3,000 acres, 250 of them irrigated.

Potter notices the little things as she works her rounds. A young bear comes down to the ditch to drink water. She carefully sets aside a caterpillar she comes across cleaning the bank. She keeps a wary eye on a steep embankment where leaky ditches have periodically washed out the road in the past.

"When we shut off the water and I find fish in the ditches," she says, "I return them to the river. Any kind of fish."

"We usually have water into mid-August," Potter says. "When the gage at Bonner gets down to 700 cfs, we have to cut back by 50% for instream flows. When it gets to 600 cfs, we have to shut things down."

"We buried Bill right here on the ranch," she says, suddenly. "On his grave it says something he used to tell me. 'When it's all said and done, we are only caretakers of the land.'"

"That's what I'm trying to do. It's not a way to get rich. It's a way of life, and I wouldn't trade that for anything." ■

II. Introduction

At the time of this writing, 2014 has been a banner water year for Montana. The Clark Fork and Kootenai River Basins have been blessed with above average precipitation. This year their streams and reservoirs are able to provide the water necessary to satisfy both consumptive and non-consumptive uses across the basin. However, Clark Fork and Kootenai water users are keenly aware of their vulnerability to drought. This is particularly true for irrigated agriculture where many users depend on return flows from upstream flood irrigators to satisfy their rights. Similarly, instream flow advocates remain vigilant knowing that during low-flow periods, non-consumptive uses such as habitat, tourism and hydropower can be adversely affected by consumptive uses operating outside priority dates.

With the potential for increasing demands and supply variability, the time is ripe to put Montana on a course toward a more sustainable water future, a course that provides the water necessary for existing and potential future uses necessary for economic growth. The guiding legal principles are in place: the Montana Constitution with its provisions for a clean and healthful environment, and the Montana Water Use Act with its provisions for allocation according to the prior appropriation doctrine ("first in time is first in right"). However, like so many complex resource stewardship challenges, a wide range of opinion exists about how to achieve the end goal of increasing water availability.

Statutory Authority for Water Planning

Article IX, Section 3 of Montana's Constitution states "All surface, underground, flood, and atmospheric waters within the boundaries of the state are the property of the state for the use of its people and are subject to appropriation for beneficial uses as provided by law". The Constitution also states that "The use of all water that is now or may hereafter be appropriated ….shall be held to be a public use.

The Montana Legislature recognizes that in order to achieve the public policy objectives specified in § 85-1-101 MCA "and to protect the waters of Montana from diversion to other areas of the nation, it is essential that a comprehensive, coordinated multiple-use water resource plan be progressively formulated to be known as the 'state water plan'" (§ 85-1-101(10) MCA).

Responsibility and statutory authority for developing the state water plan is given to DNRC in § 85-1-203 MCA with instructions to "*gather from any source reliable information relating to Montana's water resources and prepare from the information a continuing comprehensive inventory of the water resources of the state*." As directed by the Legislature in § 85-1-203(2), MCA, "*the state water plan must set out a progressive program for the conservation, development, utilization, and sustainability of the state's water resources, and propose the most effective means by which these water resources may be applied for the benefit of the people, with due consideration of alternative uses and combination of uses".*

Sections of the state water plan must be completed for the Missouri, Yellowstone, and Clark Fork River Basins, submitted to the 2015 Legislature, and updated at least every 20 years. Montana citizens are given a formal role in the planning process through water user councils established in accordance with the instructions given by the legislature in § 85-1-203(4), MCA. The role of the water user councils is to make recommendations to DNRC on the basin-wide plans.

In developing and revising the state water plan, DNRC is instructed to consult with, and solicit advice from, the Environmental Quality Council. The legislature, by joint resolution, may revise the state water plan.

History of Water Planning in MT

STATE-WIDE PLANNING HISTORY

Water is arguably Montana's most valuable natural resource. The rivers, streams, lakes, and groundwater have shaped the stories of our rich history of settlement, agriculture, mining, industry, and recreation, and our quality of life. As the physical and economic needs of the state evolve, planning for the conservation and development of our water resources also evolves.

Initial efforts at water resources planning in Montana centered on the development of irrigated agriculture to promote settlement of the west. Water development projects were seen not just as desirable but as essential to the economic viability of the state. In 1895, the Montana Legislature created the Arid Land Grant Commission to manage the reclamation of lands granted to the State under the federal Carey Land Act of 1894. In 1903, the Commission was abolished and replaced by the Carey Land Act Board. 1903 also saw the U.S. Congress authorize construction of the Milk River Project as one of the first five reclamation projects built by the newly created Reclamation Service (now Bureau of Reclamation) under the Reclamation Act of 1902.

In the 1920s, the Montana Irrigation Commission produced county-by-county plans for irrigation development. In addition, the Commission assisted in organizing and management of irrigation districts around the state. It also had jurisdiction over the sale of water, water rights, and the contracting of water for irrigation. The Commission was abolished in 1929.

The precarious position of agriculture and the livestock industry in Montana during the early 1930s promoted extensive individual and group effort towards seeking ways to put Montana's water resources to beneficial use. Late in 1933, a special session of the state legislature passed House Bill No. 39, creating the State Water Conservation Board. The act creating the Board declared that the public interest, welfare, convenience and necessity required the construction of a system of works for the conservation, development, storage, distribution, and utilization of water. Broad powers were given to the Board, allowing it to cooperate and enter into agreements with all federal and state agencies, and to investigate, survey, construct, operate, maintain, and finance the construction of projects.

Between 1934 and 1960, the Board built 181 water conservation projects. These included 141 dams and reservoirs, 815 miles of canals, 23 miles of domestic water supply pipelines, and 24 miles of transmission lines to bring power to pumping stations. All told, the Board's actions created 438,017 acre-feet of storage and developed 405,582 acres of irrigated land (R. Kingery, personal communication 12 July 2013.). This period also saw congressional approval of all the major federal water projects in Montana. These include Fort Peck, Canyon Ferry, Hungry Horse, Tiber, Yellowtail, and Libby dams.

When Montana began to negotiate the Yellowstone Compact with Wyoming and North Dakota in 1939, the need for cataloging the state's water resources and their use became apparent. As a result, the 1939 Legislature authorized the collection of data pertaining to water use. Between 1942 and 1971, Montana undertook a comprehensive county-by-county assessment of water use. The resulting reports, known collectively as the Montana Water Resources Survey, contain an examination of water rights, water uses, and irrigation development in almost every county in Montana. This information was collected and published from 1943 thru 1965 by the State Engineer's Office and from 1966 through 1971 by the Water Conservation Board. The historical information contained in the surveys is an invaluable tool in today's efforts to adjudicate Montana's water rights.

In 1967, the Montana Legislature recognized the need for a comprehensive state water plan with passage of the Montana Water Resources Act of 1967 (89-101.2 R.C.M. 1947). The act abolished the Water Conservation Board and transferred its powers and duties to the Water Resources Board. The act stated that the *"public policy of the state is to promote the conservation, development, and beneficial use of the state's water resources to secure maximum economic and social prosperity for its citizens."* The act also designated the Water Resources Board as the state agency with responsibility to "*coordinate the development and use of the water resources of the state as to effect full utilization, conservation, and protection of its water resources."* The Board was empowered to prepare a *"continuing comprehensive inventory of the water resources of the state"*, and prepare a "*comprehensive, coordinated multiple-use water resources plan known as the 'state water plan'."*

The responsibilities given to the Board reflect a change in direction and purpose of water resource planning—from "conservation" of water through irrigation to a total concern for full use of our water resources through comprehensive multiple-use planning. In 1971, the Water Resources Board became the Water Resource Division of the Montana Department of Natural Resources and Conservation (DNRC).

Between 1972 and 1981, DNRC conducted a number of reconnaissance-level planning studies in each of Montana's major river basins in conformance with federal principals and guidelines and with federal grant assistance. While these plans produced volumes of valuable technical information, inadequate consideration was given to the institutional and political feasibility of implementing the plan recommendations. Consequently, the plans had little effect on water management decision-making. These plans were also ineffective vehicles for addressing the state's most critical water management problems such as interstate water allocation, quantification of federally reserved water rights, water use efficiency, instream flow protection, and groundwater management. Federal funding to support state water planning ended in 1981.

In 1987, DNRC embarked on a new approach to developing the state water plan. After reviewing the water planning processes of other western states, DNRC adopted an approach similar to that used in Kansas. Under this approach, the state water plan provided a forum for all affected parties, including those without jurisdictional responsibility, to collaboratively work together on resolving water management issues. This new approach included the formation of a State Water Plan Advisory Council and issued-focused Steering Committees. The resulting state water plan focused on the following nine water resource issues:

1. Agricultural Water Use Efficiency (1989)
2. Instream Flow Protection (1989)
3. Federal Hydropower and State Water Rights (1989)
4. Water Information System (1989)
5. Water Storage (1990)
6. Drought Management (1990)
7. Integrated Water Quality and Quantity Management (1992)
8. Upper Clark Fork Basin Water Management (1994)
9. Groundwater (1999)

Between 1999 and 2009, DNRC water planning resources were focused on assisting irrigation districts, conservation districts, and local watershed groups with water supply studies and drought management plans.

In 2009, the Montana Legislature amended the state water planning statute to direct DNRC to update the state water and report to the 2015 Legislature. The 2009 amendments also specify a number of items that the state water plan must address, including:

- Inventory of consumptive and non-consumptive uses associated with existing water rights.
- An estimate of the amount of groundwater and surface water needed to satisfy new future demands;
- An analysis of the effects of frequent drought and new or increased depletions on the availability of future water supplies.
- Proposals for the best means to satisfy existing water rights and new demands.
- Possible sources of water to meet the needs of the state; and
- Legislation necessary to address water resource concerns in the Yellowstone, Missouri, and Clark Fork Basins.

BRIEF HISTORY AND BACKGROUND OF THE CLARK FORK TASK FORCE 2001-2012

The 2001 Montana Legislature passed House Bill 397, "An Act Establishing the Clark Fork River Basin Task Force." In response to this legislation, on July 2, 2001, Governor Martz asked the Montana Consensus Council (MCC) to "take the lead in organizing, convening, and facilitating a task force to develop a water management plan for the Clark Fork River basin in Montana." In passing HB 397, the legislature provided $120,000 to support its implementation beginning on July 1, 2002.

Developing the Management Plan

The CFTF met 24 times from start through adoption of the plan on August 16, 2004, adopting ground rules and a work plan to guide its activities in developing the management plan, including the decision-making process and procedures for media relations. MCC was responsible for process support, including meeting facilitation and logistics, meeting summaries, and the drafting CFTF documents, including the water management plan.

Development of the management plan began with a series of expert briefings to provide a shared understanding of basin hydrology and water use, Montana water law and the water appropriation process, and existing constraints on basin water management. The CFTF then identified issues arising from the three statutory plan mandates and alternatives for addressing them: *Identify options to protect the security of water rights; provide for the orderly development of water, and to provide for the conservation of water in the future.*

Plan Adoption

The CFTF adopted the plan pursuant to its ground rules on August 16, 2004 (http://www.dnrc.mt.gov/mwsi). The Confederated Salish and Kootenai Tribes declined to accept and sign the plan due primarily to the fact that they were in the process of negotiating a water compact with the state. The Tribes' reason for declining was plainly stated in a letter: "The Clark Fork River Basin adjudication and subsequent effective water management planning are dependent upon quantification and settlement of Basin reserved water rights."

WATER RESOURCE SURVEYS

As mentioned above, early water planning activities in Montana and the nation were focused on developing irrigation projects to distribute water across the landscape to support and promote agricultural production. During the 1930-1940s, the state and federal governments spent much of their time and money on designing and implementing water conservation projects. Then, between 1953 and 1972, the Montana Water Conservation Board and the State Engineers office produced and published comprehensive water resource surveys of the irrigation projects in most of the counties in the state. These surveys were developed from courthouse records, individual contacts, state and federal agency data, field surveys and aerial photographs. They summarize settlement and water use, including survey maps, at the time of publication. These important documents are still used for historical reference and provide the basis for understanding water use, development, water planning, and adjudication in each county. These water resource surveys remain a valuable tool for characterizing and understanding the communities and water distribution systems in the basin.

Methodology for Developing the Clark Fork/Kootenai Basins Water Plan

CONVENING THE CLARK FORK / KOOTENAI RIVERS TASK FORCE 2013-2015

For the purposes of the Montana Water Supply Initiative (MWSI), in the Clark Fork River Basin the process for convening a basin advisory council was different from that of the Missouri and Yellowstone River Basins. Section 85-1-203 (4)(a), MCA required that "The department shall create a water user council in both the Yellowstone and Missouri River Basins that is inclusive and representative of all water interests in those basins. For the Clark Fork River Basin, the department shall continue to utilize the Clark Fork River basin Task Force established pursuant to 85-2-350." Although the legislation overlooked the Kootenai River Basin in the text of the legislation, DNRC felt that inclusion of the Kootenai was essential in developing the State Water Plan.

DNRC made public its intent to convene a 20-member Basin Advisory Committee pursuant to 85-1-203 MCA and solicited individuals representing the spectrum of water resource stakeholders across the basin. Ten returning members were joined by eleven new members as well as seven "Technical Advisory /Ex Officio" individuals from the public and private in addition to those representing themselves as a resident of one or more of the Clark Fork and Kootenai tributary basins. The reformed CFTF adopted guidelines and ground rules governing decision making to help guide their process. The ***Table II-1*** lists the CFTF representatives and ***Table II-2*** lists the ex-officio members.

Table II-1 List of Clark Fork Task Force Members

Name	Primary Affiliation	Organization
Stan Bradshaw	Conservation	Trout Unlimited
Maureen Connor	Agriculture/Public Interest	Upper Clark Fork Steering Comm.
Kerry Doney	Agriculture	Jocko Irrigation District
Holly Franz	Energy	PPL Montana
Harvey Hacket	Agriculture	Bitterroot Irrigation District
Nate Hall	Energy	Avista
Barbara Chilcott	Conservation	Clark Fork Coalition
JR Iman	Agriculture	Ravalli Irrigation District
Lloyd Irvine Steve Lozar (Alternate) Mary Price (Proxy)	Tribes	Confederated Salish & Kootenai Tribes
Verdell Jackson	Government / Agriculture	MT Senate District 5
Paul Lammers	Mining	Revett Minerals
Ross Miller	Municipal	Mountain Water
J. Gail Patton	Agriculture	Sanders / Mineral Counties
Jennifer Schoonen	Conservation	Blackfoot Challenge
Molly Skorpick	Agriculture	Mt Assoc. Dams & Canals Systems
Marc Spratt Dean Sirucek (alternate)	Agriculture	Flathead Conservation District
Brian Sugden	Timber	Plum Creek Timber
Susie Turner	Municipal	City of Kalispell
Vicki Watson	Public Interest	Academia
Ted Williams	Conservation / Recreation	Flathead Lakers

Table II-2 List of Clark Fork Ex-Officio Task Force Members

Name	Primary Affiliation	Organization
Derek Edge	Consulting	ARCADIS, U.S., Inc.
Gregory Hoffman	Libby Dam & Lake Koocanusa	U.S. Army Corps of Engineers
Ian Magruder	Consulting	Kirk Engineering
Mike McLane	Government	MT DFWP
Caryn Miske	Flathead Basin Commission	DNRC
Dennis Philmon	Government	Bureau of Reclamation
Mike Sweet	Academia	Montana Climate Office

MWSI PHASE ONE: PUBLIC SCOPING AND ENGAGEMENT

Issue Identification

To kick off the MWSI water planning process, the CFTF and DNRC engaged the public to "scope" the major water management issues in the Clark Fork and Kootenai River Basins between October and December 2013. The citizen input helped the CFTF to identify and prioritize a variety of water management issues. The University of Montana Center for Natural Resources & Environmental Policy (CNREP) was contracted to facilitate the public engagement process. Citizen input was gathered through two efforts:

- Public meetings were held in Anaconda, Deer Lodge, Hamilton, Kalispell, Libby, and Missoula, and attended by 169 participants. Meeting locations were chosen based on input from the CFTF and DNRC. All meetings were publicized through local newspaper ads, radio spots, various list servers, an online video, and word-of-mouth.
- A public survey was completed by 57 individuals from 17 different zip codes across Western Montana.

Table 11-3 List of Public Scoping Meetings

Scoping Meetings in the Clark Fork and Kootenai Basins (2013)		
Location	Date	Public Attendance
Missoula – UM Campus	Oct. 15	41
Hamilton – City Hall	Oct. 17	30
Anaconda – Fairmont Hot Springs	Oct. 24	13
Kalispell – Best Western	Oct. 29	38
Libby Dam Visitors Center	Oct. 30	21
Deer Lodge – Powell County Community Center	Nov. 13	26
	Total	**169**

In sum, participants engaged in the public scoping efforts identified 308 individual water management issues and concerns in the Clark Fork and Kootenai River basins. The data collected from the scoping process was detailed in the report *The Clark Fork /Kootenai River Basins Water Resources Issues Scoping Report* which is available online (http://www.dnrc.mt.gov/mwsi) Staff from CNREP organized the 308 issues into 21 issue categories:

- Aquatic Invasive Species
- Climactic Changes
- Drought Readiness
- Federal Regulation of water
- Fisheries and Instream Flow
- Gages and Monitoring
- Groundwater Wells
- Growth and Development
- Indian and Federal Reserved Water Rights
- Infrastructure and Irrigation
- Recreation
- Riparian Areas
- Water Allocation and Adjudication
- Water Availability
- Water Conservation and Efficiency
- Water Marketing
- Water Planning
- Water Quality
- Water Rights Change Process
- Water Rights Enforcement
- Water Storage

In order to develop a realistic scope of work, the CFTF deliberated and discussed the 21 issue categories and themes from the scoping efforts, built off the public's input, and combined and prioritized those issues into 4 broad categories to address with recommendations in the next phases of the MWSI. The CFTF selected the following categories:

- **Meeting Future Water Demand**, which includes future growth and development (industrial, municipal, and agricultural), water storage, and groundwater wells
- **Ensuring Natural Systems Health**, which includes fisheries, instream flow, riparian areas, and water quality
- **Maintaining Water Availability**, which includes water conservation and efficiency and drought readiness
- **Water Rights Administration and Protection**, which includes the water rights change process, water rights enforcement, water allocation, and adjudication

In January 2014, the CFTF and DNRC began work to frame each of the issues in a way that better explained the issue rationale and reasoning. Based on the initial framing of each issue, the CFTF was able to start developing options and alternatives for water planning strategies and recommendations.

MWSI PHASE TWO: INFORMATION TRANSFER

In addition to collecting information from the public about issues of concern in the planning basins, the CFTF also relied upon a host of outside experts to provide information and data on a variety of water resource issues. The group chose each expert speaker in order to improve and invigorate the CFTF's existing body of knowledge and directly address issues the CFTF was struggling to resolve. Since CFTF membership represents a significant body of water management, conservation, law, and science expertise, the group also benefitted from strong meeting attendance and vigorous discussion. Below is a summary of the information transfer process, including meeting dates, times, attendance, and information presented.

Water Rights

Stan Bradshaw, Senior Attorney, Montana Water Project of Trout Unlimited, discussed the framework of Montana's water rights change process.

JR Iman, Ravalli County Commissioner and Water Commissioner, discussed formation of the Painted Rocks Water Users Association in the larger context of historic water management struggles and success in the Bitterroot sub-basin.

Holly Franz, Water law attorney -In order to inform and help guide discussion on administering/protecting water rights discussions (one of the four primary issues), Holly led an interactive discussion with CFTF members focused on water rights enforcement mechanisms, water commissioner operations, and Montana's water rights legal framework.

Proposed Water Rights Compact

Mary Price, Senior Policy Analyst, Confederated Salish-Kootenai Tribes, presented on the topic of the "Proposed Water Rights Compact between the State of Montana, the Confederated Salish and Kootenai Tribes and the United States." Mary's presentation focused on the Flathead System Compact Water, which is one component of the CSKT Compact, and involves the portion of the CSKT water right that the Tribes may withdraw from the Flathead River or Flathead Lake, which includes 90,000 acre feet per year stored in Hungry Horse Reservoir.

Water Supply

Aaron Fiaschetti, DNRC Surface Water Hydrologist, presented on the topic of "Provisional Numbers for Water Supply and Demand in the Clark Fork and Kootenai Basins." Aaron discussed groundwater, water storage, water demand, irrigation consumption, and non-consumptive use across Western Montana.

John Wheaton, Senior Research Hydrogeologist, Montana Bureau of Mines and Geology (MBMG) Ground Water Investigation Program (GWIP), presented an "Overview of Past, Current, and Discussion of Possible Future MBMG research in the Clark Fork." John explained GWIP's project identification process, research focus areas, and prospects for future research.

Andrew Larson, Forest Ecologist with the University of Montana Department of Forest Management, presented on "Forest Canopy Effects on Snow Accumulation and Ablation." While discussing recent findings and future research prospects, Andrew explained that mean winter temperatures in the Clark Fork and Kootenai River Basins suggest that high forest density may not result in greater snow retention. In some cases, lower forest density will result in greater snow retention.

Bruce Sims, Surface Water Hydrologist with the U.S. Forest Service, discussed, "The Role of Wetland, Riparian, and Floodplain Water Storage in western Montana.

MWSI PHASE THREE: RECOMMENDATIONS DEVELOPMENT PROCESS

Prior to initiating the work of developing recommendations, the CFTF felt that it was important to revisit the recommendations developed in the 2004 planning process in order to determine which important outstanding issues were left unresolved from that effort. A subcommittee was formed to revisit the 2004 recommendations and determine what actions if any were made to address those recommendations. The subcommittee developed a comprehensive report that analyzed each of the recommendations contained in the 2004 Plan and that actions taken since that time see Appendix II-1.

The CFTF began to work toward developing recommendations in January 2014. To initiate this effort, the DNRC provided a framework for writing recommendations. According to the framework, an "issue statement" explains the importance and rationale of the issue. Following the issue statement, several goals and objectives specify the purpose and best possible outcome of the recommendations. Recommendations are then suggested for each objective. Implementation tasks, or specific steps needed to carry out the recommendations, add a final layer of specificity to certain recommendations.

Developing Issue Statements

The CFTF divided their efforts into four working groups at the January 2014 meeting to draft and refine issue statements for the four primary issues (*Meeting Future Demand, Ensuring Natural Systems Health, Maintaining Water Availability, and Water Rights Administration and Protection).* After drafting the statements, the entire CFTF reviewed each issue statement and suggested changes. CFTF members continually revised and improved the issue statements between January and April 2014.

Developing Alternatives
The following process was used to develop alternatives for water management planning:

January 2014: The same working groups that developed issue statements met via conference call to develop goals and options, or *alternatives*, to address each issue statement. The options were viewed as strategies that could be used to address the goal. For example, in order to address the goal of improving water rights enforcement, one suggestion, or *alternative,* was that DNRC should improve the training offered to water commissioners.

***February 2014*:** Working groups met during and between CFTF meetings to draft goals and brainstorm objectives for each of the four issues. During the February meeting, members also agreed on a list of evaluation criteria, or criteria used to screen recommendations. The criteria are below.

- Is it [the recommendation] specific?
- Is it technically feasible?
- Is it politically feasible (with the governor's likely support)?
- Is it financially feasible?
- Is there public support?
- Are there likely willing partners (for implementation)?
- Is it actionable?
- Does the pertinent agency have the authority to implement?
- Does the pertinent agency have buy in?
- Is it in accordance with the MT Constitution?
- Is it in accordance with statutory & administrative law?
- Is it in accordance with case law?

March 2014: CFTF members finished drafting and refining issue statements, goals, and objectives, and began to draft recommendations. In order to better develop the recommendations, members chose a five-person team of "point people" to represent each of the four issue-based working groups. The team put in a tremendous amount of work to draft recommendations and refine documents containing issue statements, goals, and objectives.

April 2014: As a plenary The CFTF evaluated and screened all drafted recommendations, along with the goals, objectives, and issue statements. In addition to evaluating recommendations for each of the four issues, a proposal for continued funding of the CFTF was included as a fifth issue. The product of the April meeting was therefore a set of preliminary, draft issue statements, goals, objectives, and recommendations. The CFTF was able to reach preliminary agreement via consensus on roughly 80% of the draft recommendations. However, several recommendations represented "areas of disagreement," and were therefore discussed in more depth at the May meeting discussion

Gathering Public Input
The CFTF and DNRC hosted a public review and comment period between April 28 and May 16, 2014. The CFTF decided at the March 2014 meeting to gather public input via a two-part approach.

First, participants decided to schedule a series of informal public discussions. CFTF members volunteered to "host" the public discussions in their communities, and took responsibility for scheduling the meetings and advertising the meetings to their networks ***(Table II-4)***. DNRC and CNREP staff assisted with advertising, including press releases, flyers, and legal notices.

Second, the CFTF asked the DNRC to develop an online survey to distribute widely to the public. DNRC staff developed the survey in Survey Monkey, and prepared a "portal" for each of the five issues. The survey yielded thirteen online survey responses. In addition, the CFTF received three public comment letters, including one official letter from the Montana Department of Fish, Wildlife and Parks.

Table II-4 Public Scoping Meetings

Public Discussion Sessions in the Clark Fork and Kootenai Basins (2014)		
Location	**Date**	**Public Attendance**
Missoula – Holiday Inn Downtown	April 30	3
Kalispell – Flathead Conservation District	May 1	2
Hamilton – City Hall	May 1	13
Libby – Venture Inn Hotel	May 5	9
Deer Lodge – Powell County Community Center	May 7	30
Deer Lodge – Elks Lodge	May 7	5
	Total	**62**

Issue statements underwent several re-organizations along the way, and recommendation language was considered and debated during face-to-face meetings and conference calls. By the third week of April, the BAC was ready to present its work to the public for comment. A *Draft Recommendation Development Report* was developed and distributed online and via email to an extensive list of interested of parties. The public had the opportunity to comment on the report via an online comment form, through written comments, or by attending four public meetings that were held throughout the basin. Attendance at the public meeting was limited (Table II-5), but the conversation was spirited at all of these discussions. The BAC received valuable public input on all of the recommendations presented.

On May 29, 2014, the CFTF met to consider comments gathered through the six public meetings as wells as comments by submitted by individuals online. After much discussion, the CFTF adopted all of the recommendations by unanimous consent. A complete presentation of issue statements, goals, objectives, and final recommendations are detailed in Chapter IX of this report. A presentation of the topics considered and changes made through the course of public meetings and final deliberations is available online in the *Final Recommendations Development Report* (http://www.dnrc.mt.gov/mwsi) and as Appendix I-1 to this report.

III. Basin Profile of the Clark Fork and Kootenai Basin

Socioeconomic Portrait – Clark Fork / Kootenai River Basins

POPULATION

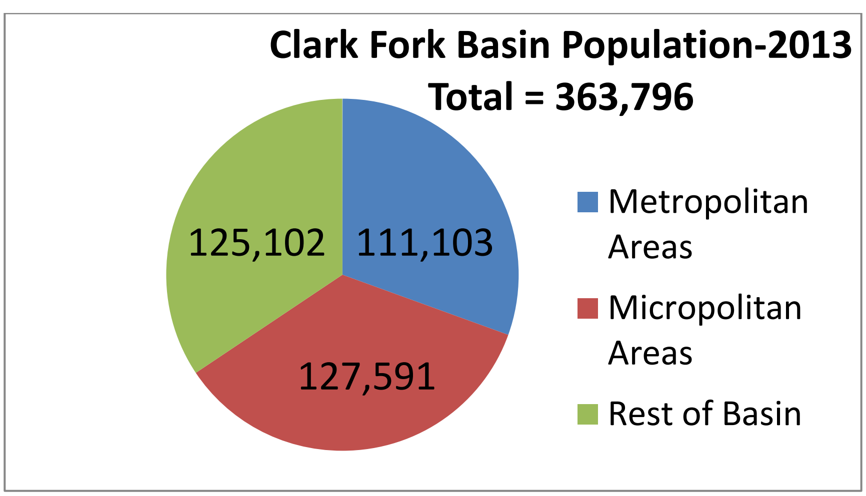
The population profiles of the Clark Fork and Kootenai basins of western Montana are summarized by population: distribution, trends and projections. Additional information about the population of the basins can be found in Appendix III-1.

Population Distribution

Two-thirds of Clark Fork Basin residents live within areas considered to be “Metropolitan” or “Micropolitan” by the Executive Office of the President, Office of Management and Budget (OMB). According to OMB (Executive Office of the President 2013), a “Metropolitan Statistical Area” is considered to have “at least one urbanized area of 50,000 or more population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties.” “Micropolitan Statistical Areas” are defined similarly with the exception that the area’s core consists of “at least one urban cluster” with a population between 10,000 and 50,000 (***Figure III-1***).

Missoula is the second largest of Montana’s three Metropolitan Areas. In 2013, one-third of the Basin’s residents lived in the Missoula area, the only Metropolitan Area in the Basin. The Missoula Metropolitan Area grew 1.7 percent between 2010 and 2013, trailing the state’s rate of growth by nearly one percentage point. More than one-third of the Basin’s residents live in the Micropolitan Areas, Butte and Kalispell. Kalispell is the Basin’s largest Micropolitan Area and it continues to grow at a greater rate than the rest of the Basin, but more slowly than the entire state. One-third of the Basin’s population is found in “rural” areas outside of the areas characterized as Metropolitan or Micropolitan.

Figure III-1 Clark Fork basin population distribution by urban and rural areas.



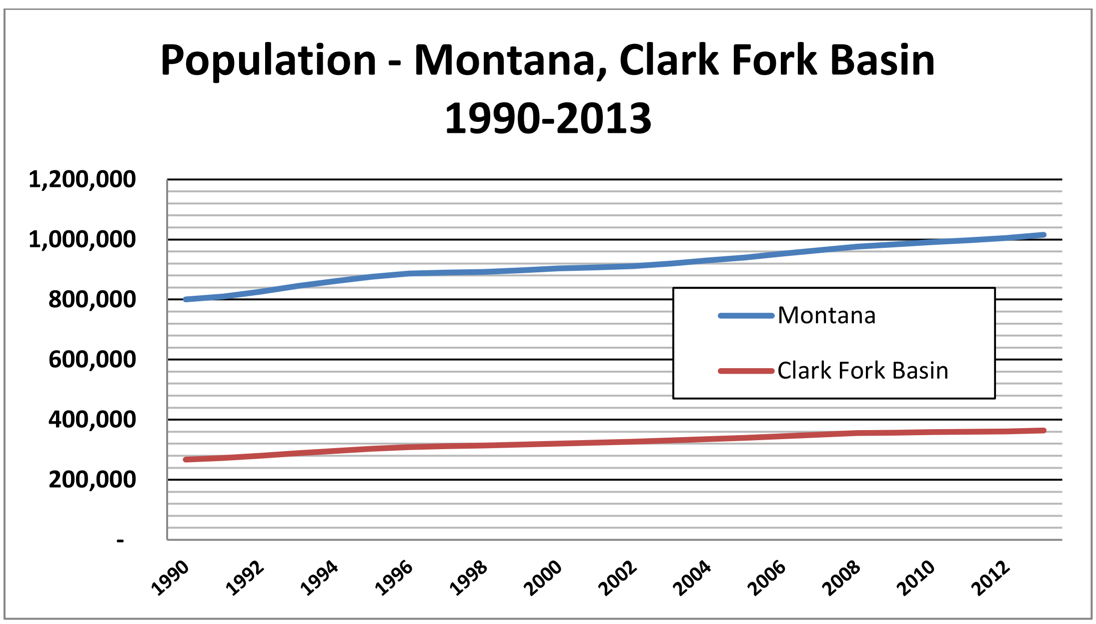
In 2010, the median age of residents of counties in the Clark Fork Basin ranged from 34 years in Missoula County to 51.4 years in Granite County. The median age for Montana was 39.7 years and 36.9 for the U.S. Compared to the state-wide age distribution in 2010, the Clark Fork Basin had proportionately more residents between the ages of 20 and 24 and between the ages of 45 and 75. The age structure of the Basin's population is affected by the large number of young residents in the Basin's largest population center, Missoula County, and by the large number of migrants to the region that have relocated after beginning careers elsewhere, particularly during the 1990s.

Population Trends

The Clark Fork was the largest and the fastest growing major basin in Montana between 1990 and 2010, with a population increasing by 36 percent to 339,005. While Montana's population increased by 27 percent (***Figure III-1***). Ravalli, Flathead, and Missoula Counties were the most rapidly growing counties with populations increasing by 63 percent, 56 percent, and 41 percent, respectively. The increasing population density of this portion of the Basin sometimes referred to as the "93 Corridor," extending from the Flathead through Missoula to the headwaters of the Bitterroot River. . Growth in the Basin's population is primarily due to immigration to the basin—and, to a lesser degree, natural increases.

Deer Lodge County was the only county in the Basin with a declining population during the period, decreasing by 10 percent. Between the 2010 Census and July 1, 2013, the population of the Clark Fork Basin (including the Kootenai Basin) increased 1.6 percent to 363,796. During the same period Montana's population increased 2.6 percent to 1,015,165.

Figure III-2 Population trends in the Clark Fork basin since 1990



Population Projections

Predicting population changes is an undertaking that grows increasingly speculative as the time horizon expands and the region under consideration diminishes in size. For the purposes of this planning effort, population projections are provided to inform deliberations of water management issues in which population levels are one factor among many comprising the demand for water.

Two sets of population projections are offered here. One set extrapolates trends seen in the period between the 1990 and the 2010 censuses. These projections are provided at the state, county, basin, and sub-basin levels. The other set relies on projections at the state and county levels developed by the Montana Department of Commerce (MT Commerce) using eREMI, a population projection product of Regional Economic Models, Inc. (REMI). Population levels were projected through the twenty-year planning period to 2035.

Table III-1 displays projections of the Clark Fork Basin's population based on each method. The MT Commerce forecasts predict a population increase for the Clark Fork Basin by 2035 that is less than half of the projection that relies on extrapolations of trends from 1990 to 2010. Extrapolating Basin-wide population growth at the average annual rate of population change for the period between 1990 and 2010 would result in 159,492 additional Basin residents in 2035. If the 1990 to 2010 trend were to continue, the Clark Fork population would exceed half a million by 2035 and comprise approximately 40 percent of the state's population. Nearly 80 percent of the projected increase in population would occur in three sub-basins, Flathead Lake, the Bitterroot, and the Middle Clark Fork.

Table III-1 Clark Fork Basin Population Projections

Population Projections – Clark Fork Basin

	Average Annual Rate	2035	Change 2010-35
1990-2010 Extrapolation	1.54%	518,245	159,492
MT Commerce	0.63%	419,407	61,047

Rather than extrapolate recent trends, the MT Commerce projections forecast declining rates of population change through 2035, reflecting assumptions about the Basin's age structure, natality and survival rates, and migration patterns over the period. This projection forecasts a substantially lower average annual rate of growth and an increase of 61,047 in the Basin's population to 419,407 by 2035.

Income and Employment

Total personal income (TPI) is comprised of: net earnings in the forms of wages and salaries, supplemental earnings, and proprietors' income; transfer payments; and income from dividends, interest, and rent. In 2012, TPI in the Clark Fork Basin was $13.0 billion, 33 percent of TPI for Montana of $39.3 billion.[1] Between 1990 and 2012, TPI in the Clark Fork Basin

Table III-2 Personal Income – Major Basins 2012

	Total	Per Capita
Clark Fork	13.0 billion	35,896
Lower Missouri	3.1 billion	40,528
Upper Missouri	12.8 billion	40,676
Yellowstone	10.4 billion	41,448
Montana	39.3 billion	39,126

Adjusted to 2013 $s.

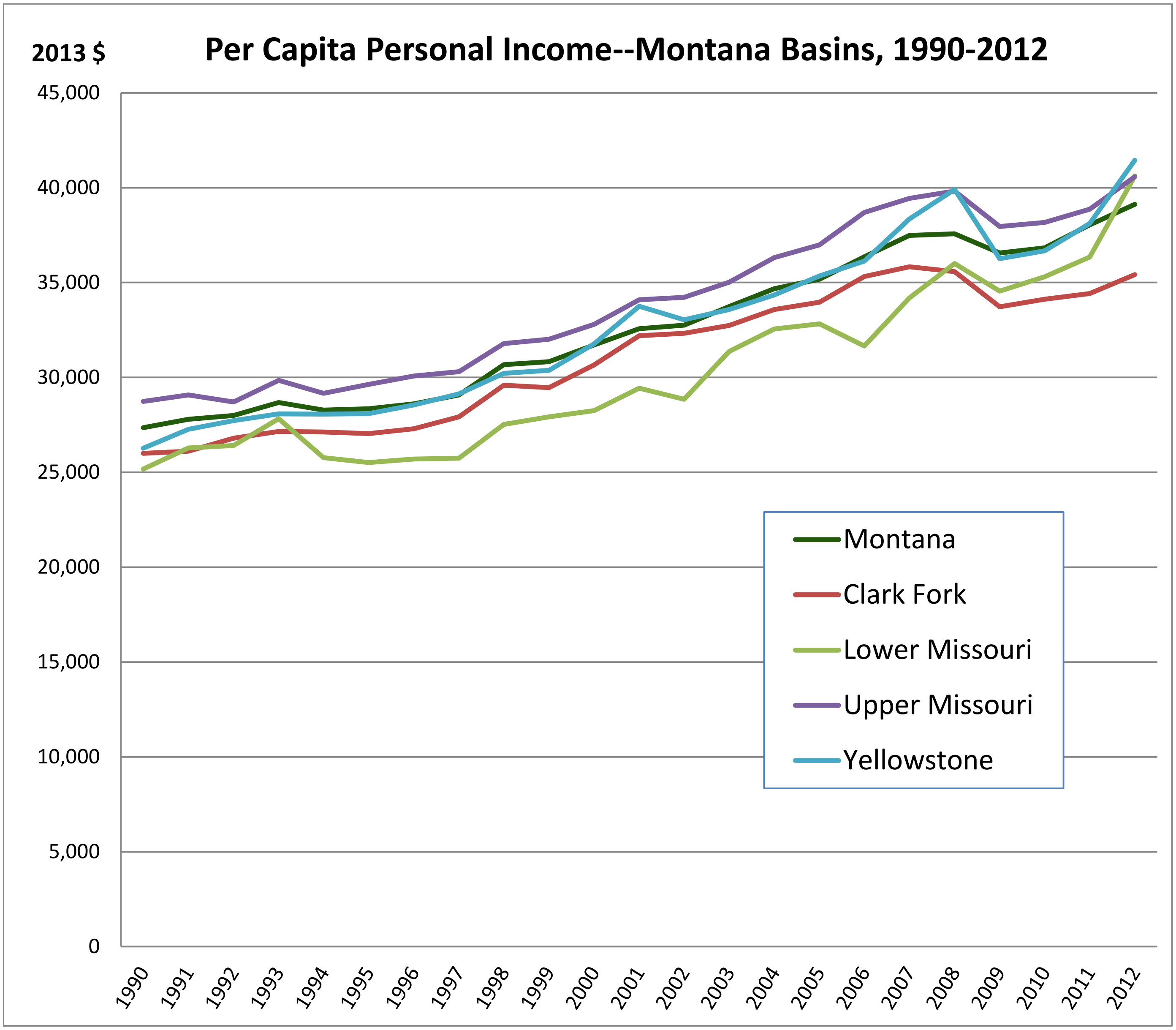
[1] Figures are from the U.S. Department of Commerce, Bureau of Economic Analysis, Table CA30, adjusted for inflation to 2013 dollars. Estimates are based on administrative records and survey and census data collected by various agencies.

increased by 85 percent, compared to an increase for Montana of 80 percent.

Per capita personal income (PCPI) in the Clark Fork Basin in 2012 was reported to be $35,896, compared to $39,126 for Montana. Personal income in 2012 (adjusted to 2013 $s) for the major basins in Montana is displayed in **Table III-2**. With $13.0 billion, the Clark Fork Basin was the basin with the highest amount of total personal income, but the lowest per capita personal income by a substantial margin. The sparsely populated Lower Missouri had the lowest TPI by a considerable amount, but the Basin nearly matched the Upper Missouri's $40,676 for the highest PCPI among the state's four major basins.

Between 1990 and 2012, per capita income in the Clark Fork Basin and in Montana, adjusted for inflation, increased by 37 percent. **Figure III-3** below presents similar upward trends in PCPI for each of the major basins over the period. PCPI in the Lower Missouri and the Yellowstone Basins increased at rates greater than the statewide increase with increases of 61 percent and 58 percent, respectively. Between 2007 and 2012, PCPI in the Lower Missouri increased by 19 percent while PCPI in the Clark Fork declined by 1 percent. The impacts of the recent recession are evident from the graph as are the contributions of strong prices for agricultural commodities and activity in the energy sector.

Figure III-3 Per Capita Personal Income



KEY ECONOMIC AND WATER USE SECTORS

Agriculture

Irrigation is the dominant commercial use of the state's water resources, accounting for 96 percent of all surface and ground water withdrawn for any purpose, about 11 million acre-feet. Irrigation water withdrawals include all water consumed by irrigated crops and pasture in addition to water lost in irrigation conveyance and application systems. Montana's irrigated crops include alfalfa, barley, cherries, corn, grass, oats, potatoes, sugar beets, and wheat. Irrigated agriculture is also an important component of the state's economy producing direct economic benefits through increased production and crop value and generating jobs and income for many Montanans.

Agricultural water usage varies across the state and is affected by climate, geology and soils, and proximity to water. In the eastern two thirds of Montana, irrigated agriculture is generally more robust economically than in the western third of the state. In these areas, agriculture is expanding, with more expansions planned, in part because water supplies are available for appropriation and suitable land is relatively cheap and available as compared with land in the western third of the state. In the mountain valleys that lie west of the Continental Divide, however, land suitable for agriculture is more limited and subdivision and other development has increased land values significantly in the last 20 years. Water availability is also affected by numerous basin closures.

Irrigation also has important indirect economic effects. These impacts materialize as irrigation increases the ecosystem's ability to produce some non-crop goods and services and decreases its ability to produce others. These effects, called externalities, have an impact on jobs and income throughout Montana. For example, some irrigation systems increase the supply of recreational opportunities on reservoirs and generate jobs in related economic sectors. At the same time, they eliminate recreational opportunities and affiliated jobs by dewatering streams and reducing instream water quality.

The externalities of irrigation are economically important throughout the state, although their importance varies from place to place. In many locations, they are more important than the direct increase in crop values resulting from irrigation. Evidence for this conclusion comes from several sources. In many places, the value of irrigated land is determined more by the land's ability to provide attractive scenery and other amenities than by its ability to increase net farm earnings. Several analyses have determined that society's willingness to pay to leave water in some streams and rivers exceeds farmers' willingness to pay to use the water for irrigation. All else equal, counties in the upper Great Plains with greater water-related recreational opportunities, often at irrigation-related reservoirs, typically have higher household incomes than those with lesser opportunities. Throughout Montana and other western states, counties with stronger natural resource amenities, such as water-related recreational opportunities, have higher rates of growth in jobs, higher levels of household income, and higher concentrations of entrepreneurs.

Industrial, Mineral and Energy Resources

Mining and petroleum production energy is an important use of water through-out Montana. These uses of water are more episodic than others; with use closely tied to economic markets and the life of an ore body or petroleum play. Most of the water used for hydro-fracking is used in the lower Missouri and Yellowstone basins. Hydropower is also an important non-consumptive use of water throughout the state.

Industrial water uses in the Clark Fork and Kootenai River Basins include mining, wood and paper products, hydropower generation, and non-agricultural food production. Metals are the primary natural resources mined in the basins. These other water uses are relatively small in comparison to water used for irrigated agriculture and hydropower generation.

Municipal and Domestic

This water use category includes domestic water use, whether supplied by an individual on-site well, a major municipality's water supply system or a community system in a subdivision. Municipal suppliers have diverse demands they must fulfill, which makes planning challenging. Water quality plays a role as well. Many municipalities rely on higher-elevation storage, which brings unique challenges (ice damage, forest fire effects, etc.). Municipal water demand figures vary widely, and may include residential, commercial, industrial, universities and government agencies. In-home water use is not generally highly consumptive, but lawn and garden uses sometimes are. Municipalities are being creative in other ways in planning for future water needs, including buying shares from state-owned reservoirs, leasing Bureau of Reclamation contract water, requiring existing water rights be transferred to the city when a city annexes land (both surface water and groundwater rights), and purchasing nearby rights to change to municipal use. DNRC continues to develop policies for rainwater harvesting and wastewater reuse. Generally, if the capture is within the place of use of an existing right, there is not a concern. DNRC is asking that anyone proposing rainwater harvest of more than 0.1 acre feet contact DNRC before moving forward. Regarding wastewater reuse, if the reuse is a new beneficial use of water a water right permit or change may be needed.

Recreation and Tourism

Recreation and tourism are also major uses of water in the state. Montana residents make frequent use of rivers, streams, natural lakes and reservoirs. Ten million visitors a year come to Montana to hike, fish, ski, bike, hunt, kayak, boat, and explore. When travelling in Montana, visitors indicated that clean waterways and clean air are among the most important attributes to their experience, as well as wildlife viewing opportunities, scenic vistas, open space, opportunities to view the night sky, and access to public lands and waterways.

Walking Fence Lines

The Challenge of History, Culture, and Jurisdiction in the Jocko

Kerry Doney is a man who embodies the demographics of his land. He lives just south of Arlee, in the Jocko River valley, where he currently serves as water commissioner for the Jocko Irrigation District and sits on the Clark Fork Task Force.

On his father's side, his lineage goes back to the homestead days, generations deep in ranching and logging. On his mother's side, he is Pend d'Oreille, an enrolled member of the Salish and Kootenai Tribes of the Flathead Nation. His dad grew up along nearby Doney Road, while his mom lived just half a mile from Doney's current home on Agency Road. Many of his family members still live in the valley. To say that Doney is embedded in his landscape is an understatement. He refers to a neighboring landowner who has lived there for 30 years as a newcomer.

Doney is soft-spoken, his handshake gentle, his face earnest. His home is modest and tidy, the ranch yard neat, full of pickup trucks, tractors, fuel tanks. It is early summer—the grass rich green, the willows leafed out, blackbirds raucous in the fields. The peaks up the drainage are still covered in snow. It looks like a good year for water.

"Ever since I was seven or eight," Doney says, "I was always on a tractor or riding a horse or fixing fence.

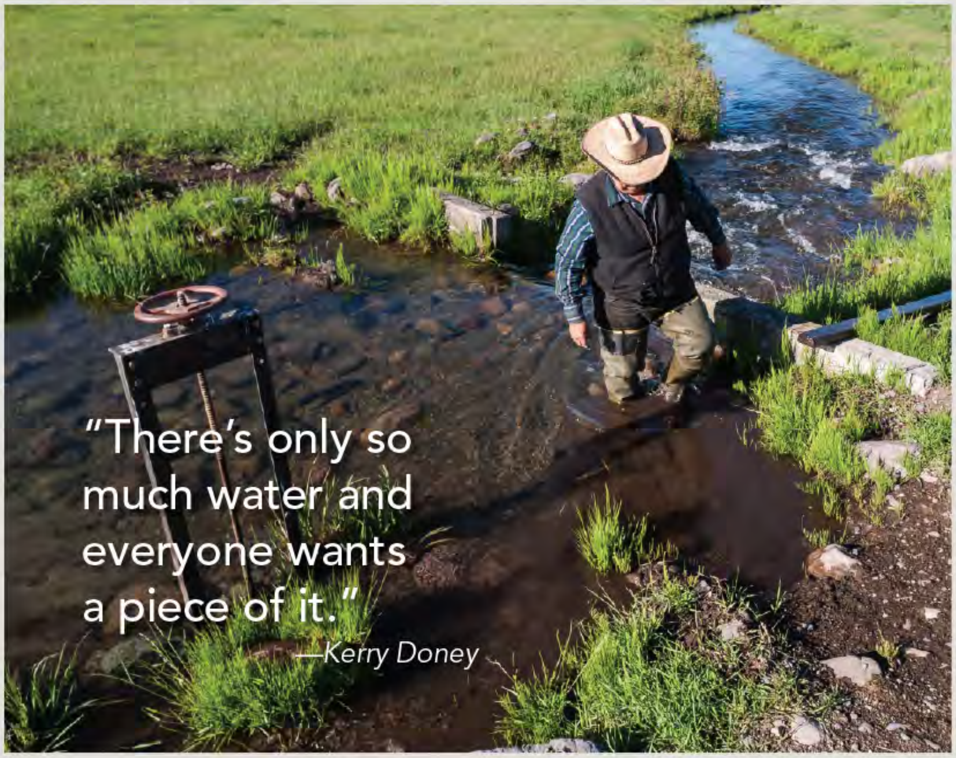
"By the time I graduated from high school, I had my own herd of twenty cattle. I hired my high school teachers to buck hay for me in the summers. Didn't seem to help my grades any," he laughs.

Doney now manages roughly 1,000 acres, a combination of his land, leased ground, and his mother's acreage. That land falls into a medley of categories, from 'fee land' to 'trust land' and some 'secretarial land'. "I'm fairly typical," he says.

The Jocko District is fed by water supplied by a series of small reservoirs, including Jocko Lakes and Black Lake, along with the flows from tributary streams. It is tribal water, administered through a federal agreement overseen by the Bureau of Indian Affairs. Tribal water is allocated just like irrigation water anywhere in Montana, but depending on the status of a given property, it falls into one of several categories.

Trust lands are acres held for tribal members by the federal government. Fee lands refer to property with assessed fees for water use and administrative costs. Secretarial land predates the irrigation district and is

STATE WATER-USER PROFILE



subject to a different fee rate. What Doney refers to as non-district land is acreage in a kind of limbo status, where the courts have yet to settle the legal designation.

More than 7,000 acres in the Jocko District are fee lands, split up among more than 400 users, some of whom irrigate as little as two or three acres.

"We don't have enough water storage to fill all of our water rights," says Doney. "We use water until it's gone."

That takes some paying attention. On his property, for example, Doney closely monitors the water supply. When it is about used up, he'll flood irrigate one last time, hoping water will soak in and keep the ground moist for the final cutting of hay. "I've never really been caught short," he says, "but 'weekend farmers' who aren't watching can get surprised when everything dries up all of a sudden. For someone like me, it's my livelihood. I can't afford to get caught."

"Last year we ran out of water on August 28. That's about two weeks shy of the usual irrigation season," Doney remembers.

Particularly in dry years, the two ditch riders in the Jocko District tend to take some heat. While Doney in his role as water commissioner doesn't ride ditches and negotiate individual disputes, he acts as "the on-the-ground eyes and ears for the BIA ."

"Last year one of my neighbors called, saying he wasn't getting water in his subdivision," Doney says.

"We talked about how to get it to him. I went up there and cleaned the ditch on some neighboring land, and then left the water running a little longer on my eighty acres upstream. He's been paying for water for years, but now, for the first time he was getting water. He was really tickled. I did that partly as the water commissioner, but mostly to be a good neighbor," Doney says.

As with precious water everywhere, that neighborliness can get strained. Add in the element of tribal ownership, and tensions mount. Currently, lawsuits are pending against the tribes, against the BIA, and against several individuals, including Doney, over water allocation throughout northwest Montana on tribal lands.

"Frankly," says Doney, "there are people who don't like anyone telling them how to use water. Not the feds, and especially not the Indians."

"This has turned into a big court battle. I heard we even made the news in France," Doney laughs.

"Because it is tribal water, this case will go to federal court.
It will be thirty years getting worked out. I'll be gone by then. The lawyers working this case will be gone by then. The only people making any money or getting satisfaction are the lawyers. It's ugly, and in the long run, it will hurt us all."

"There's only so much water," Doney sighs, looking out the kitchen window, "and everyone wants a piece of it."

That statement sums things up for all of Montana when it comes to the liquid treasure keeping us alive. ■

Environmental Concerns

The scope of environmental concerns in the Clark Fork and Kootenai river basins is as diverse and wide ranging as the watersheds themselves. The legacy of resource extraction and processing in the Upper Clark Fork Watershed has resulted in one of the largest superfund sites in the country and a watershed with a host of impairments to water quality, water quantity, soil contamination, and resulting impacts to fish, wildlife, and riparian function. Even an abbreviated examination of the environmental issues related to water resources in the Clark Fork and Kootenai river basins is beyond the scope of this report. It is important to note, however, that environmental concerns associated with water quality, water quantity, invasive species, urban growth, and land use management were identified by the public and resource professionals throughout the basin during the planning process. These issues also figured centrally in the deliberations of the Clark Fork Task Force as they developed the policy recommendations contained in this report.

A variety of anthropogenic factors influence the Clark Fork and Kootenai rivers' flora and fauna. The rivers' natural snow-melt driven hydrograph have been altered and their longitudinal and lateral connectivity have been affected. A variety of structures such as large dams, bank revetments (i.e., riprap), flow deflection structures (barbs, jetties, spur dikes, etc.) and flow confinement structures (i.e., levees, berms, dikes, etc.) have been installed along the banks and in the floodplain to the detriment of hydrologic function. Several nonnative fish and invasive species are present in waters throughout the basins.

THREATENED AND ENDANGERED FISH SPECIES

Of the fish species listed in ***Tables III-3 and III-4*** only the White Sturgeon is a federally listed endangered species. The Bull Trout is listed as threatened and the other are identified as species of concern. Among the factors suspected of contributing to its decline: loss of longitudinal connectivity (i.e., high head run of the river impoundments, low head diversion dams), altered hydrology primarily due to water and land-use development, and impaired water quality.

Table III-3 Fish Species of Concern in the Kootenai River Basin

Fish Species Common Name	Habitat	Agency Listing	Date Listed	Listed as
White Sturgeon	Large mountain rivers	USFS/BLM	2014-09-06	Endangered/Sensitive
Torrent Sculpin	Mountain streams, rivers, lakes			Species of Concern
Westslope Cutthroat Trout	Mountain streams, rivers, lakes	USFS/BLM	NDG	Sensitive
Columbia River Redband Trout	Mountain streams, rivers	USFS	NDG	Sensitive
Pygmy Whitefish	Deep cold lakes			Species of Concern
Bull Trout	Mountain streams, rivers, lakes	USFS/BLM	1998-06-10	Threatened/Special Status

Table III-4 Fish Species of Concern in the Clark Fork River Basin

Fish Species Common Name	Habitat	Agency Listing	Date Listed	Listed as
Westslope Cutthroat Trout	Mountain streams, rivers, lakes	USFS/BLM	NDG	Sensitive
Bull Trout	Mountain streams, rivers, lakes	USFS/BLM	1998-06-10	Threatened/Special Status
Arctic Grayling	Mountain rivers, lakes	USFS/BLM	2010-09-08	Sensitive

IV. Water Resources in the Clark Fork and Kootenai Basins

Physical Setting

PHYSIOGRAPHY

The physiography of the Montana landscape west of the continental divide is composed of forested mountains and intermontane valley bottoms. The watersheds of both the Kootenai and Clark Fork extend beyond the United States and Canadian border. Runoff from the Canadian Rockies in British Columbia contributes significantly to both systems.

The geography of the Clark Fork Basin is dominated by numerous ranges of the Rocky Mountains (see figure IV-1). The highest elevations are found near the Continental Divide in the eastern boundary of the basin, and the lowest elevations in the basin are in the Clark Fork and Kootenai River valleys along the Idaho border in the western portion of the basin. Elevations in the basin range from 10,793-foot West Goat Peak in the Pintler Mountains to the lowest point in Montana, the Kootenai River at the Idaho border at 1,804 feet. For the purpose of the Montana Water Supply Initiative, the continental divide forms the eastern border of the basin, the Canadian border forms northern border, and the Idaho state line forms the western and southern borders of the basin within Montana.

Figure IV-1 General map the Clark Fork and Kootenai Basins.

The majority of the basin is composed of forested mountain ranges and intermountain valley rangelands. Residential, urban, and developed lands are primarily confined to the valley floors. Rural subdivisions near populated areas have expanded to the forested interfaces between the valley floors and mountains.

CLIMATE

The climate varies widely throughout the 25,131-square-mile basin, ranging from semiarid to rainforest. In general, precipitation amounts are related to elevation: higher elevations typically receive greater precipitation. But terrain features heavily influence precipitation and can result in locally higher or lower precipitation.

The highest precipitation areas in the basin occur in the mountains along the Montana/Idaho border in west-central and northwestern Montana and along the continental divide near Glacier National Park and the Bob Marshall Wilderness.

Since climatic differences are so great between the valleys and the high mountain elevations, climate data for both areas will be presented separately.

Valley Climatology

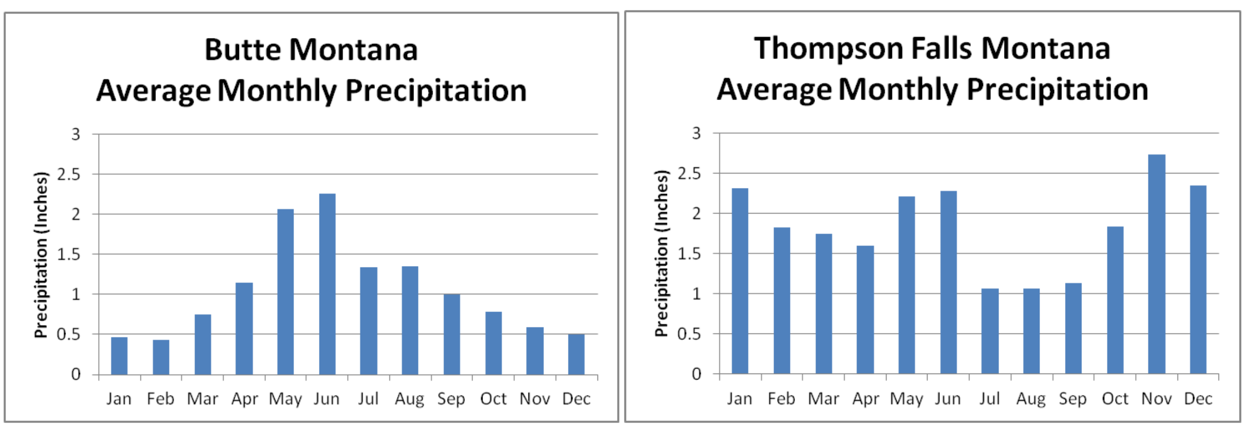
Valleys are generally drier and milder than the surrounding mountains. Table IV-1 presents average annual temperature, snowfall, and precipitation data for five valley locations. The climate of Butte (at approximately 5,550 feet) is one of the colder valley locations, with an average annual temperature of 40^{o}F, compared to 49^{o}F in Thompson Falls (at 2,400 feet). In valleys with cooler temperatures such as Butte and Kalispell, more of the precipitation falls as snow.

Table IV-1 Annual weather data for Missoula, Kalispell, Butte, Libby and Thompson Falls.

Location	Missoula	Kalispell	Butte	Libby	Thompson Falls
Average Annual Precipitation (Inches)	14	17	13	18	22
Average Annual Snowfall (Inches)	40	58	57	45	23
Average Annual Temperature (^{0}F)	45	43	40	47	49

May and June are the wettest months, with the exception of Thompsons Falls. There, November and December are the wettest months. The Lower Clark Fork and northwestern valleys have the wettest weather. Figure VI- 2 shows variability in monthly precipitation for Butte and Thompson Falls.

Figure IV-2 Monthly precipitation in Butte and Thompson Falls Montana.



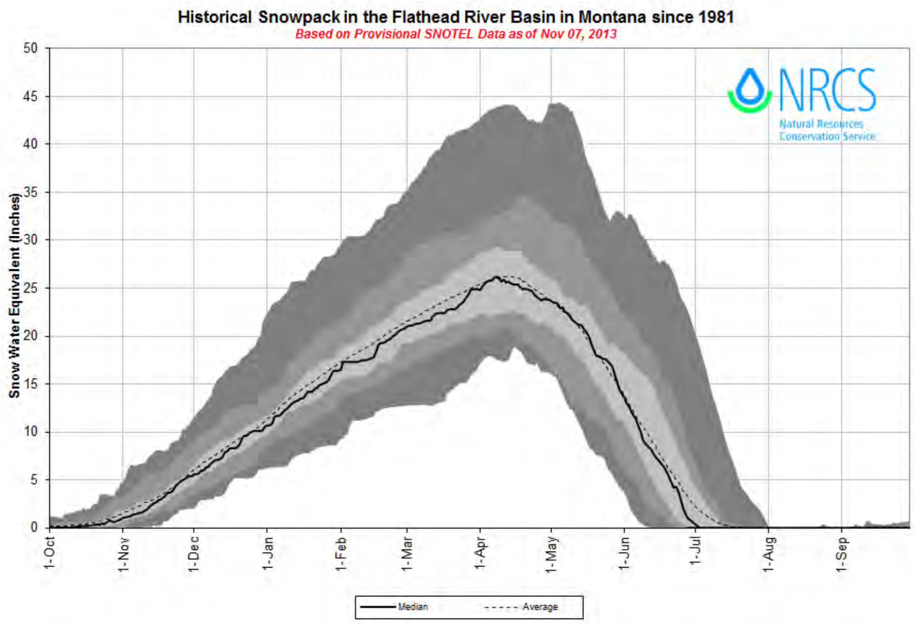
Mountain Climatology

Mountain temperature and precipitation is characterized by a much colder and wetter climate than found in the valley locations. Mountain climate data is collected primarily by the Natural Resources Conservation Service (NRCS) as part of their automated SNOTEL (Snow Telemetry) system for water supply forecasting. Mountain precipitation as snow, rain or Snow Water Equivalent (SWE) is measured at 32 locations in the Clark Fork and Kootenai Basins (Figure VI- 3). SNOTEL sites are listed in Appendix IV-1. SNOTEL sites are located at elevations ranging from 4,250ft to 8,250ft in the basin capturing mountain weather conditions and snowpack information at locations representative of variable climatic areas found in western Montana.

Figure IV-3 Map of SNOTEL sites in the Clark Fork and Kootenai basins.

Accumulation and melting of the winter of snowpack as SWE is presented for the Flathead Basin in the graph below (Figure IV- 4). Graphs for the rest of the basin can be found in Appendix IV-1. The graph for each area includes composite data from all of the SNOTEL sites in the basin and is representative of the timing of: snowpack accumulation, peak snowpack and melting of the snowpack. The average and median snowpack for the basins are indicated as well as variability as the dark gray shaded area indicates the 10th and 90th percentile snowpack. In general, the Upper Clark Fork has the lowest snowpack and the Flathead has the highest.

Figure IV-4 Accumulation of Snow Water Equivalent (SWE) in the Mountains of the Flathead River basin.

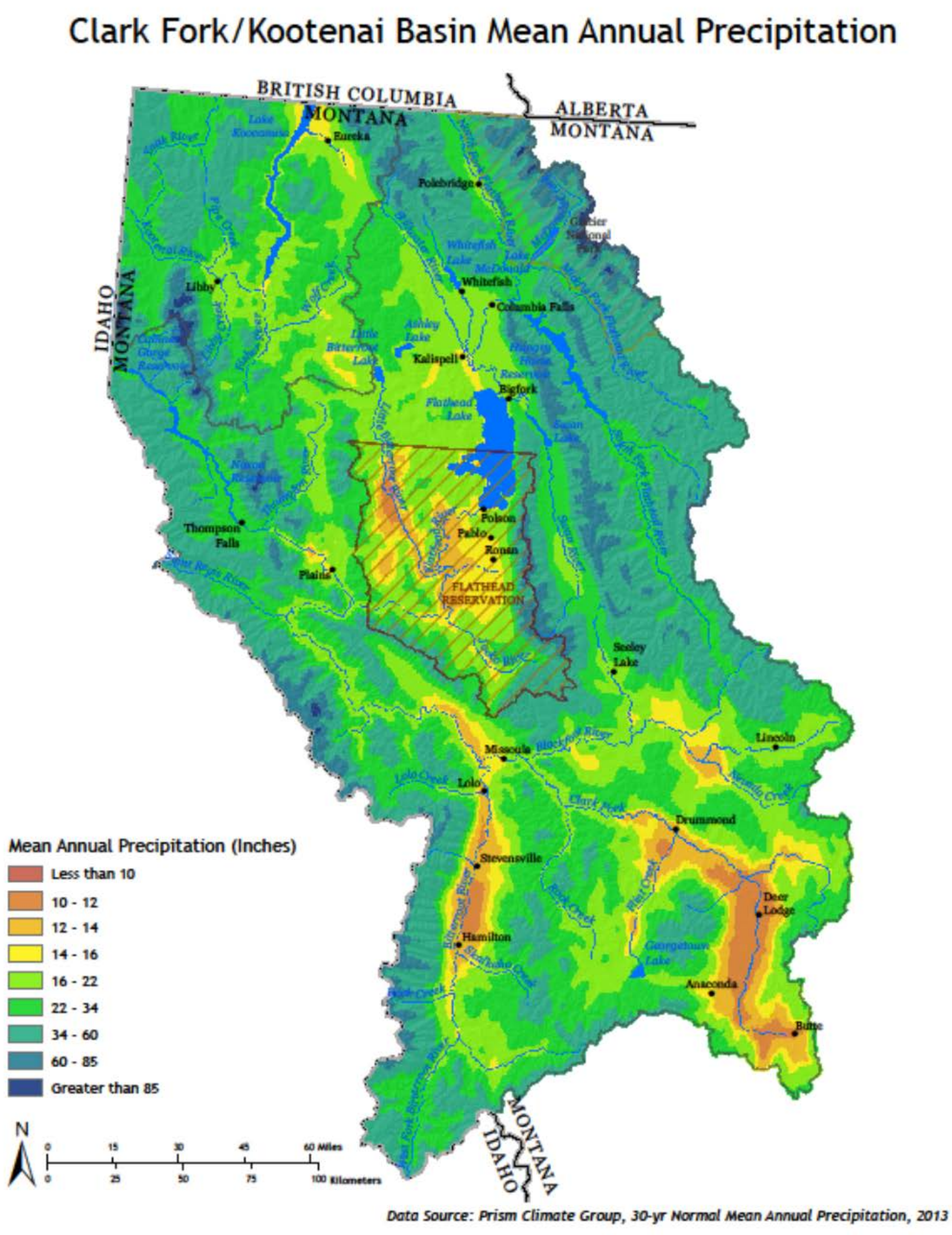


Basin Precipitation and Temperature

Precipitation and Temperature data for the Clark Fork and Kootenai basins are created using the Parameter-elevation Relationships on Independent Slopes Model (PRISM) model (Daly et al., 1998). PRISM estimates average monthly precipitation and temperature based on a climate-elevation relationship. Mean annual precipitation and temperature maps are created using the 30 year normals for the last thirty years of record 1981-2010.

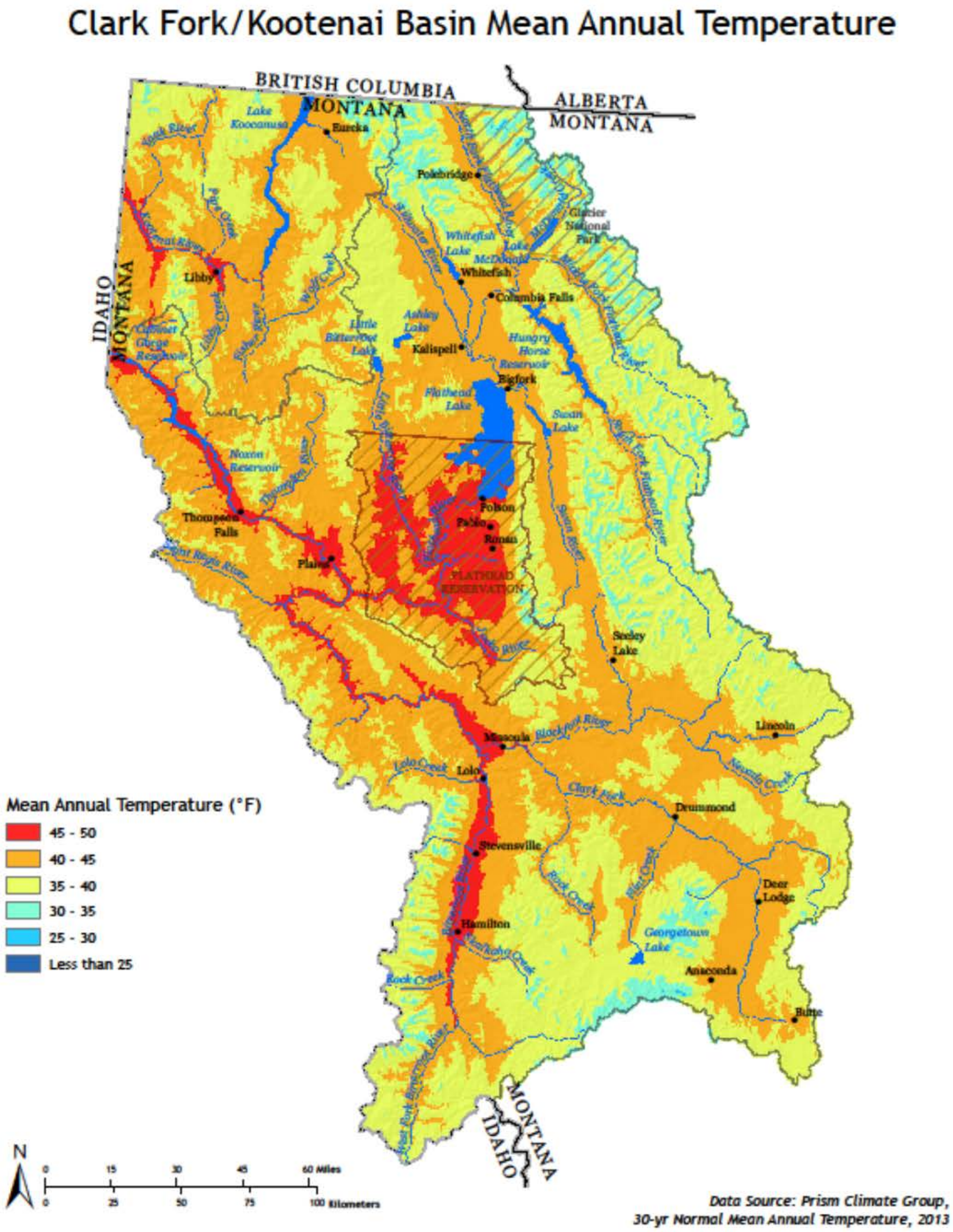
A mean annual precipitation map is presented in Figure IV- 5. The precipitation map indicates that mountains in Northwestern Montana and along the Idaho/Montana border have the highest precipitation in the basin. The mountains in the Southwestern portion of the basin receive less precipitation than mountain locations farther to the west and north.

Figure IV-5 Average annual precipitation (Inches) in the Clark Fork and Kootenai Basins



A mean annual temperature map is presented in Figure IV- 6. The temperature map indicates that the highest elevations in the basin have the coldest temperatures and the valley locations have the lowest temperatures. In general valley temperatures increase from east to west in the basin.

Figure IV-6 Average annual temperature (Fahrenheit) in the Clark Fork and Kootenai Basins.



GEOLOGY

Upper Clark Fork Region

Mountain uplift, intrusion of granitic rock, basin subsidence, and erosion in the Upper Clark Fork region have resulted in the deposition of complex sequences of sedimentary materials in valleys surrounded by bedrock mountains. The relatively broad valleys were formed when blocks of bedrock dropped along mountain-front faults as the Earth's crust was stretched. The resulting roughly parallel valleys contain thousands of feet of unconsolidated sediments and semi-consolidated sedimentary rocks eroded from the mountains. The variable character of the basin fill sediments reflects variations of climate, erosion rates, sediment deposition processes, and volcanic activity.

Unconsolidated surficial sediments generally consist of less than 100 feet of alluvium deposited along floodplains of the major streams, glacial till and outwash, dissected terraces remnants of older floodplains, and alluvial fan deposits that form benches around modern floodplains. Semi-consolidated sedimentary rocks overlying fine-grained units underlay unconsolidated surficial sediments and outcrop along the margins of many of the basins. Shallower coarser-grained Tertiary-age deposits were deposited as mud and debris flows and channel fills on alluvial fans (Fields et al., 1985). Deeper fined-grained Tertiary deposits consist of volcanic origin, lakebed silt, fine sandstone, wetland deposits, and local conglomerate (Fields et al., 1985).

Mountains in the Upper Clark Fork region include the Anaconda Range, Flint Creek Range, and Garnet Range. Bedrock units include granitic igneous rocks of the Bolder Batholith and the core of the Flint Creek Range, volcanic igneous rocks flanking the Bolder Batholith, metasedimentary quartzite, carbonate and argillite rock of the Belt Supergroup in the Garnet Range and Flint Creek Valley, and Mesozoic and Paleozoic carbonate and clastic rocks in the Anaconda and Flint Creek ranges.

Bitterroot and Middle Clark Fork Region

The Bitterroot Valley is down dropped between faults along the Sapphire and Bitterroot Mountains. Alluvial fan and glacial outwash terrace deposits form mountain foothills. Floodplains of the Bitterroot River and its major tributaries are underlain by surficial alluvium deposits and more than 3,000 feet of Tertiary semi-consolidated sediments.

Alluvium along the modern channels of the Clark Fork and Bitterroot Rivers is mostly less than 50 feet thick. Tertiary sediments in the Missoula Valley are exposed along the valley margins and are characterized as channel and floodplain deposits. Surficial deposits along the Middle Clark Fork include stream alluvium, terraces, and glacial flood and lake deposits.

Tertiary metamorphic rocks form the eastern face of the Bitterroot Mountains and Tertiary and Cretaceous intrusive igneous rocks make up the Bitterroot and Sapphire Mountains (Smith, 2006). Bedrock surrounding and underlying the Missoula Valley and the Clark Fork River valley downstream of Missoula is predominantly metasedimentary rocks of the Belt Supergroup.

Northwestern Region

The broader valleys in the northwestern region, including the Kalispell, Swan, and Mission valleys, contain thousands of feet of complex sequences of glacial lake deposits, glacial till, coarse-grained glacial outwash, and alluvium consisting of glacial sediments reworked by modern streams. Libby Creek near Libby and Lake Creek near Troy are shallower sediment-filled basins that are filled with hundreds of feet of glacial drift, glacial-lake bed deposits, and alluvium (Kendy and Tresch, 1996, Levings et al., 1984). The Kootenai River Valley and Tobacco Plains occupy the Rocky Mountain Trench north of Eureka and consist of till, lake deposits, and poorly to well-sorted outwash deposits.

Bedrock throughout the northwestern region is predominantly 1.4- to 1.5-billion-year-old metasedimentary carbonate rocks of the middle-Protozoic Belt Supergroup. Lesser amounts of granitic and volcanic igneous rocks as well as clastic and carbonate rocks of various ages outcrop throughout the region.

HYDROGRAPHY

The Clark Fork River is the largest river by volume in Montana. The Clark Fork River drainage comprises approximately 85 percent of the lands west of the continental divide in Montana, with the Kootenai River basin draining the remaining 15 percent.

The Clark Fork River originates west of the continental divide near Butte in southwest Montana. Flows from the Bitterroot and Blackfoot Rivers near Missoula increase the volume of the Clark Fork by 185 percent. Downstream of Missoula the Clark Fork River flows to the northwest where the Flathead River enters the system near Paradise, Montana. The Flathead is the largest tributary to the Clark Fork, which contributes 58 percent of the total flows of the Clark Fork at the Idaho border. The Clark Fork crosses the Idaho border near Heron, Montana and drains into Lake Pend Oreille. Here it becomes the Pend Oreille River, which continues to flow to the northwest into Canada where it joins the Columbia River.

The headwaters of the Kootenai River are located west of the Continental Divide in the Canadian Rockies of southeastern British Columbia. The total size of the watershed upstream of the Montana/Idaho border is 11,740 square miles, with 68 percent or 8,040 square miles, located in Canada. Once the Kootenai River crosses the Montana/Idaho border, it flows into Canada where it enters Kootenay Lake near Creston, British Columbia. The Kootenai River joins the Columbia River near Castlegar, British Columbia. The primary tributaries of the Kootenai River in Montana are the Yaak, Fisher, and Tobacco Rivers. These three tributaries add approximately 10 percent of the total flow of the Kootenai River at the Montana/Idaho border.

Three watersheds in the Clark Fork and Kootenai basins receive inflows from headwaters located in British Columbia, Canada. The most significant of these is the Kootenai River, followed by the North Fork of the Flathead and Yaak Rivers.

Sub-basins

Sub-basins of the Clark Fork and Kootenai basins are identified as major river basins to delineate between the hydrology of the headwaters areas of the Flathead and Clark Fork Rivers and the areas lower in the basin. Table IV-2 below indicates the major Sub-basins and associated drainage areas. Sub-basins further classified by the Hydrological Unit Code (HUC) eight digit or 4th order codes developed by the USGS to characterize drainage areas. Major sub-basins and basin 4th order HUCs can be seen Figure IV-7. Sub-basin names and size can be seen in Appendix IV-1.

Table IV-2: Major sub-basins of the Clark Fork and Kootenai watersheds.

Major Sub-Basin	Major River(s)	Drainage Area (Montana) Sq Miles
Clark Fork Headwaters	Clark Fork, Bitterroot, Blackfoot	8,856
Flathead Headwaters	North,South and Middle Forks of the Flathead River	3,765
Lower Flathead River	Flathead	8,469
Lower Clark Fork River	Clark Fork	21,641
Kootenai River	Kootenai, Fisher,Yaak and Tobacco	3,702

Figure IV-7 4th Order/ 8 Digit HUC Sub-basins of the Clark Fork and Kootenai Watersheds.

Surface Water Resources of the Clark Fork and Kootenai Basins

STREAMFLOW

Hydrology in the Clark Fork and Kootenai River Basins responds to the frequency, magnitude, and distribution of rainfall and melting snow. Mountainous source areas throughout the basins supply water to valley streams. The headwaters of the Clark Fork River include the Clark Fork and Flathead River Basins. The Clark Fork River originates along the west slope of the Continental Divide in west-central Montana. The Flathead River originates along the west slope of the Continental Divide in northwest Montana and in eastern British Columbia.

CLARK FORK BASIN

Headwaters of the Clark Fork Basin

The primary headwater tributaries of the Clark Fork River at Missoula are the Bitterroot, Blackfoot, and Upper Clark Fork Rivers. The typical hydrograph in the upper reaches is dominated by snowmelt from April through June when peak flows generally occur, followed by base flow conditions from August through the following April.

Upper Clark Fork River

The Upper Clark Fork River originates in the mountainous eastern portion of the watershed along the Continental Divide. The Upper Clark Fork River is fed predominantly by precipitation that falls along the west slope of the Continental Divide and in the Pintler, Flint Creek, Garnet, and Sapphire Mountains. The primary tributaries of the Upper Clark Fork include Warm Springs Creek, Little Blackfoot River, Flint Creek, and Rock Creek.

The Upper Clark Fork watershed drains 3,641 square miles at elevations ranging from 10,000 feet in the Pintler Mountains to 3,320 feet at the Turah gage near Missoula.

On average, the Upper Clark Fork River produces 922,805 acre-feet of water annually. Several storage projects exist in the basin. Three reservoirs in the Upper Clark Fork provide irrigation storage. The East Fork Rock Creek, Lower Willow Creek, and Georgetown Reservoirs, store 16,000, 6,230, and 32,000 acre-feet respectively. The East Fork Reservoir project transfers water from the Rock Creek drainage to the Flint Creek drainage. Silver Lake, located in the headwaters of Warm Springs Creek, provides 17,100 acre-feet of storage for municipal and industrial uses for Butte-Silver Bow County.

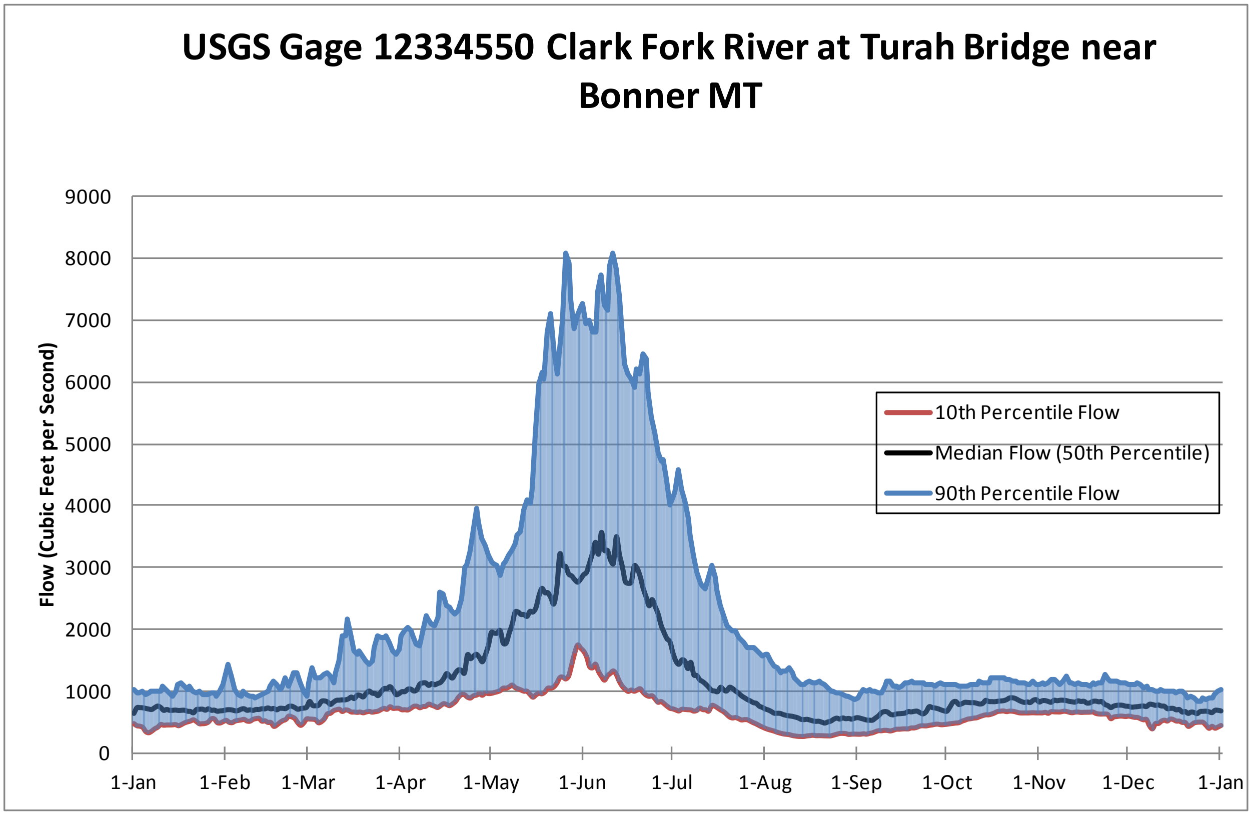
The Warm Spring settling ponds were constructed from 1911 to the late 1950s to remediate heavy metal contamination associated with mining activities in the Silver Bow Creek drainage. The Clark Fork River begins below the outlet structure of the lowermost pond at the confluence of Mill, Willow, and Silver Bow Creeks. The Warm Springs Ponds retain approximately 15,135 acre-feet (Warm Springs Ponds Operation and Maintenance Plan January 2006).

Figure IV-8 displays the normal range of flow for the Upper Clark Fork River near Bonner. The hydrograph represents flows leaving the watershed and reflects all contributions from tributaries and groundwater as well as depletions from consumptive uses. The period of record for the hydrograph is 27 years (1985-2012).

Daily median flow over the water year varies from the base (low) flow conditions from August through March, to elevated and peak flows in May, June, and July. The variability of flows between wet (90^{th} percentile) and dry (10^{th} percentile) years is greatest during runoff when water supply conditions are the highest for the year. During base flow conditions, the range of flows between wet and dry is less than during runoff, but the potential impact of low flows at this time is most noticeable. The Clark Fork Turah hydrograph shows a recovery in flows

in September, which is likely a function of reduced irrigation demand, irrigation return flows, fall precipitation, and a decrease in basin evapotranspiration.

Figure IV-8 Normal range of flow for the Clark Fork River near Bonner.



BITTERROOT RIVER

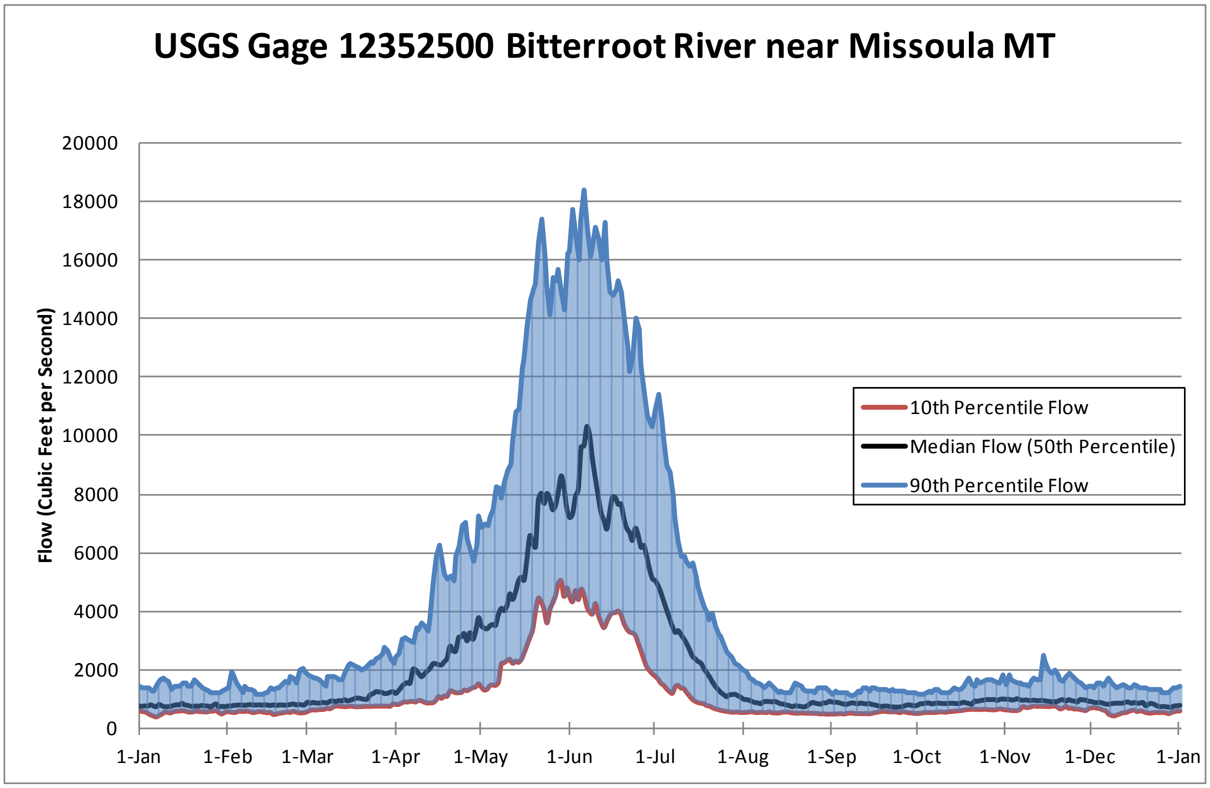
The Bitterroot River originates in the mountainous southern portion of the watershed. The Bitterroot River is fed predominantly by precipitation that falls in the Bitterroot Mountains and to a lesser extent in the Sapphire Mountains. The primary tributaries of the Bitterroot include the East and West Forks of the Bitterroot River, Skalkaho Creek, and Lolo Creek.

The Bitterroot watershed drains 2,814 square miles, with elevations ranging from 10,157-foot Trapper Peak in the Bitterroot Mountains to 3,100 feet near the confluence of the Bitterroot and Clark Fork Rivers.

On average, the Bitterroot River produces 1,722,986 acre-feet of water annually. There are two irrigation storage projects in the basin: Painted Rocks Reservoir on the West Fork of the Bitterroot River, and Lake Como, located on Rock Creek, a tributary of the main stem. Painted Rocks Reservoir and Lake Como store 32,362 and 38,495 acre-feet respectively, used primarily for irrigation and instream flows.

Figure IV-9 displays the normal range of flow for the Bitterroot River near its mouth at Missoula. The hydrograph represents flows leaving the watershed and reflects all contributions from tributaries and groundwater as well as depletions from consumptive uses. The period of record for the hydrograph is 27 of the 30 years represented from 1897-1901 and 1990 to 2012. Daily median flow over the water year varies from the base (low) flow conditions from August through March to elevated and peak flows in May, June, and July. The variability of flows between wet (90th percentile) and dry (10th percentile) years is greatest during runoff when water supply conditions are the highest for the year.

Figure IV-9 Normal range of flow for the Bitterroot River near Missoula.



BLACKFOOT RIVER

The Blackfoot River originates in the mountainous northwest portion of the watershed. The Blackfoot River is fed predominantly by precipitation that falls on the west side of the Rocky Mountain Front and on the Garnet, Swan, and the Mission Mountains. The primary tributaries of the Blackfoot include the North Fork Blackfoot River, Landers Fork, Nevada Creek, and Clearwater River.

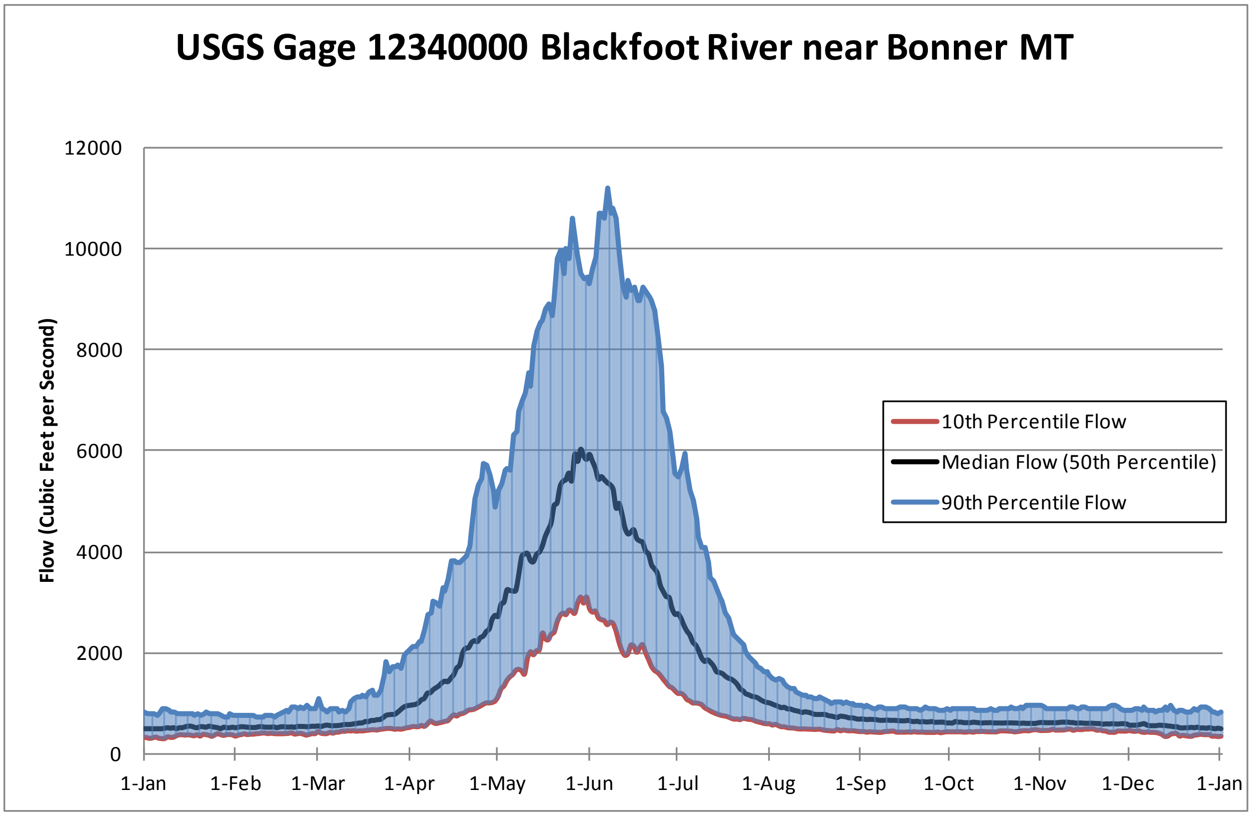
The Blackfoot watershed drains 2,290 square miles with elevations ranging from 9,000 feet in the Swan and Lewis Ranges to 3,344 feet near the confluence of the Blackfoot and Clark Fork Rivers.

On average, the Blackfoot River produces 1,138,512 acre-feet of water annually. There is one irrigation storage project in the basin. Nevada Creek Reservoir on Nevada Creek stores 11,000 acre-feet primarily for irrigation. The Blackfoot watershed contains numerous natural lakes and ponds, including the Seeley chain of lakes, Browns Lake, and Kleinschmidt Lake.

Figure IV-10 displays the normal range of flow for the Blackfoot River near Bonner. The hydrograph represents flows leaving the watershed and reflects all contributions from tributaries and groundwater as well as depletions from consumptive uses. The period of record for the hydrograph is 76 years of 80 years (1897-2012). Daily median flow over the water year varies from the base (low) flow conditions from August through March to elevated and peak flows in May, June, and July. The variability of flows between wet (90th percentile) and dry

(10th percentile) years is greatest during runoff when water supply conditions are the highest for the year. During base flow conditions, the range of flows between wet and dry is less than during runoff, but the potential impact of low flows at this time is most noticeable.

Figure IV-10 Normal range of flow for the Blackfoot River near Bonner.

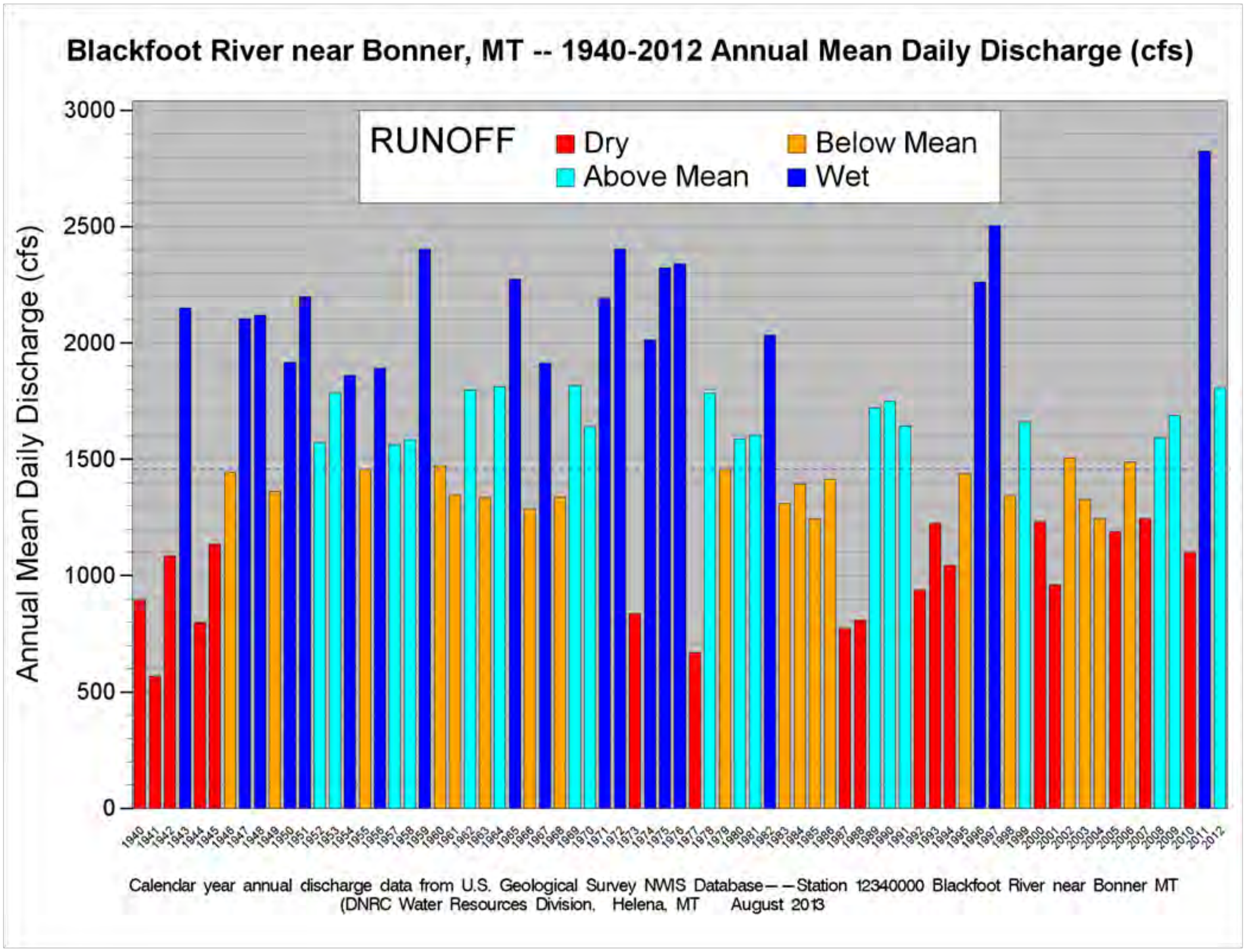


LONG TERM ANNUAL FLOW VARIABILITY IN THE HEADWATERS OF THE CLARK FORK BASIN

Water supply in the headwaters of the Clark Fork is dependent on snowpack, precipitation, and demand. Water supply varies throughout the year as shown in the hydrographs. Long-term annual records have been averaged to identify the mean (average), the highest 25 percent of flows (wet year), the lowest 25 percent of flow (dry), and years that fall above and below the mean.

The annual average discharge on the Blackfoot River near Bonner is presented in Figure IV- 11. Annual flows can demonstrate great variability from year to year as wet and dry years can occur sequentially. Average annual flows range from 550 to 2,800 cfs. As compared to the period from 1940 to 1976, the frequency of above-average or wet years has decreased from 1976 to 2012. The years 2000 to 2007 are notable as being the longest period without above-average flows.

Figure IV-11 Variability of average annual discharge of the Blackfoot River.



Headwaters of the Flathead River

The primary headwater tributaries of the Flathead River are the South Fork, Middle Fork, and the North Fork of the Flathead River.

South Fork Flathead River

The South Fork Flathead River originates in the mountainous eastern portion of the watershed. The South Fork Flathead River is fed predominantly by precipitation that falls in the Lewis, Swan, and Flathead Ranges. The headwaters of the South Fork of the Flathead are located primarily within the Bob Marshal Wilderness.

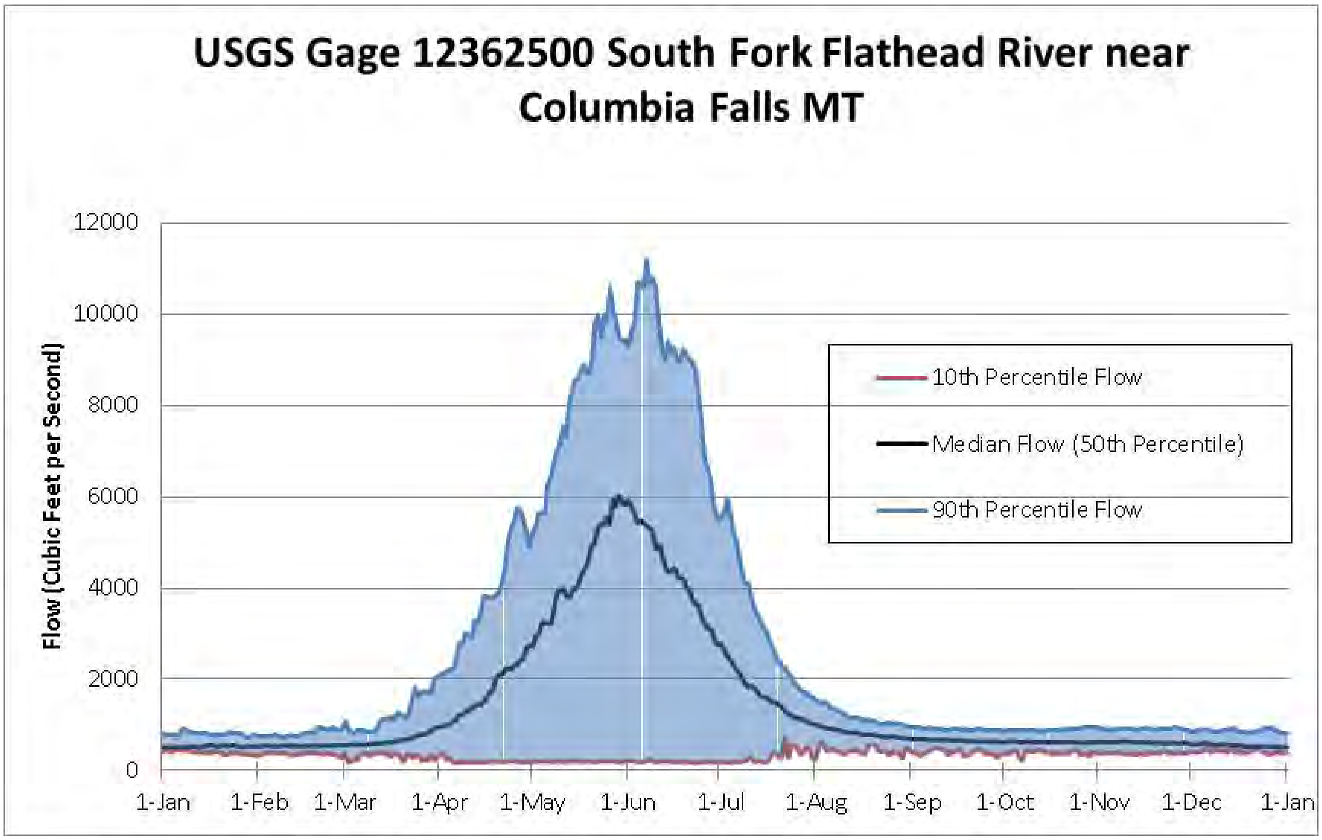
The South Fork Flathead watershed drains 1,663 square miles, with elevations ranging from 9,000 feet in the Swan and Lewis Ranges to 3,040 feet near the confluence of the South Fork Flathead and Flathead Rivers.

On average the South Fork Flathead River produces 2,515,366 acre-feet of water annually. The South Fork Flathead River is regulated by Hungry Horse Dam (constructed in 1952), which stores 3,588,000 acre-feet primarily for flood control and hydropower.

Figure IV-12 displays the normal range of flow for the South Fork Flathead River near Columbia Falls. The hydrograph represents flows leaving the watershed and reflects all contributions from tributaries and groundwater and depletions from consumptive uses. The period of record for the hydrograph is 84 years of the 92-year period from 1910 to 2012.

The hydrograph of the South Fork shows the effects of regulation for flood control and hydropower. Peak flows below the reservoir are reduced by approximately 40 percent, compared to the unregulated inflows to Hungry Horse reservoir. Minor peaks are likely related to reservoir drafting for flood storage or large runoff events that cause spilling. Regulation under varying water supply conditions is likely keeping the broad range between the 90^{th} and 10^{th} percentile flows during non-runoff periods (base flow conditions).

Figure IV-12 Normal range of flow for the South Fork Flathead River near Columbia Falls.



Flathead River at Columbia Falls MT

The Flathead River begins at the confluence of the Middle and North Forks of the Flathead River near Columbia Falls. The USGS gage on the Flathead River at Columbia Falls is representative of conditions found in the headwaters of the river. The North and Middle Forks of the Flathead River are unregulated. Flows on the South Fork are regulated by Hungry Horse Dam. The drainage area for the Columbia Falls gage is 4,464 square miles.

The North Fork originates in the mountainous headwaters along the west slope of the Continental Divide in southeastern British Columbia in the northern portion of the watershed. The North Fork of the Flathead River is fed predominantly by precipitation that falls in Glacier National Park and the Canadian Rockies. The North Fork Flathead watershed drains approximately 1,548 square miles. Elevations in the watershed range from 10,000

feet in the Livingston Range in Glacier National Park to 3,145 feet near the confluence of the North and Middle Forks northeast of Columbia Falls.

The Middle Fork of the Flathead River originates in the mountainous headwaters along the west slope of the Continental Divide in the eastern portion of the watershed. The Middle Fork is fed predominantly by precipitation that falls in the Flathead, Lewis, and Lewis and Clark Ranges. The headwaters of the Middle Fork are primarily located in the Great Bear and Bob Marshall Wilderness Areas. The Middle Fork Flathead watershed drains approximately 1,128 square miles. Elevations in the watershed range from 9,000 feet in the Lewis Range in Glacier National Park to 3,128 feet near the confluence of the South Fork Flathead and Flathead Rivers.

On average, the headwaters of the Flathead River produce 7,089,677acre-feet of water annually. As discussed earlier, the South Fork Flathead River is regulated by Hungry Horse Dam, which contains 3,588,000 acre-feet of storage used primarily for flood control and hydropower.

Figure IV-13 Normal range of flow for the Flathead River at Columbia Falls

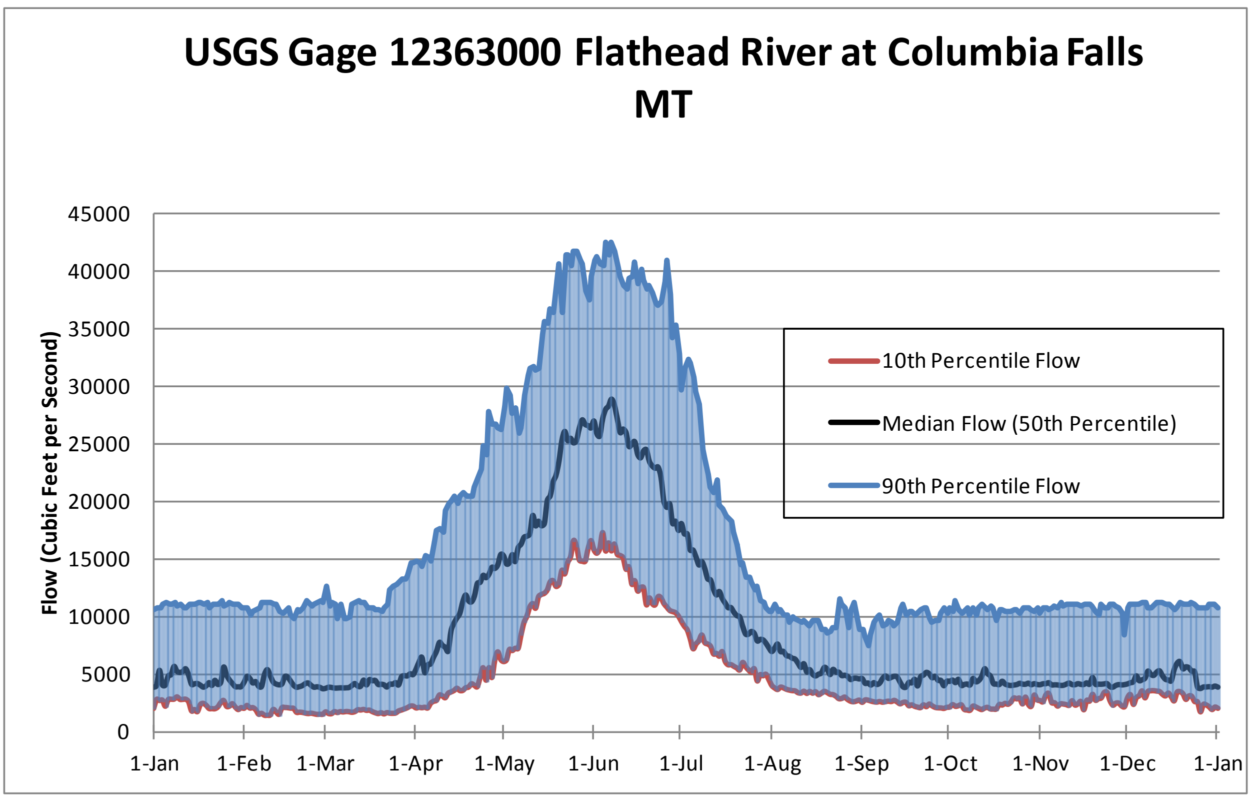


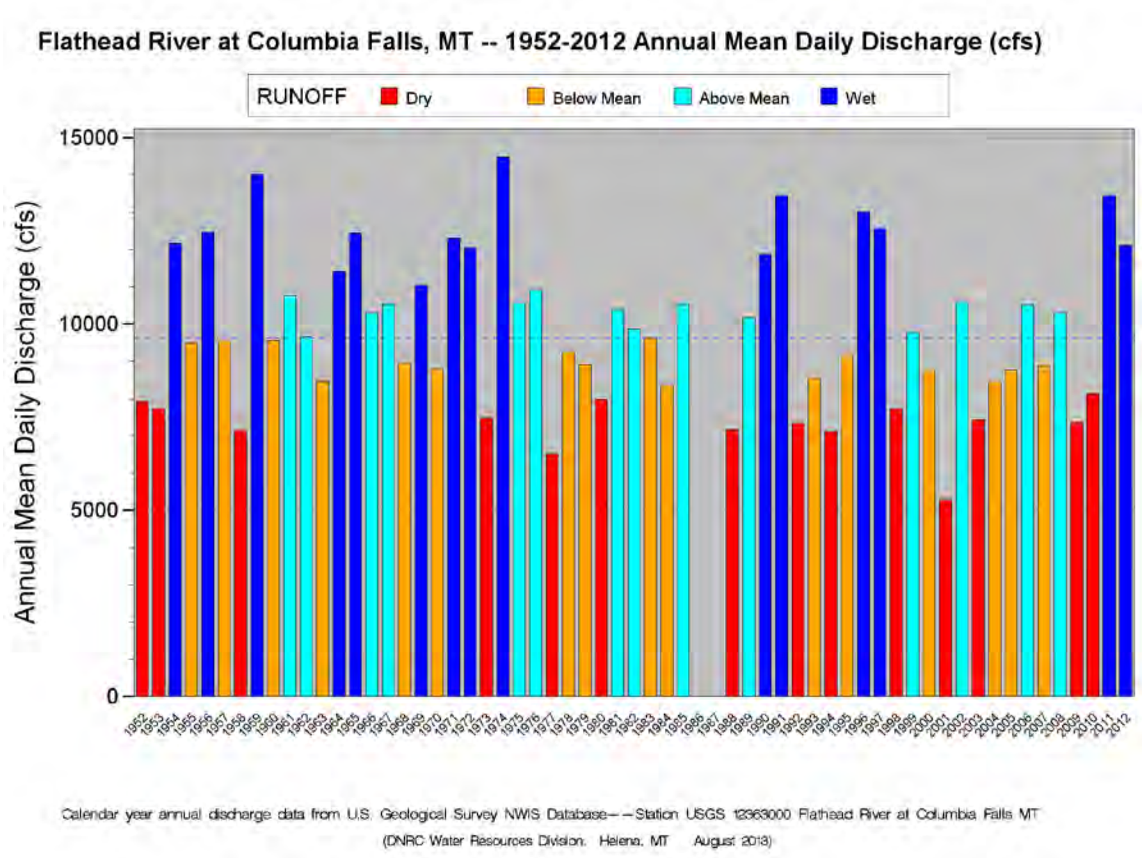
Figure IV-13 displays the normal range of flow for the Flathead River a Columbia Falls. The hydrograph represents conditions in the headwaters of the Flathead River. Consumptive uses in the South, Middle, and North Forks of the Flathead River above the Columbia Falls gage are minimal. Regulation of flows in the South Fork drainage is reflected in the hydrograph. The period of record for the hydrograph is 60 years of the 60-year period from 1951 to 2012.

Daily median flows over the water year vary from the base (low) flow conditions that occur from August through March to elevated and peak flows that occur in May, June, and July. The variability is flows between wet (90th percentile) and dry (10th percentile) years is notable. This is likely a function of minimal consumptive uses of water above the gage, regulation of the South Fork and the potential for the high rate accumulation of precipitation in the mountainous headwaters (Glacier National Park) that keep flows elevated during wet years.

Long term Annual Flow Variability in the Headwaters of the Flathead River Basin
Water supply in the headwaters for the Flathead River is dependent on snowpack and precipitation. The Flathead benefits because of the high precipitation rates in the drainage area and storage. The USGS gage on the Flathead River at Columbia Falls (12363000) was used for the period of the record 1952-2012.

The annual average discharge on the Flathead River at Columbia Falls is presented in Figure IV-14. Annual flows can demonstrate great variability from year to year as wet and dry years can sequentially. Annual average flows range from 5,000 to 14,000 cfs. Wet years on the Flathead River were less frequent during 1982-2012 than during 1952-1981. The periods from 1977 to 1980 and 1992 to 1995 are of note as being the longest time spans during which above-average flows were not observed.

Figure IV-14 Annual mean daily discharge on the Flathead River 1952-2012



LOWER CLARK FORK RIVER BASIN

Lower Flathead River

The lower Flathead River includes contributions from the mountainous headwaters in the northwestern portion of the watershed, mountainous areas of the west-central watershed, and contributions from drier lowlands in the central and lower portions of the basin. The primary tributaries of the lower Flathead River include the South, Middle, and North Forks of the Flathead River, Stillwater River, Swan River, Jocko River, and Little Bitterroot River.

The Flathead watershed drains 8,795 square miles. Elevations in the watershed range from 10,000 feet in the Livingston Range in Glacier National Park to 2,469 feet near the confluence of the Flathead and Clark Fork Rivers.

On average, the lower Flathead River produces 8,424,814 acre-feet of water annually. The Flathead River is regulated by Hungry Horse Dam on the South Fork with 3,588,000 acre-feet of storage for hydropower and flood control and by Kerr Dam on Flathead Lake with 1,200,000 acre-feet of storage for hydropower. Nine storage projects associated with the Flathead Indian Irrigation Project exist in Lake and Sanders Counties for the purpose of irrigation. These projects range in size from 28,400 acre-feet (Pablo Reservoir) to 7,225 acre-feet (McDonald Reservoir). The Flathead River feeds Flathead Lake, which is the largest freshwater lake (18,788,352 acre-feet) west of the Mississippi River (Flathead Biological Station).

Figure IV-15 Normal range of flow for the Flathead River at Perma.

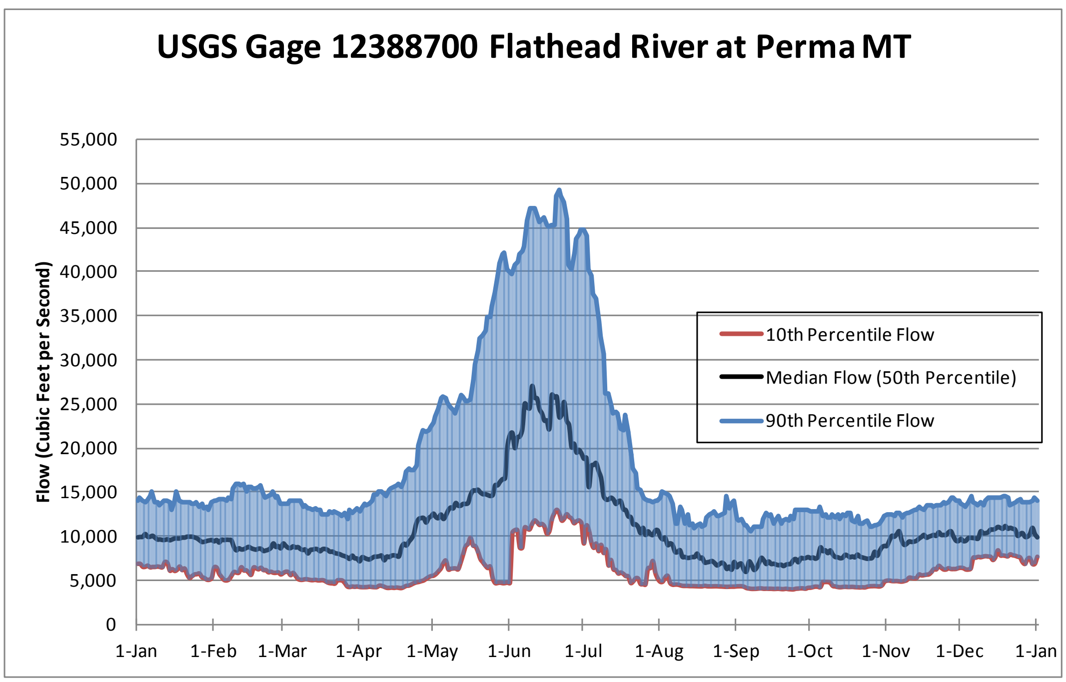


Figure IV-15 displays the normal range of flow for the Flathead River at Perma. The hydrograph represents flows leaving the watershed and reflects all contributions from tributaries and groundwater and depletions from consumptive uses. Flows of the Flathead River are regulated by Hungry Horse and Kerr Dams. The period of record for the hydrograph is 29 years (1983 to 2012).

Daily median flows over the water year vary from the base (low) flow conditions that occur from August through March to elevated and peak flows that occur in May, June, and July. The variability of flows between wet (90th

percentile) and dry (10th percentile) years is a similar to those conditions found upstream at the Columbia Falls gage. Dry year (10th percentile) flows are generally higher than the Columbia Falls gage, but the dry year peak is lower. This may be due in part to contributions of tributaries and regulation of flows in Flathead Lake.

Lower Clark Fork River

The lower Clark Fork River includes contributions from the entire Flathead watershed and contributions from the headwaters of the Clark Fork River, as well as tributary contributions from mountainous areas in the lower basin.

The Clark Fork watershed drains 21,833 square miles. Elevations in the watershed range from 10,000 feet in the Livingston Range in Glacier National Park and the Pintler Range to 2,185 feet near the Montana/Idaho state line.

On average, the lower of the Clark Fork River produces 14,346,847 acre-feet of water annually. The Clark Fork River is regulated by Hungry Horse and Kerr Dams in the Flathead watershed. The main stem of the Clark Fork is further regulated by hydropower projects at Thompson Falls and Noxon Rapids Dams, which store 8,300 and 400,000 acre-feet respectively.

Figure IV-16 Normal range of flow for the Clark Fork River below Noxon Rapids Dam near Noxon MT.

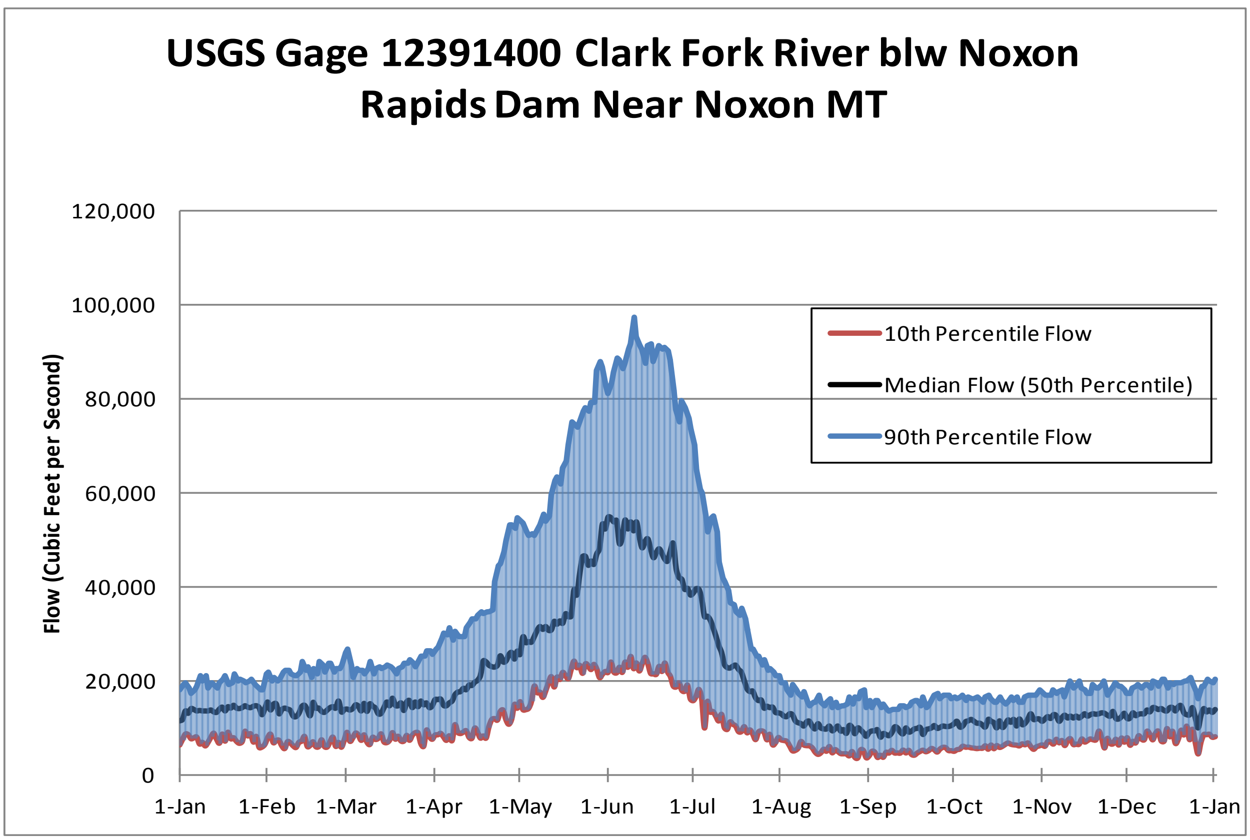


Figure IV-16 displays the normal range of flow for the Clark Fork River below Noxon Rapids Dam near the Idaho state line. The hydrograph represents flows leaving the watershed and reflects all contributions from tributaries and groundwater and depletions from consumptive uses. The period of record for the hydrograph is 52 years of the 53-year period from 1959 to 2012.

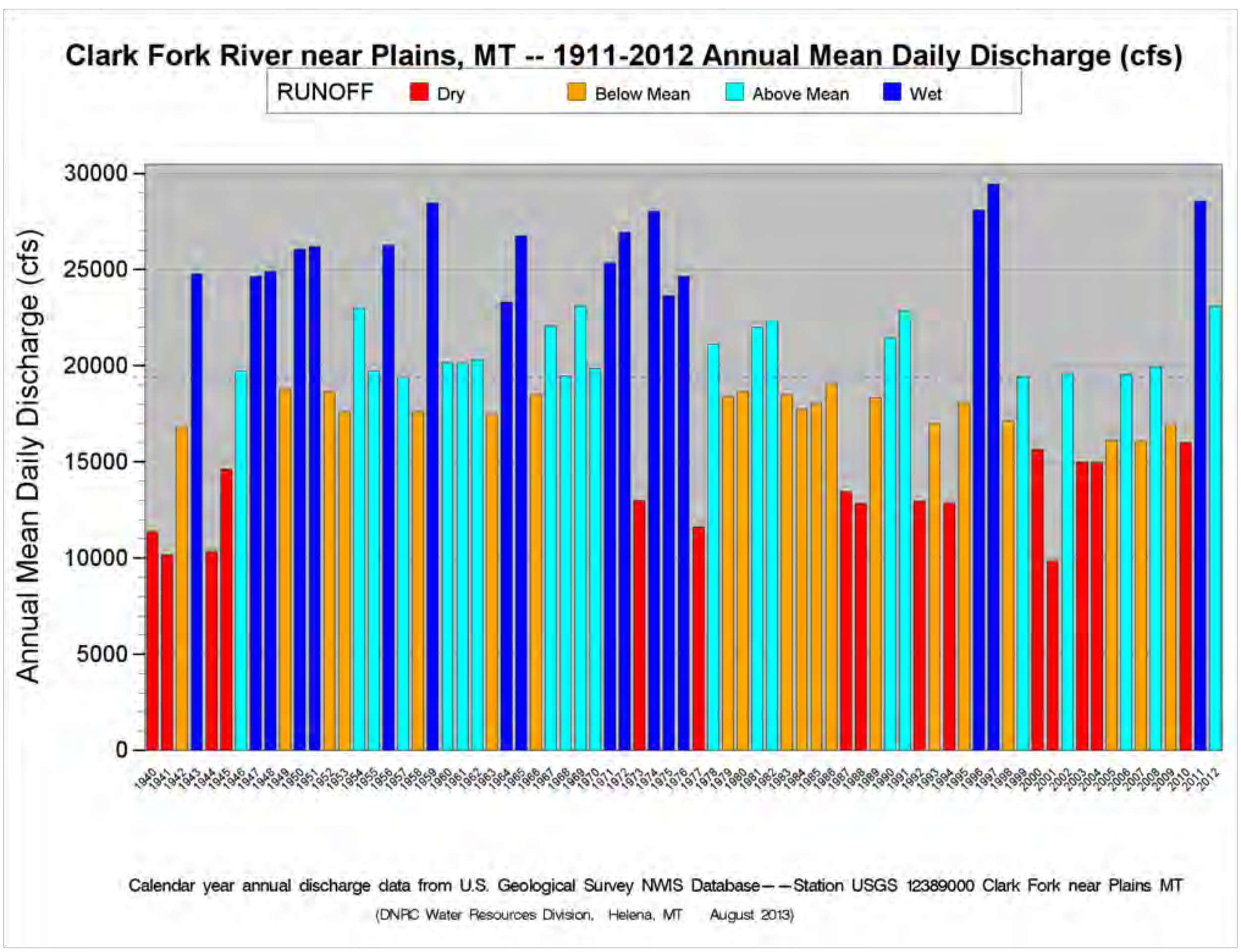
Daily median flows over the water year vary from the base (low) flow conditions that occur from August through March to elevated and peak flows that occur in May, June, and July. The variability of flows between wet (90th percentile) and dry (10th percentile) years is greatest during runoff, when water supply conditions are the highest for the year. During base flow conditions, the range of flows between wet and dry is less than during runoff, but the potential impact of low flows at this time is most noticeable. The hydrograph shows a recovery in flow conditions in September; this is likely a function of reduced irrigation demand, irrigation return flows, fall precipitation, and decreased evapotranspiration.

Long term Annual Flow Variability in the Lower Clark Fork Basin

Water supply in the lower Clark Fork is dependent on snowpack, precipitation, and demand. The lower Clark Fork Basin benefits because of the larger drainage area and increased water supply conditions in the lower basin. The USGS gage on the Clark Fork River near Plains (12389000) was used for the period of the record 1911-2012.

Variability in water supply varies throughout the year has been shown in the hydrographs. Yearly variability in annual flow conditions are show below. Figure IV- 17 shows the mean annual discharge on the Clark Fork River near Plains. Annual flows can vary greatly from year to year. The years 1983 to 1989 are of noted as being the longest period at which above average flows were not observed.

Figure IV-17 Mean Annual discharge on the Clark Fork River near Plains 1911-2012



KOOTENAI RIVER BASIN

The Kootenai River Basin drains 11,740 square miles upstream from the Montana/Idaho border, with 3,700 square miles in Montana and the remainder, including the headwaters, in Canada. The primary tributaries of the Kootenai in Montana are the Fisher, Yaak, and Tobacco Rivers.

Kootenai River

The headwaters of the Kootenai River are located west of the Continental Divide in the Canadian Rockies of southeastern British Columbia. The Kootenai flows south from the Canadian headwaters into Lake Koocanusa (formed by Libby Dam), which occupies lands in both in Canada and the United States. The Kootenai flows out of the lake, through Libby Dam, and then northwest to the Idaho border. The Kootenai River is fed primarily by precipitation that falls in the Canadian Rockies as well as the mountainous areas of northwestern Montana.

Elevations in the Montana portion of the watershed range from 7,500 feet in the Cabinet Mountains to the lowest elevation in the state at 1,820 feet where the Kootenai River exits Montana.

On average, the Kootenai River produces 10,044,398 acre-feet of water annually. The Kootenai River is regulated by Libby Dam, which stores 6,027,000 acre-feet primarily for flood control, hydropower, and other downstream uses. The Kootenai watershed contains numerous natural lakes and ponds, particularly in the Tobacco Valley.

Figure IV-18 Normal range of flow for the Kootenai River at Leonia, Idaho, near the Montana/Idaho border

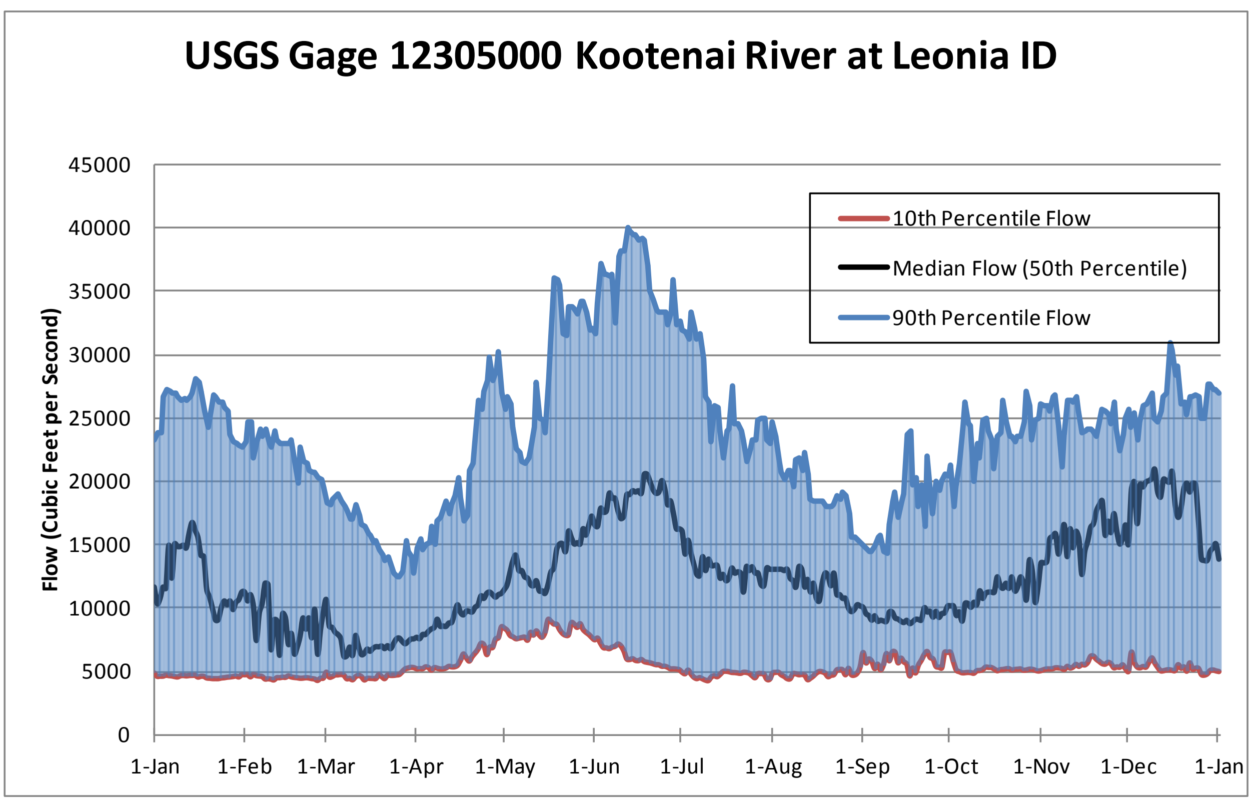


Figure IV-18 displays the normal range of flow for the Kootenai River at Leonia, Idaho, near the Idaho/Montana border. Flows measured at the Leonia gage reflect contributions from Montana tributaries and groundwater and depletions from consumptive uses in Montana. Kootenai River flows are regulated by Libby Dam, and the hydrograph reflects regulation for hydropower, flow control, and other downstream uses. The period of record for the hydrograph is 41 years (1971-2012).

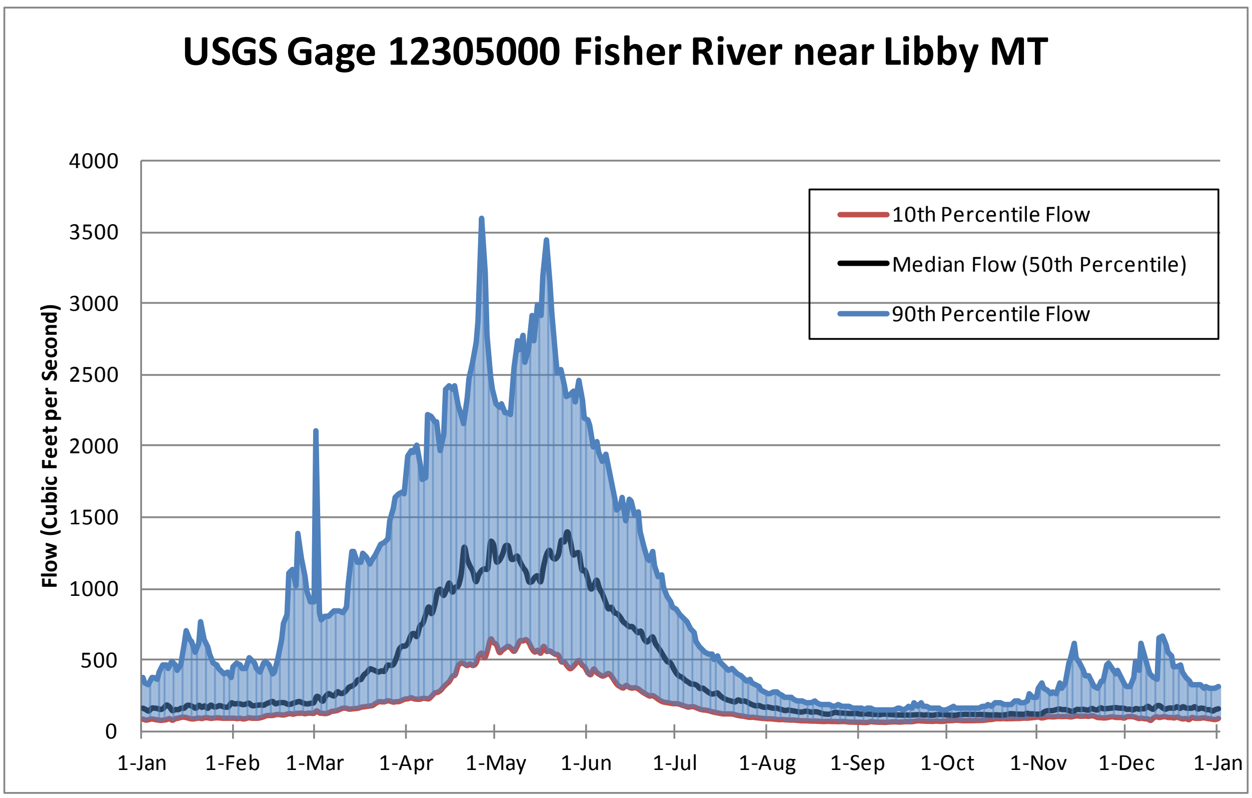
FISHER RIVER

The Fisher River originates in the mountainous headwaters of the eastern portion of the watershed. The Fisher River is fed predominantly by precipitation that falls in the forested Purcell Mountains of northwestern Montana.

The Fisher River watershed drains 838 square miles. Elevations in the watershed range from 6,000 feet in the Purcells to 2,137 feet at the Fisher River gage near the confluence of the Fisher and Kootenai Rivers.

On average, the Fisher River produces 338,425 acre-feet of water annually. No storage projects exist in the watershed.

Figure IV-19 Normal range of flow for the Fisher River near Libby MT.



The hydrograph in Figure IV-19 displays flows leaving the Fisher watershed and is representative of contributions from tributaries and groundwater and depletions from consumptive uses. The period of record for the hydrograph is 45 years (1967-2012).

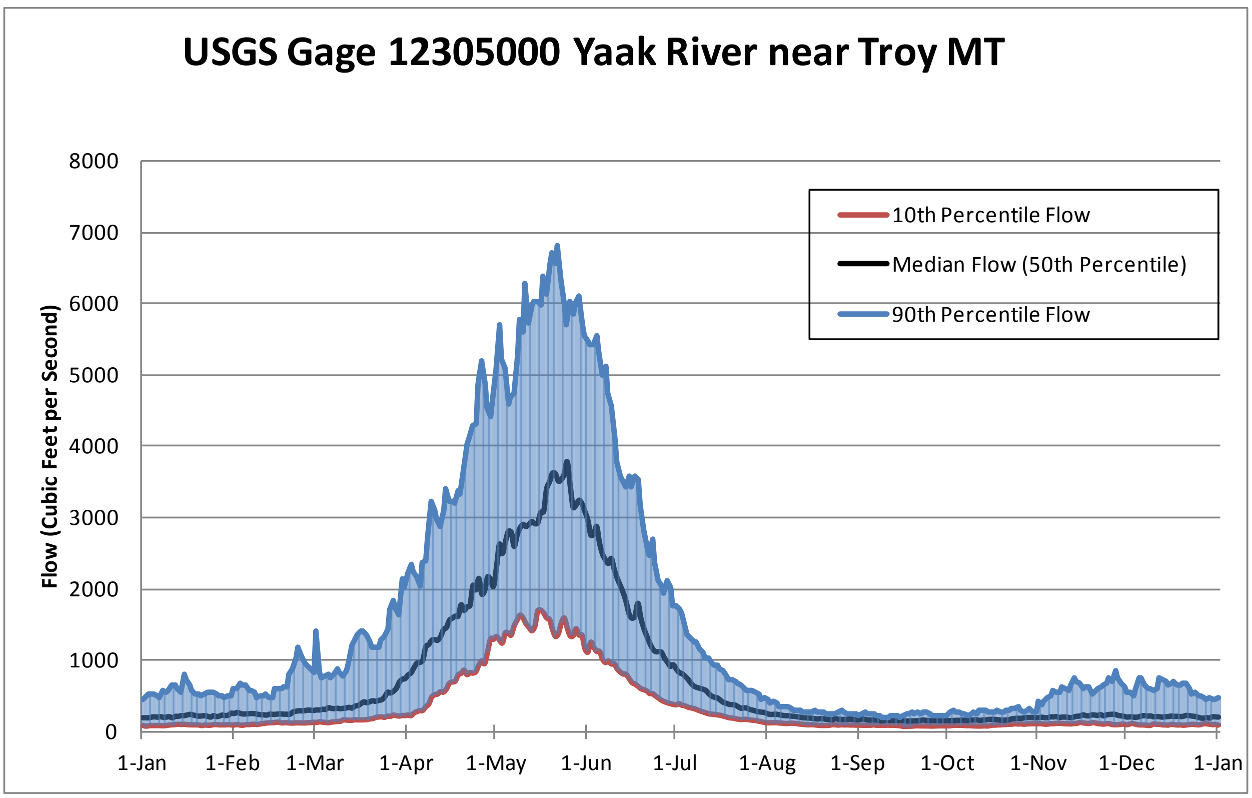
YAAK RIVER

The Yaak River originates in the mountainous headwaters of the northern portion of the watershed in Canada and Montana. The Yaak River is fed predominantly by precipitation that falls in the forested Purcell Mountains of northwestern Montana and Canada.

The Yaak watershed drains 791 square miles. Elevations in the watershed range from 7,000 feet in the Purcells to 1,839 feet at the Yaak River gage near the confluence of the Yaak and Kootenai Rivers.

On average, the Yaak River produces 585,442 acre-feet of water annually. No storage projects exist in the watershed.

Figure IV-20 Normal range of flow for the Yaak River near Troy MT.



The hydrograph in Figure IV-20 shows flows leaving the watershed and is representative of contributions from tributaries and ground water and depletions from consumptive uses. The period of record for the hydrograph is 56 years (1956-2012).

OPPORTUNITIES FOR RESEARCH AND INVESTMENT

For the larger streams in the Clark Fork and Kootenai River Basin, the USGS operates a comprehensive real-time streamflow gaging network. The data from which characterizes the amount, patterns, and ranges of flow for these streams. Most mid-sized and smaller streams in the basin are not gaged, and existing gages on these streams typically are seasonal, with no flow data collected during the winter. Funding the USGS long-term gaging program is important to continuing to characterize the flow on larger streams, to monitor flow trends, and for managing reservoir operations and diversions. A more comprehensive network of real-time gages on smaller streams would allow for better characterization and management of the flow of these streams too.

Groundwater Resources of the Clark Fork and Kootenai Basins

GROUND WATER

The groundwater inventory for the Clark Fork and Kootenai Basin includes discussions of source aquifers, estimates of groundwater contribution to surface water, and groundwater storage. Information on and the description of the aquifers is based on review of reports published by the Montana Bureau of Mines and Geology (MBMG) and the USGS, master's theses, and reports prepared by consultants for water right applications. Wells and springs yield water from aquifers in shallow alluvium, deeper semi-consolidated to consolidated basin-fill sediments, and bedrock.

Shallow Alluvium Aquifers

Alluvial aquifers comprised of river alluvium, terrace deposits, and glacial outwash deposits that occur along major streams are by far the most common sources of water for irrigation, municipal, industrial, household, and livestock purposes in the Clark Fork and Kootenai basins (Figure IV-21). Alluvial aquifers are typically less than 100 feet thick and are accessible by shallow wells at relatively low expense. Terrace deposits are older floodplain or alluvial deposits that have been left behind after a stream shifts position. Glacial outwash is exposed widely, especially in the Kootenai River Basin and the Flathead River sub-basin, with productivity depending on variable degrees of grain size sorting (Coffin et al., 1971).

Alluvium and terrace deposits are generally unconfined and are recharged by direct infiltration of precipitation, leakage from irrigation ditches, irrigation return flows, and seepage from streams, and they constitute a single water-bearing unit. Aquifer discharge includes diversion to wells, base flow discharge to surface water, seepage to springs, evapotranspiration, and subsurface underflow to other aquifers or basins.

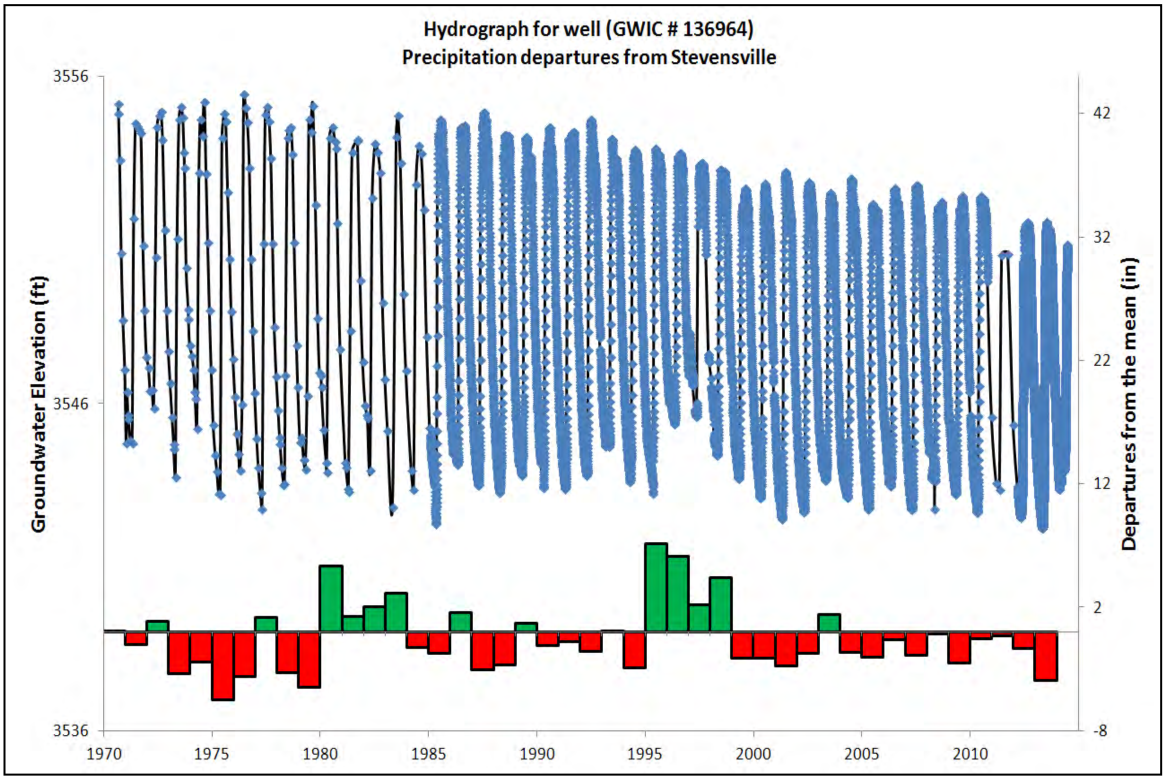
The Missoula Valley aquifer is a highly productive alluvial aquifer consisting of up to 200 feet of sand, gravel, and cobbles that is designated a sole source aquifer for Missoula (Smith, 2006; Woessner, 1988). The Missoula Valley aquifer discharges to streams, including the Bitterroot River and the Clark Fork River downstream of its confluence with the Bitterroot. Figure IV- 22 shows the annual increase in water levels during irrigation season from irrigation and canal leakage.

In the Deer Lodge valley, important source aquifers include 10 to 70 feet of sand and gravel alluvium in floodplains and adjacent terraces, glacial outwash deposits originating in the Flint Creek Range, and alluvial fan deposits (Smith, 2009). Alluvium and glacial outwash aquifers also are source aquifers in the Philipsburg Valley, Upper Flint Creek Valley, Blackfoot-Clearwater Valley and the adjacent Avon Valley (Kendy and Tresch, 1996). Coarse-grained unconsolidated alluvium and alluvial fans are less than 50 feet thick in the vicinity of Butte (Smith, 2009). Glacial outwash north of the Blackfoot River on Kleinschmidt Flat is possibly several hundred feet thick (Roberts and Warren, 2001).

Valleys of the Kootenai River Basin contain glacial sediments and alluvium that is relatively well sorted and provides for potentially high well yields. Libby is located in the Libby Creek Valley, which is filled with glacial sediments and alluvium estimated to be 100 feet thick and that can yield more than 500 gpm (Kendy and Tresch, 1996). Troy is located at the confluence of Lake Creek and the Kootenai River at the north end of the Lake Creek Valley, which is underlain by alluvial and glacial deposits consisting of sand and gravel (Levings et al., 1984). The Kootenai River Valley and Tobacco Plains consist of till and glacial lake and outwash deposits (Coffin et al., 1971). From 10 to 100 feet of well-sorted outwash is present beneath the Tobacco Plains; however, according to Coffin et al. (1971), much of it is found in terraces above the level of the Tobacco River and is drained. Outwash in the Eureka area generally is poorly sorted and low producing. In contrast, outwash along the Stillwater River is at river elevation and has greater production potential (Coffin et al., 1971).

Figure IV-21 Map of shallow aquifers in the Clark Fork and Kootenai Basins

Figure IV-22 Hydrograph of a well in the Bitterroot Valley that shows recharge from irrigation (*GWIC # 136964*)



Basin-Fill Aquifers

Discontinuous sand and gravel layers in the upper sequence of coarse-grained Tertiary-age basin-fill sediments can be productive aquifers although production generally is less predictable and at greater depth and expense than unconsolidated alluvial aquifers. Often there is no clear, distinct boundary between the Quaternary alluvium and the underlying Tertiary sediments. Recharge to Tertiary basin fill is through leakage from overlying alluvium and infiltration of precipitation and irrigation returns where they are at the surface around valley margins. Discontinuous water-bearing zones in Tertiary sediments are capable of producing only small yields to domestic and stock wells and produce sufficient amounts of water for irrigation where thicker gravel and sand sequences occur.

The most utilized water source in the Kalispell valley is a relatively deep alluvial aquifer referred to as the deep aquifer that underlies an area of 300 square miles and is up to 3,000 feet thick (LaFave et al., 2004). In the Little Bitterroot Valley, this deep aquifer is referred to as the Lonepine aquifer and also is the most productive aquifer in the area south of Flathead Lake. According to LaFave et al. (2004), large amounts of recharge enter the deep aquifer from the Mission and Swan Ranges.

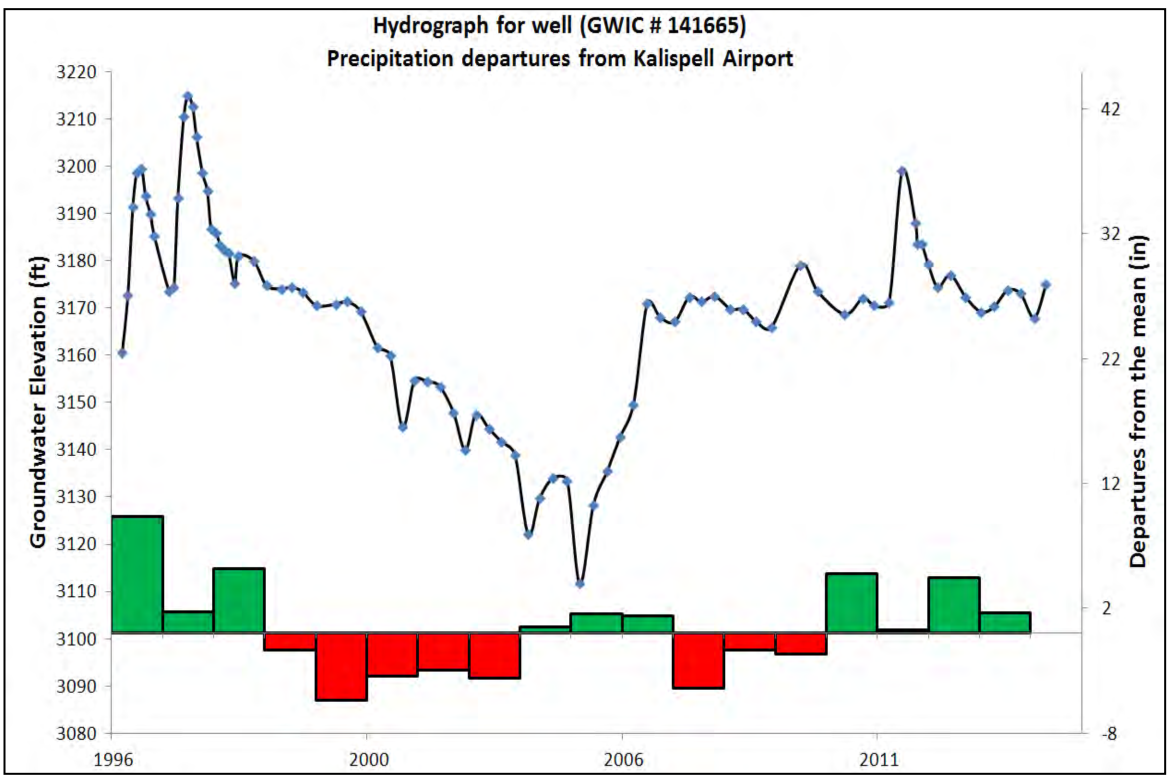
Tertiary basin-fill sediments in the Deer Lodge valley are estimated to range from 5,000 to 8,000 feet thick (Konizeski et al., 1968). In the Butte area, thin sequences of recent alluvial and glacial deposits are underlain by semi-consolidated Tertiary sedimentary rocks from 800 to 900 feet thick that compose most of the basin-fill material.

Productive aquifers in Tertiary sediments in the Bitterroot sub-basin are semi-confined near the mountain front to confined near the valley center and consist of multiple producing zones separated by confining units. Groundwater flow is from the valley margins toward the Bitterroot River, where it discharges by upward leakage to shallow unconfined aquifers and ultimately to surface water or evapotranspiration (LaFave, 2006). The primary recharge area for the deep basin-fill aquifers is the perimeter of the valley along the mountain fronts where confining layers are thin or absent.

Bedrock Aquifers

Groundwater within bedrock, primarily of the Belt Supergroup, is found primarily in discontinuous fractures and faults. Yields from bedrock wells can be large locally; however, fracturing is discontinuous and, as a result, Belt rocks do not form regional aquifers and wells typically are only sufficient to supply individual residential or small public water systems that use multiple wells. Recharge to bedrock aquifers is primarily derived from seepage from the streams, infiltration of precipitation, snowmelt in topographically high outcrop areas, and leakage from shallower alluvial aquifers (LaFave et al., 2004). Figure IV- 23 shows variations in groundwater trends related to climate variability in a Belt Supergroup well.

Figure IV-23 An example of a well in the Belt Supergroup that shows the result of changes in recharge due to climate (GWIC # 141665).

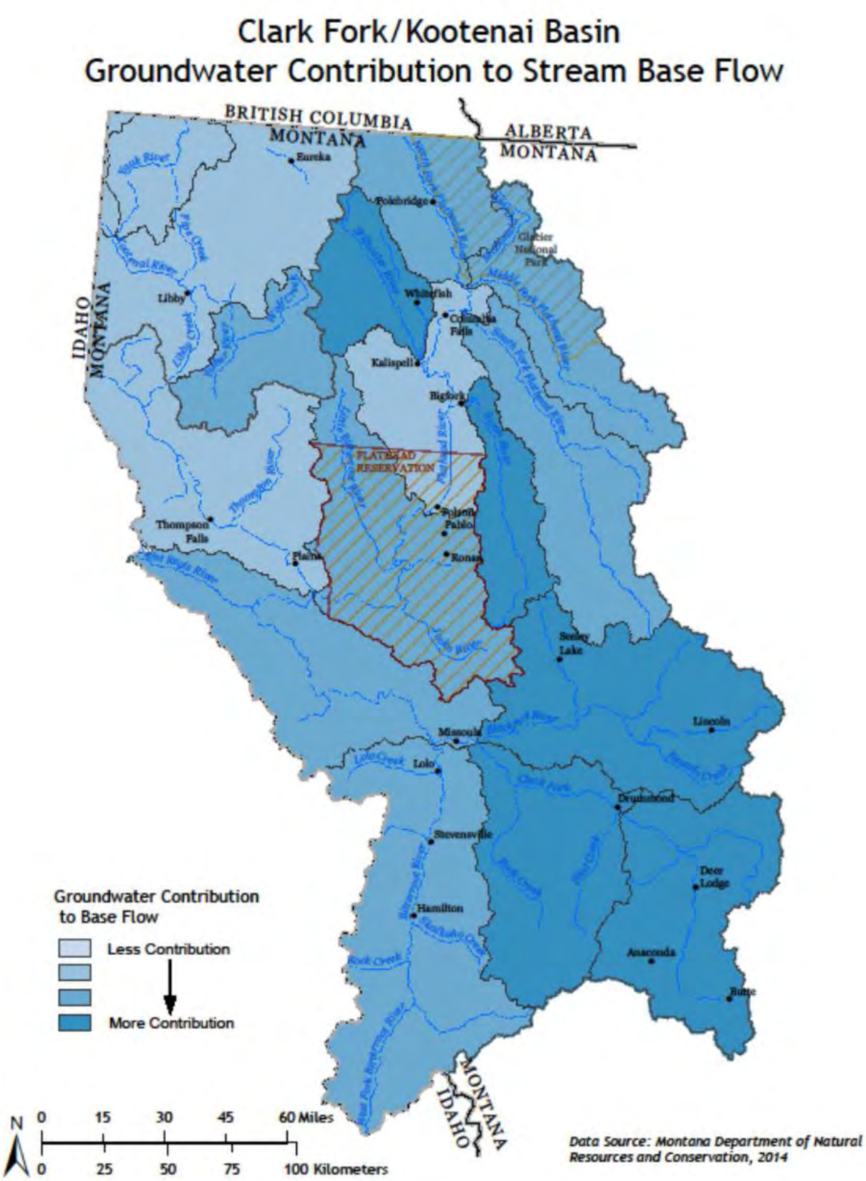


Base Flow Contribution

The contribution of groundwater to surface water base flow (Figure IV- 24) is derived from Base Flow Index (BFI) information from (Wolock, 2003A). BFI values, representing the ratio of base flow to total annual flow, are estimated by the USGS by automated hydrograph separation and are available for many historic gage sites across the United States (Wolock, 2003B). Where no gage exists, or for sites that are influenced by reservoir effects, BFIs can be estimated from another USGS product, an interpolated grid of BFI values (Wolock, 2003C).

To estimate the contribution of base flow in Montana, one gaged site was used to determine a representative BFI for each 8 Digit/4th Code HUC sub-basin. If a BFI specific to that site was estimated by USGS and that location was determined to be free of reservoir effects, then the BFI specific to that gage site was selected. Otherwise, the interpolated grid product was used to estimate a representative BFI. BFI values in (Wolock, 2003A) are based on surface water base flow estimates and, therefore, rely on assumptions that groundwater does not leave a basin through regional groundwater flow.

Figure IV-24 Generalized map of base flow index.

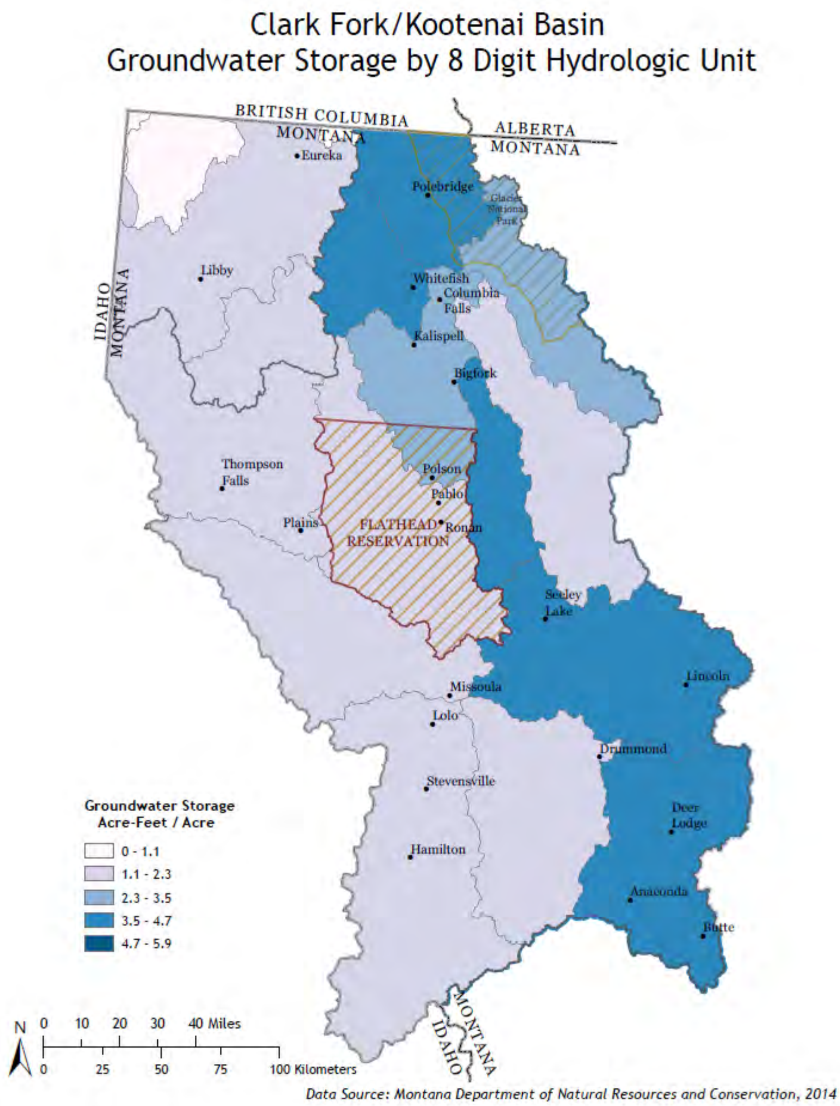


GROUNDWATER STORAGE

The groundwater storage capacity (Figure IV- 25) of the upper 50 feet saturated thickness of alluvial and Tertiary basin-fill aquifers is estimated from the areal extent of aquifers and their storage yields. The areal extent of alluvium, alluvial terraces, and Tertiary basin-fill sediments with the primary rock type identified as coarse grained is obtained from a digital geologic map available from USGS (2005). Aquifer storage is assigned a uniform specific yield value of 0.20.

The value of 50 feet for saturated thickness used in calculations is representative of the typical thickness of coarse-grained unconfined portions of aquifers and the thickness that accounts for the majority of groundwater circulation. Although an alluvial aquifer may store a considerable quantity of water, pumping cannot remove groundwater in aquifer storage without reducing discharge or inducing recharge, often to the detriment of surface water flows and rights of surface water users. Removal of even small amounts of groundwater resulting in much less than 50 feet of drawdown will deplete flows and impact existing users, thereby limiting new appropriations of groundwater.

Figure IV-25 Generalized map of groundwater storage (acre-feet per acre) in the upper 50 feet of saturated thickness of alluvium and basin-fill sediments.



OPPORTUNITIES FOR RESEARCH AND INVESTMENT

Information on the distribution and properties of aquifers is based on review of reports published by MBMG and USGS, master's theses, reports prepared by consultants for water right applications, and other documents included in a separate annotated bibliography. Maps and reports published by MBMG under the Ground-Water Characterization Program (GWCP) summarize available information and present maps and cross-sections of aquifers, and maps and hydrographs of groundwater levels and water quality. Groundwater level and water quality data are housed in the Groundwater Information Center (GWIC) database developed and managed by MBMG or in the National Water Information System (NWIS) housed with USGS. Table IV-3 lists the main data and interpretive products pertinent to the Clark Fork Basin and their availability by sub-basin. Summaries by watershed and references for these products follow.

Table IV-3 Maps and reports published by MBMG through the Ground-Water Characterization Program.

	Flathead Lake	Lolo-Bitterroot	Upper Clark Fork	Lower Clark Fork	Kootenai
Data Compilations	✓	✓	✓		
Geologic Maps	✓	✓	✓		
Geologic Cross-sections	✓	✓	✓		
Potentiometric Maps	✓	✓	✓		
Hydrographs	✓	✓	✓		
Water Quality Maps	✓	✓	✓		
Resource Development	✓	✓	✓		

The Groundwater Investigations Program (GWIP), also administered by MBMG, is a potential source of hydrogeologic information at the scale of a few square miles to address specific issues such as surface water depletion by groundwater development and water quality. Prospective GWIP projects are ranked for consideration by the Groundwater Assessment Steering Committee. Current GWIP projects are ongoing in the Florence, Stevensville, and Hamilton areas of the Bitterroot valley, and on the Flathead valley deep aquifer within the Clark Fork Basin.

V. Water Use in the Clark Fork and Kootenai Basins

Inventory of Consumptive Use in the Clark Fork and Kootenai Basins Associated with Existing Water

DNRC first published summaries of water use by county and HUC in 1986. Consumptive use of water in Montana has been most recently quantified by the USGS in the document Estimated Water Use in Montana 2000. USGS produces an estimated water use document every five years.

USGS categorizes consumptive use of water as follows: irrigation, livestock, thermoelectric, self-supplied industrial, self-supplied domestic, and public water supply. Consumptive use data compiled by USGS includes both surface water and groundwater.

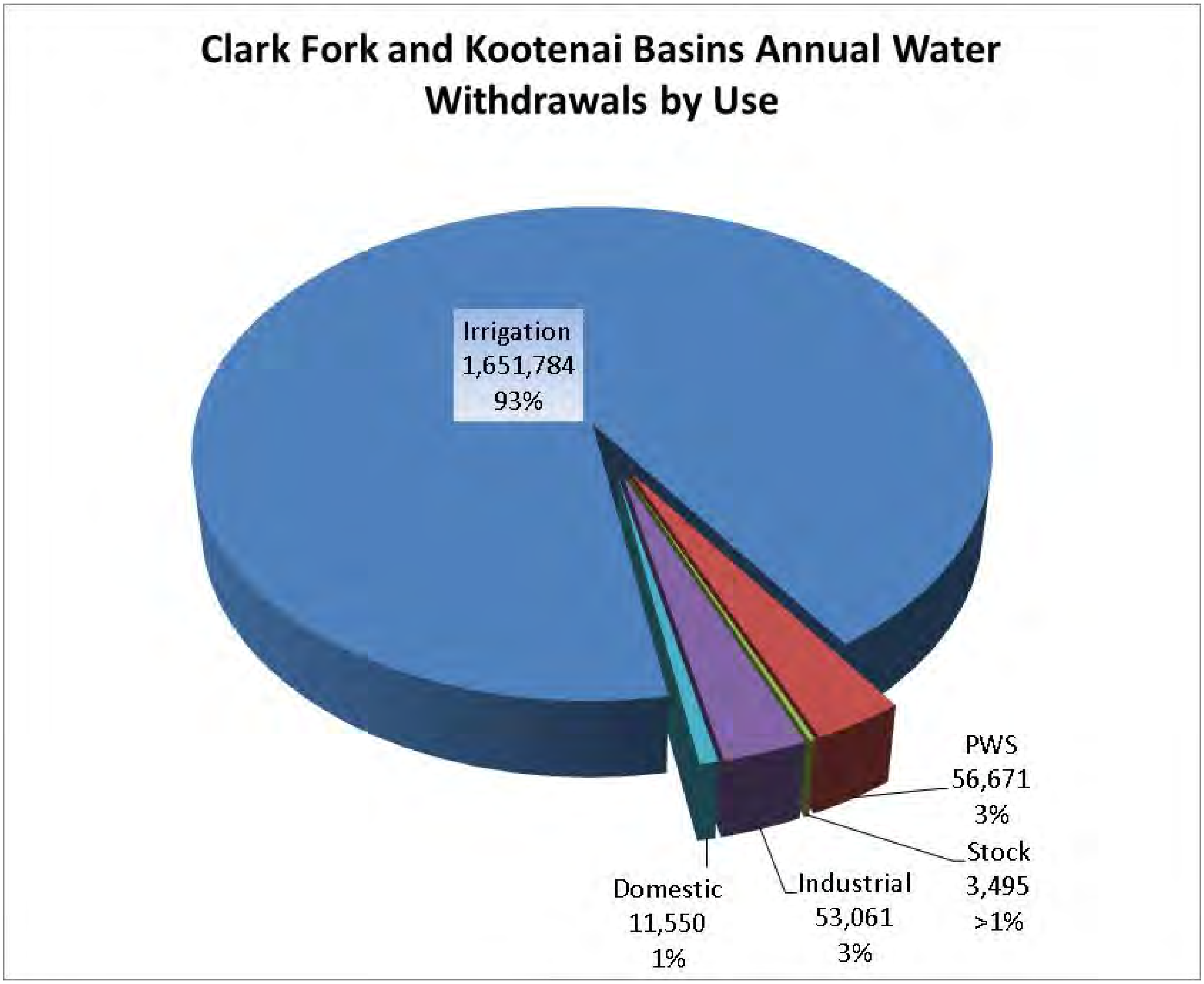
Annually, about 1.77 million acre-feet is diverted from the Clark Fork and Kootenai Rivers and their tributaries for irrigation, stock, industrial, municipal and domestic use. The largest of these uses is irrigation, which accounts for about 93 percent of all diversions. Only a portion of the water diverted for these uses is consumed. Of the total volume diverted, 486,000 acre-feet (about 27 percent) is consumed, with over 93 percent of the consumption attributed to irrigation.

Much of the water that is diverted for use will eventually return to the water source—a river, stream, or groundwater aquifer. In the case of municipal systems, most household water that is used will flow back through the waste-water system and may return to the original source, or another stream or aquifer, downstream, after treatment. In the case of irrigation, a portion of the diverted water is consumed by the crop through the process of evapotranspiration and some water is depleted, irrecoverably, during application, such as water that is evaporated before it hits the ground during application by sprinklers. Most of the rest of the water will eventually return to the source, although there can be a substantial time lag for irrigation water that returns through an aquifer system.

Surface and ground water withdrawn from the Clark Fork and Kootenai Basins is show in Figure V-1 Approximately 93 percent or 1,651,784 acre-feet of diverted water is diverted for irrigation. The other 7 percent or 124,776 acre-feet is a combination of public water supply (PWS), domestic, stock, and industrial.

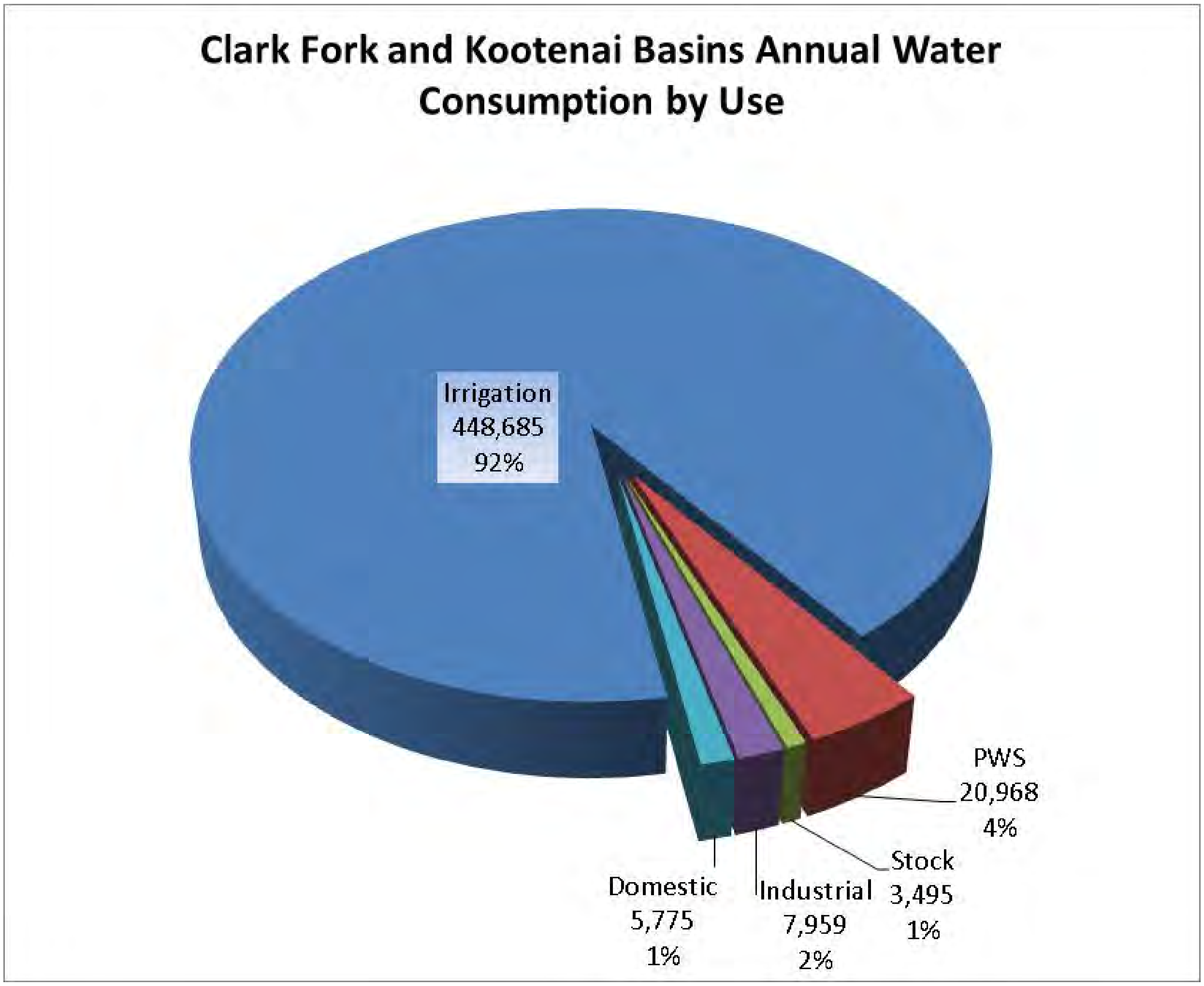
Water consumption estimates do not include water consumption for non-irrigated crops, wild range and forestlands, and wildlife.

Figure V-1 Annual water withdrawal by use in the Clark Fork and Kootenai Basins



Surface and ground water consumed in the Clark Fork and Kootenai Basins is shown in Figure V-2. Approximately 92 percent or 448,685 acre-feet of consumed water is consumed by irrigation. The other 8 percent or 38,197 acre-feet is a combination of public water supply (PWS), domestic, stock, and industrial.

Figure V-2 Annual water consumption by use in the Clark Fork and Kootenai Basins.



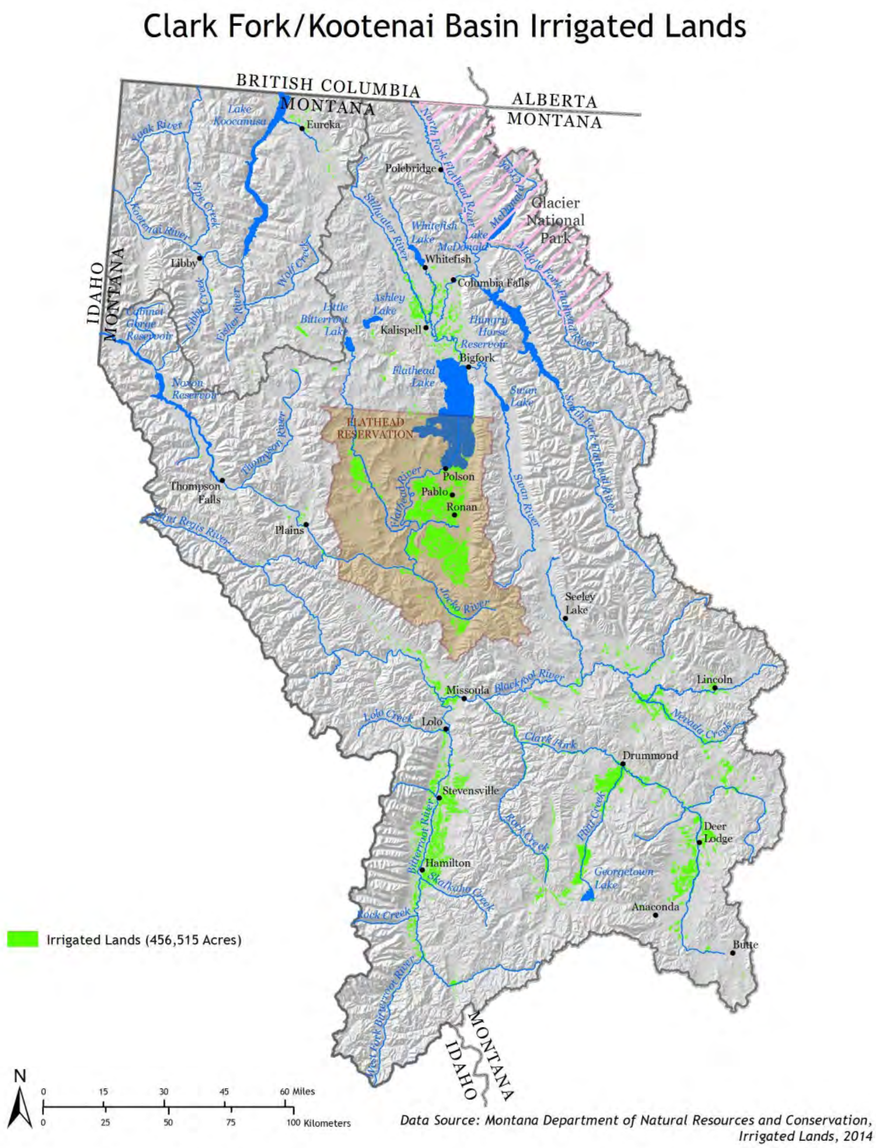
IRRIGATED AGRICULTURAL WATER USE

Irrigated Acreage

Several sources of data exist for irrigated lands in Montana. Additional information about irrigated land data sets and methods used to determine irrigated land can be found in Appendix V-1.

The Clark Fork and Kootenai River Basins contain 449,000 acres and 7,000 acres of irrigated land, respectively. The primary methods of irrigation in the Clark Fork and Kootenai Basins are flood, sprinkler, and center pivot. Figure V-3 shows irrigated lands in the basin and Table V-1 lists irrigated lands by HUC.

Figure V-3 DNRC Identified Irrigated acres.



Irrigated Crops

The primary crop types in the Clark Fork and Kootenai Basin are grass hay, alfalfa, and small grains. According to the most recent U.S. Department of Agriculture (USDA) Census of Agriculture, 82 percent of the irrigated lands in the Clark Fork and Kootenai Basins were used for forage, including hay and alfalfa, and 17 percent of irrigated lands were small grains. The remaining 1 percent is a mix of corn, garden vegetables, and other crops.

Consumption Estimates

Consumptive use of water by irrigation is associated with water consumed by the crops during plant growth by the process of evapotranspiration. In general, plant growth and irrigation frequency can be estimated using specific data obtained from the Landsat satellite system. The DNRC remote sensing method requires red, near infrared, and shortwave infrared bands of the Landsat Satellite Enhanced Thematic Mapper Plus. A description of the DNRC remote sensing estimation method can be found in Appendix V-1.

Diversion and consumption of water for irrigation is by far the largest use of water in Montana. 92 percent of irrigation water comes from surface water resources in the Clark Fork and Kootenai basin. The largest consumption of water occurs in the agricultural areas of the Mission, Bitterroot, Upper Clark Fork and Blackfoot valleys. Consumption over the irrigation season ranges from 139,000 to 36,000 acre feet in these areas. Typically during the irrigation season May to September irrigation consumes 4 to 13 percent of the water produced (See generalized water budgets, Figures V-6 to V-10).

Volumes of water diverted and consumed by HUC are presented graphically in Figure V-4 and in Table V-1. A map of the basin showing areas of high and low consumption is presented Figure V-5.

Figure V-4 Surface and ground water irrigation diversion and consumption in the Clark Fork and Kootenai Basins by HUC.

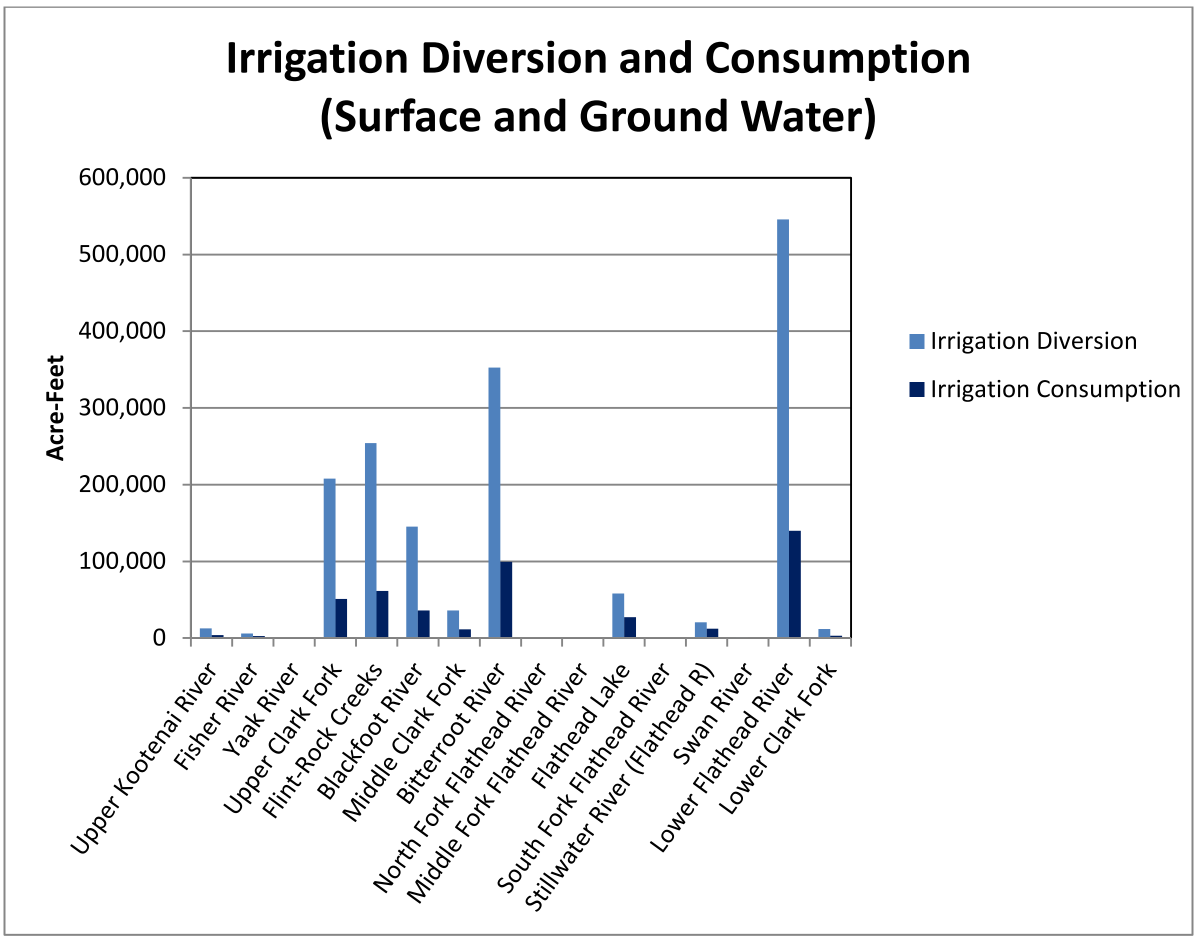
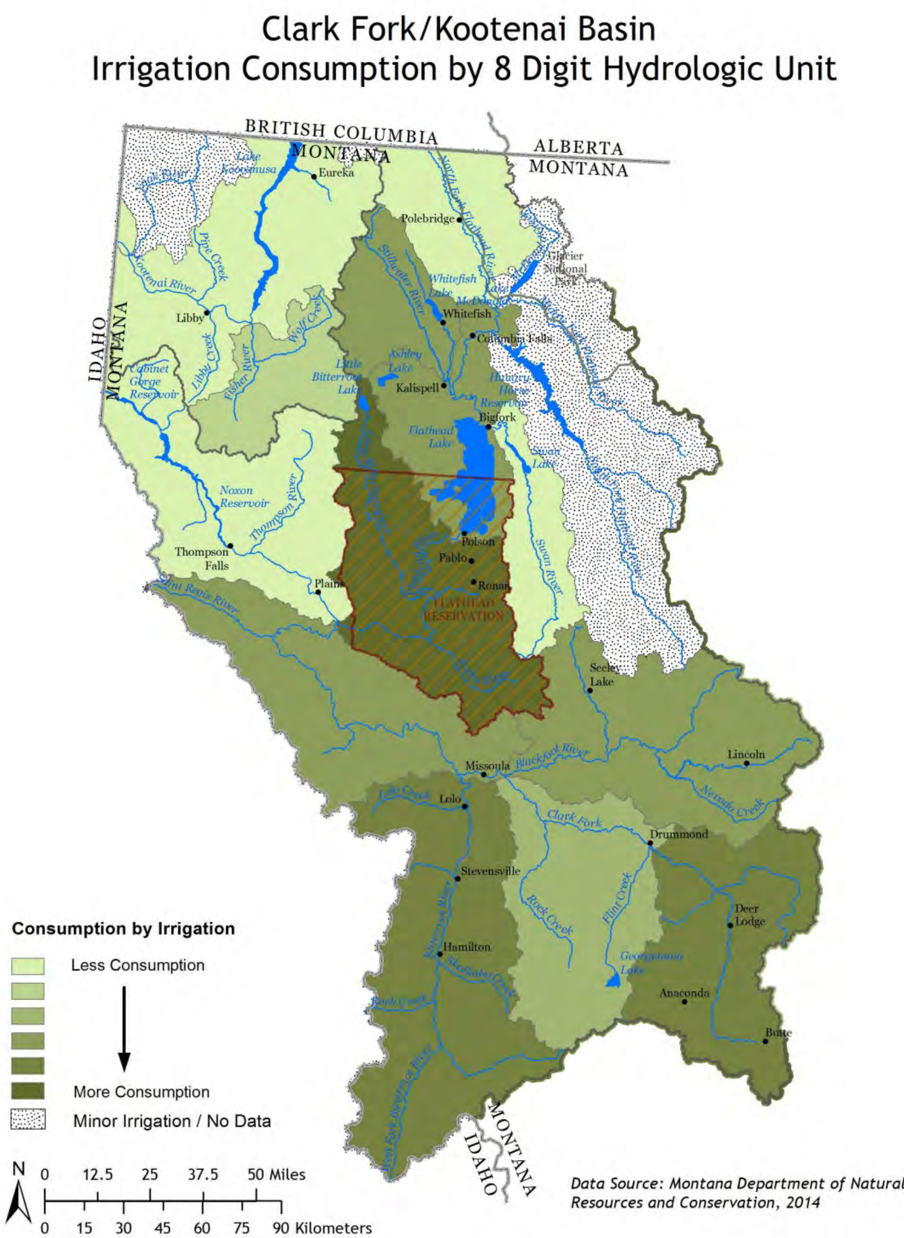


Table V-1 Table of estimated irrigated acres, diverted water, and consumed water for each HUC in acre-feet.

HUC	Acres of Irrigation	Ground Water		Surface Water	
		Water Diverted (Acre-Feet)	Water Consumed (Acre-Feet)	Water Diverted (Acre-Feet)	Water Consumed (Acre-Feet)
Upper Kootenai River	4,246	302	163	12,533	3,853
Fisher River	2,704	871	479	4,890	2,294
Yaak River	0	0	0	0	0
Upper Clark Fork	56,036	868	420	207,021	50,587
Flint-Rock Creeks	59,941	1,227	562	252,734	60,747
Blackfoot River	37,029	1,588	791	143,876	35,276
Middle Clark Fork	13,231	1,495	736	34,649	10,628
Bitterroot River	85,875	3,274	1,684	349,216	97,675
North Fork Flathead River	135	45	25	193	102
Middle Fork Flathead River	0	0	0	0	0
Flathead Lake	30,153	7,801	4,512	50,115	22,770
South Fork Flathead River	0	0	0	0	0
Stillwater River (Flathead R)	12,764	3,848	2,348	16,554	9,698
Swan River	547	121	65	1,261	459
Lower Flathead River	149,792	3,810	1,947	541,852	137,791
Lower Clark Fork	4,002	290	158	11,350	2,916
Total	456,455	25,539	13,889	1,626,245	434,795

Figure V-5 Thematic graduated color map of water consumption (acre-feet) by HUC in the Clark Fork Basin.



Diversion Estimates

The volume of water diverted from groundwater and surface water to meet the irrigation demands of crops is typically three times the actual volume of water consumed by the crop. This is due to convenience losses, efficiencies of the irrigation method, and irrecoverable losses. See Figure V-4 Table V-1. Ultimately, a significant portion of diverted water is returned to the source via surface flows or groundwater. The timing of when the water is returned can vary greatly depending on location and local hydrogeologic conditions.

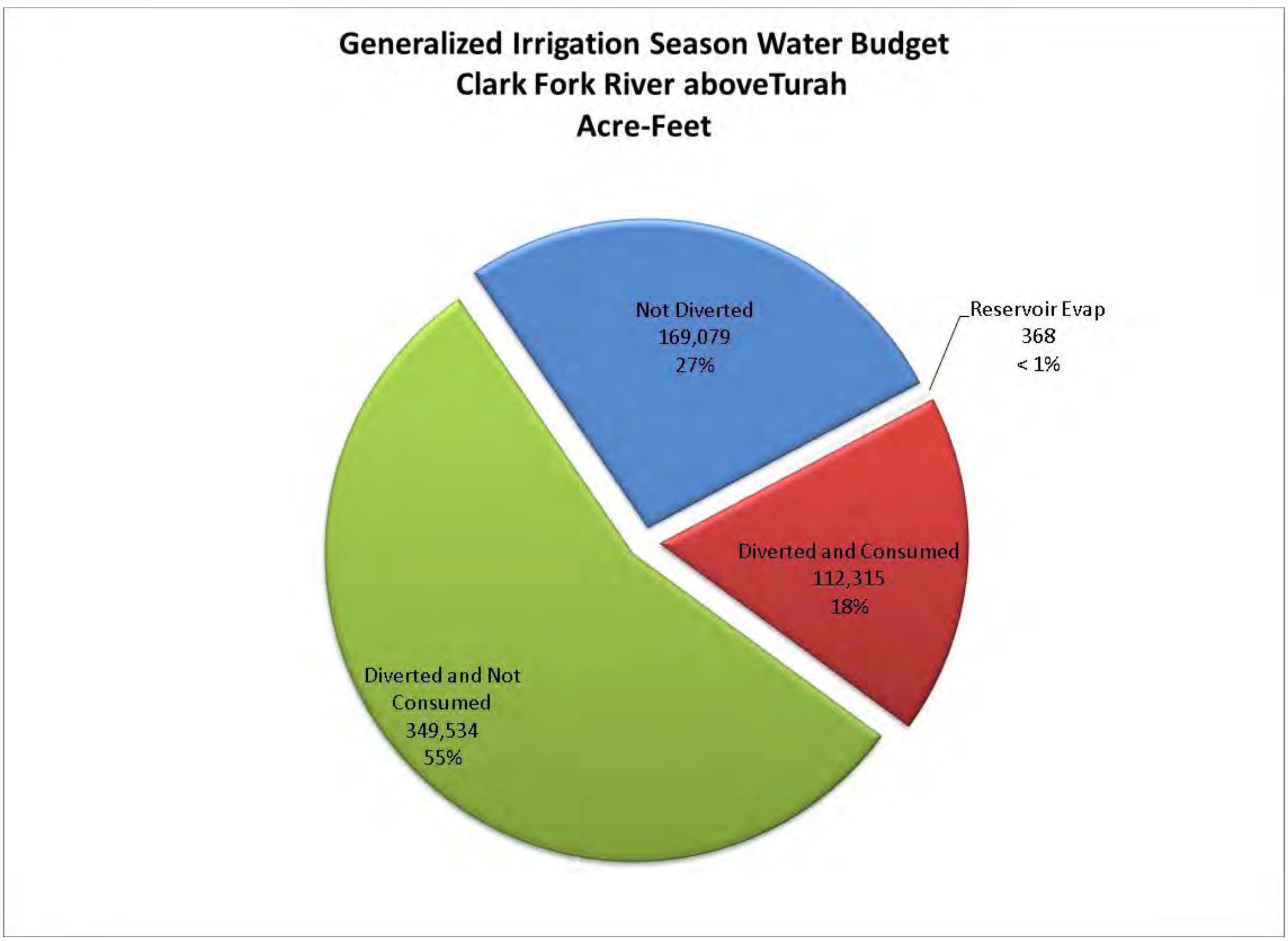
Methods of estimating water diversions and field application are located in Appendix V-1.

GENERALIZED WATER BUDGETS

Generalized budgets for surface water use are presented below using USGS stream flow data, consumptive use, and diversion estimates. Surface water flow volumes and water withdrawn and consumed by irrigation during the irrigation season (May 1 through September 30) is presented in the figures below. Water is presented by four categories: Diverted and Consumed (water lost from the system by evapotranspiration), Diverted and Not Consumed (water diverted from source and returned by surface runoff or groundwater return flows), Not Diverted (water left instream), and Reservoir Evaporation (water evaporated from reservoir surfaces). In basins where the water supply is limited, such as the Upper Clark Fork, the use and re-use of water is reflected by a larger "diverted and not consumed" volume.

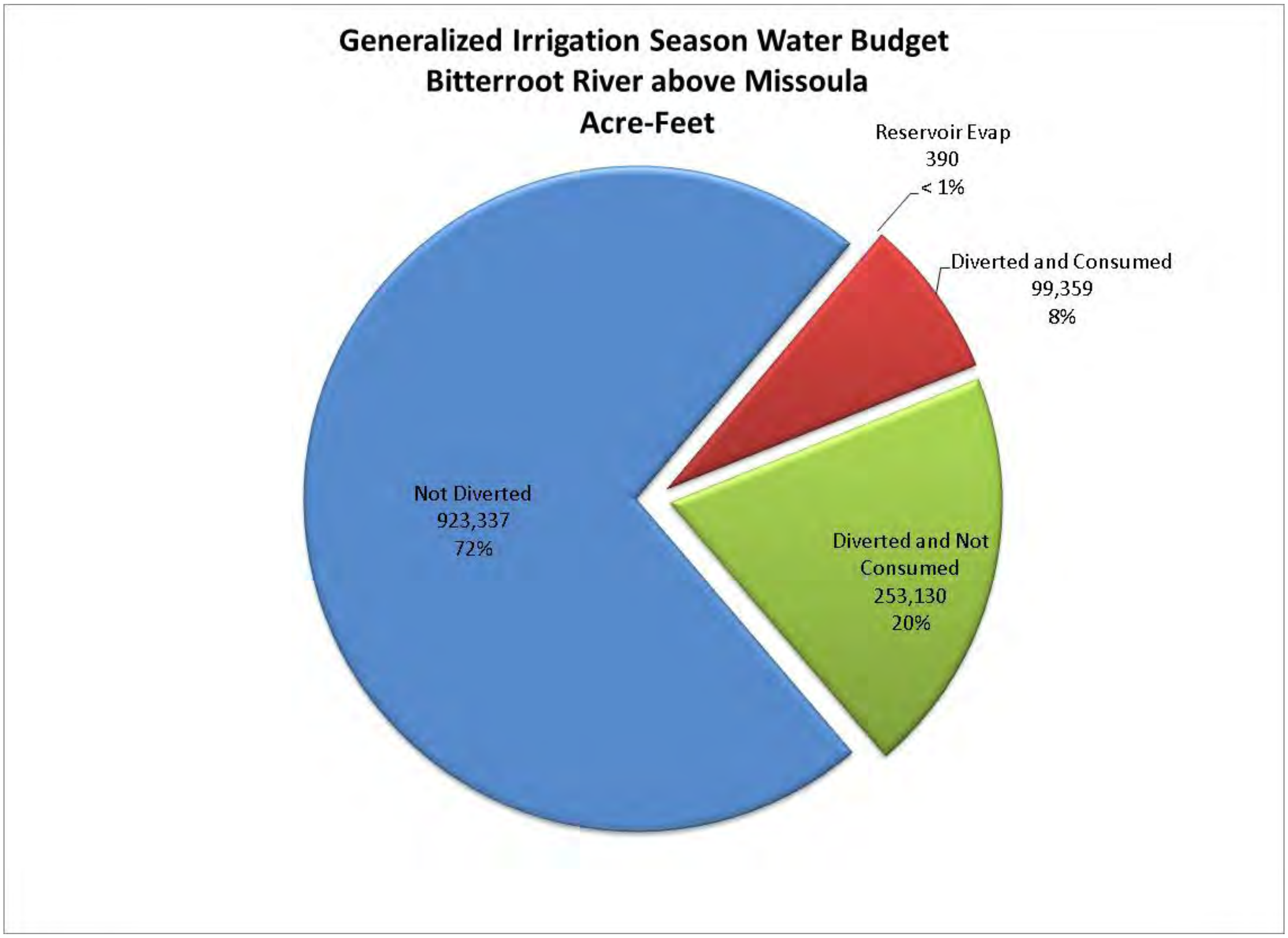
Water use in the Upper Clark Fork watershed above Turah (Figure V-6) indicates that 461,849 acre-feet of water is diverted to service the estimated 115,977 acres of irrigation. On average during the irrigation season, 18 percent (112,345 acre-feet) of water is Diverted and Consumed, 55 percent (349,534 acre-feet) is Diverted and Not Consumed, and 27 percent (169,079 acre-feet) is Not Diverted. Reservoir Evaporation is less than 1 percent.

Figure V-6 Generalized water budget in the Clark Fork watershed above the USGS gage located at Turah, MT.



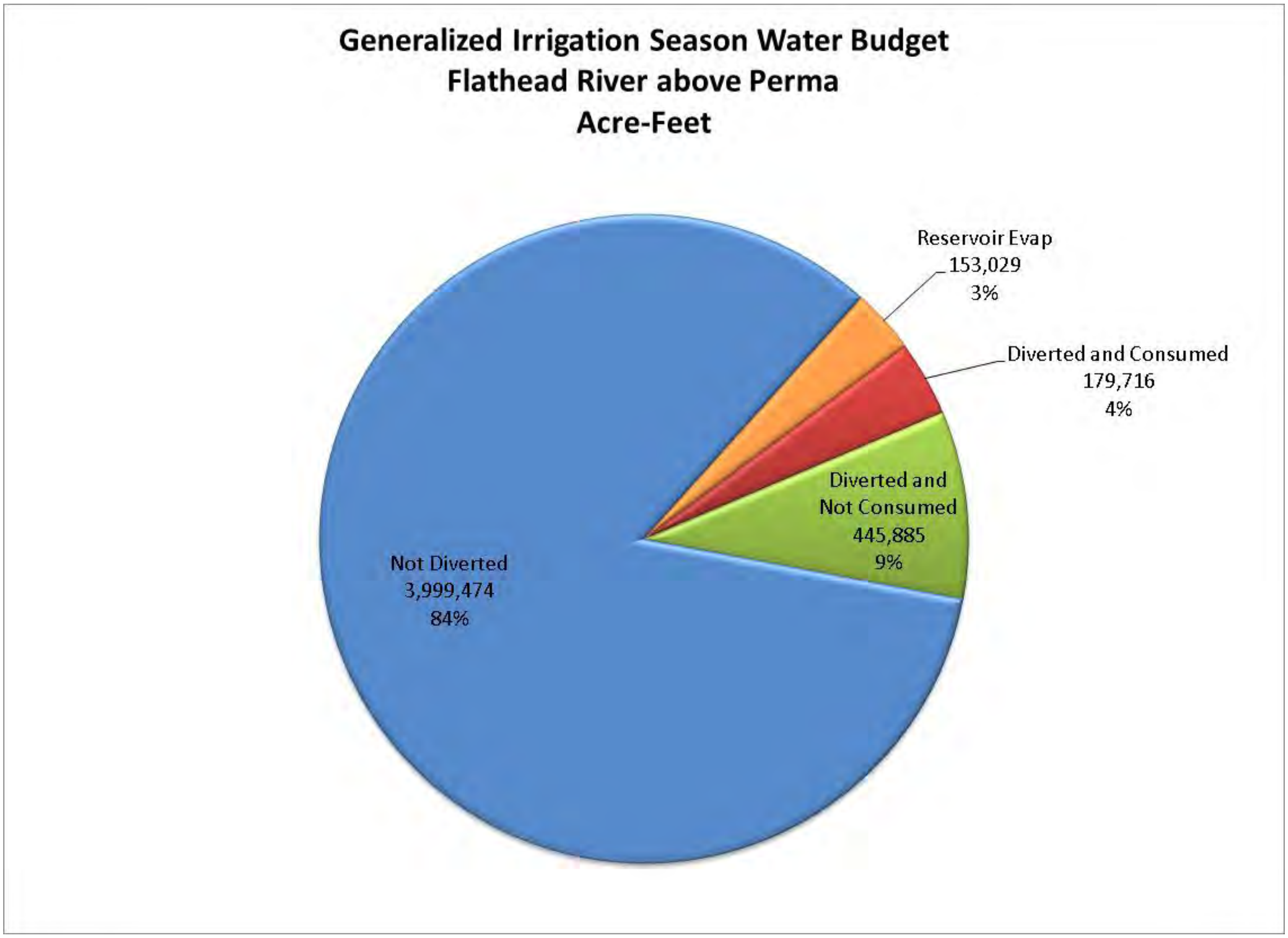
Water use in the Bitterroot watershed above Missoula (Figure V-7) indicates that 353,489 acre-feet of water is diverted to service the estimated 85,875 acres of irrigation. On average during the irrigation season, 8 percent (99,359 acre-feet) of water is Diverted and Consumed, 20 percent (253,130 acre-feet) is Diverted and Not Consumed, and 72 percent (923,337 acre-feet) is Not Diverted. Reservoir Evaporation is less than 1 percent.

Figure V-7 Generalized water budget in the Bitterroot watershed above the USGS gage located near Missoula, MT.



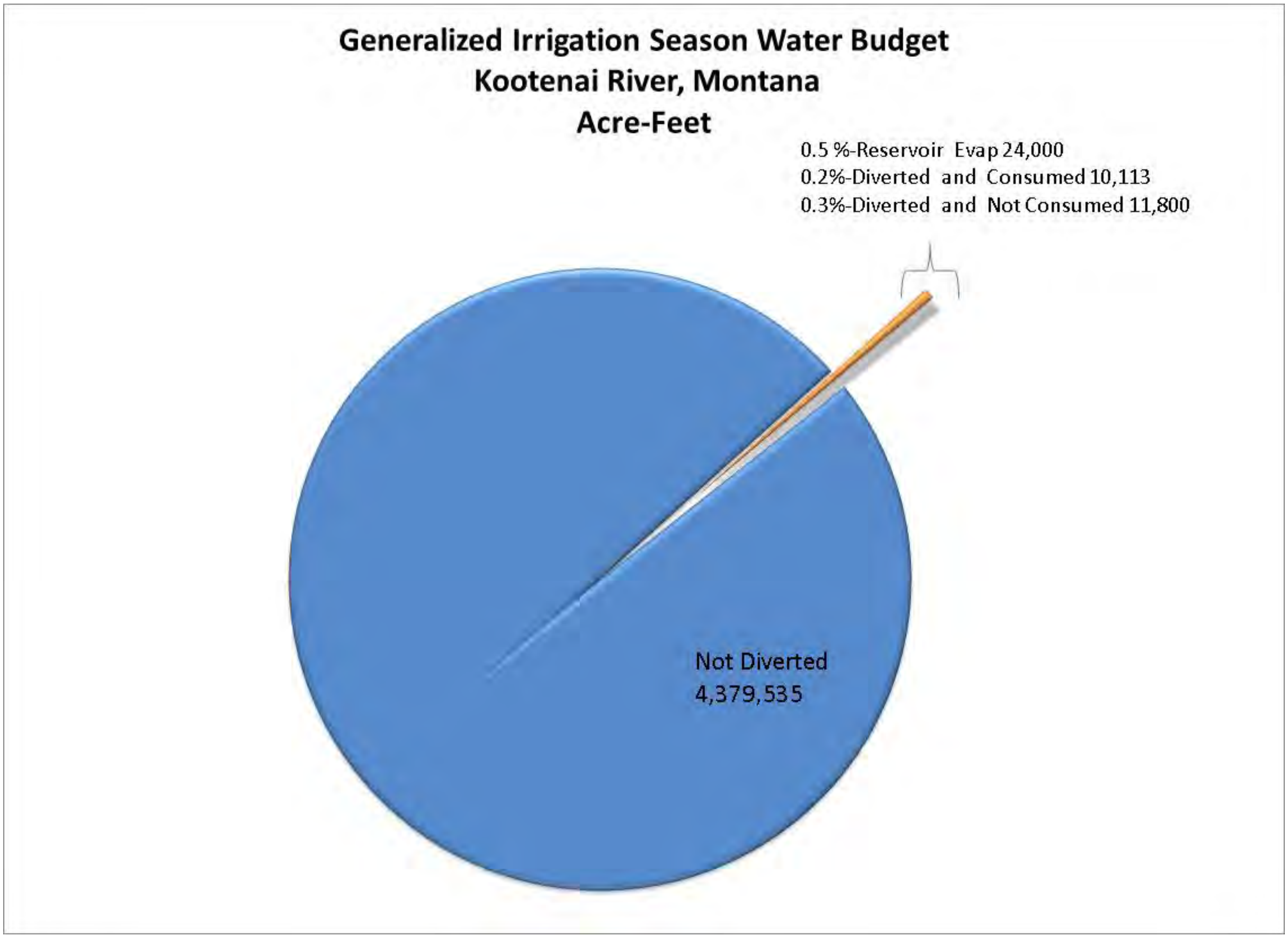
Water use in the Flathead watershed above Perma, MT (Figure V-8) indicates that 625,601 acre-feet of water is diverted to service the estimated 193,391 acres of irrigation. On average during the irrigation season, 4 percent (179,716 acre-feet) of water is Diverted and Consumed, 9 percent (445,885 acre-feet) is Diverted and Not Consumed, and 84 percent (3,999,474 acre-feet) is Not Diverted. Reservoir Evaporation is 3 percent (153,000 acre-feet).

Figure V-8 Generalized water budget in the Flathead watershed above the USGS gage located in Perma, MT.



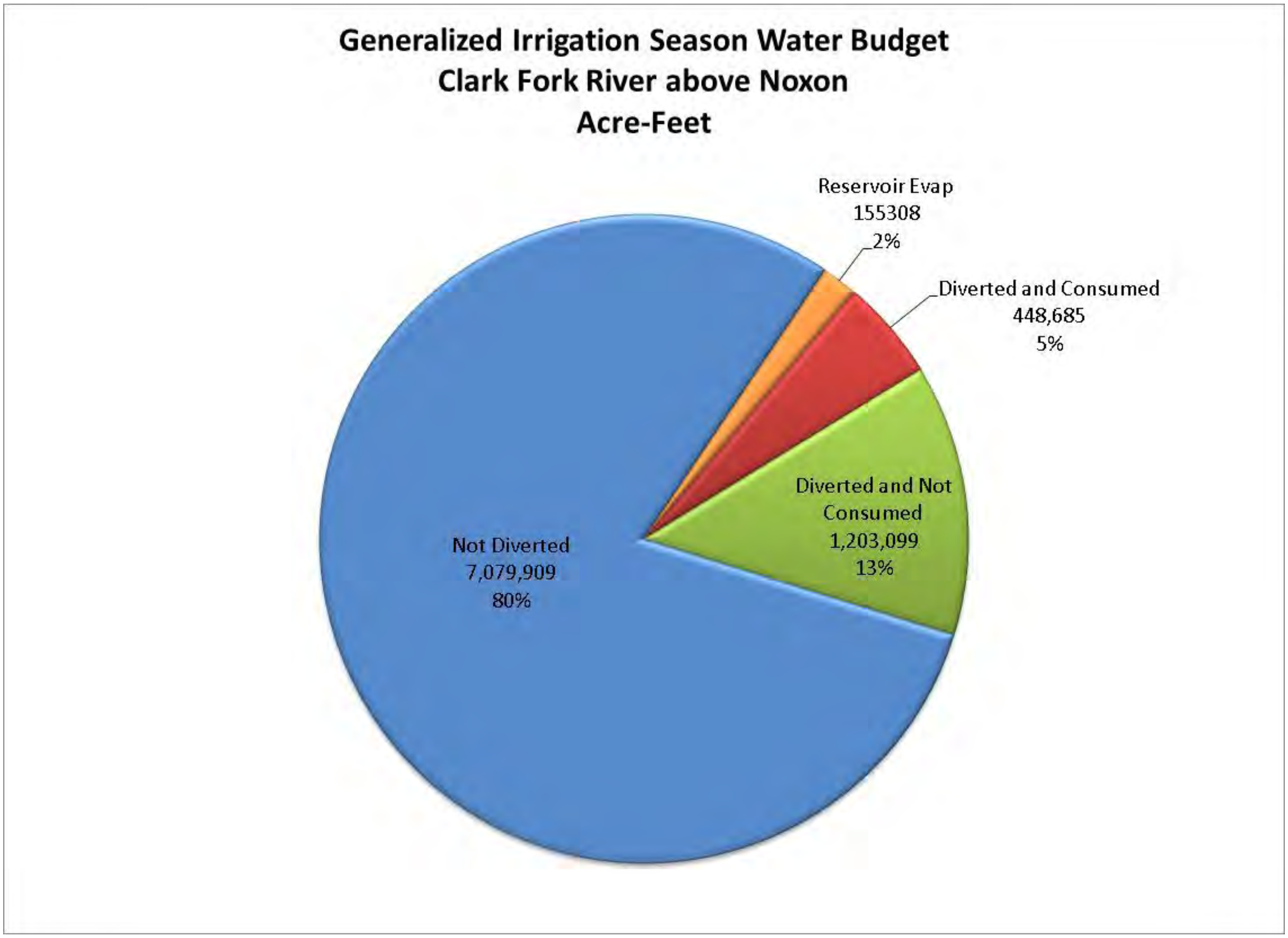
Water use in the Montana portion of the Kootenai watershed above Leona, Idaho (Figure V-9) indicates that 21,913 acre-feet of water is diverted to service the estimated 6,950 acres of irrigation. On average during the irrigation season, 0.2 percent (10,113 acre-feet) of water is Diverted and Consumed, 0.3 percent (11,800 acre-feet) is Diverted and Not Consumed, and 99 percent (4,379,535 acre-feet) is Not Diverted. Reservoir Evaporation is 0.5 percent (24,000 acre-feet).

Figure V-9 Generalized water budget in the Kootenai watershed above the USGS gage located in Leona, ID.



Water use in the Clark Fork watershed above Noxon (Figure V-10) indicates that 1,651,784 acre-feet of water is diverted to service the estimated 456,455 acres of irrigation. On average during the irrigation season, 5 percent (448,685 acre-feet) of water is Diverted and Consumed, 13 percent (1,203,099 acre-feet) is Diverted and Not Consumed, and 80 percent (7,079,909 acre-feet) is Not Diverted. Reservoir Evaporation is 2 percent (155,000 acre-feet).

Figure V-10 Generalized water budget in the Clark Fork watershed above the USGS gage located in Noxon, MT.



Opportunities for Research and Investment

There has not been a comprehensive inventory of irrigated lands in Montana since the Water Resources Surveys were completed in the 1950s, 1960s, and early 1970s. Irrigated lands have changed substantially since then, in acreages, distributions, and especially irrigation system types. A state-wide irrigation survey, of similar scope as the water resources surveys, would provide valuable information on irrigation patterns in the basins. It also could be used to characterize irrigation system types and water delivery systems. Much of the work could be done with remote sensing data, such as aerial photography and satellite imagery. There would need to be field checking in some cases to separate active irrigation from sub-irrigation and riparian areas, and to better define irrigation system characteristics and water sources.

Water consumption patterns by irrigation have not been well quantified in Montana. Most investigations to date have relied on theoretical equations to predict evapotranspiration rates and associated water use. Because these equations were developed to predict evapotranspiration in controlled conditions with unrestricted water supplies, the equations generally overestimate water use compared to what typically is occurring in the field.

Remote sensing approaches that use satellite imagery better estimate actual irrigation water use. Through incorporation with GIS, remote sensing methods can characterize irrigation water use spatially, and also by irrigation system type and crop type. DNRC is developing a remote sensing approach for estimating evapotranspiration spatially, but it still needs refinement.

The amount of water diverted from streams in the Clark Fork and Kootenai Basin for irrigation is not well known. Expanded measurement of water diversions, from surface and ground sources, and an associated water measurement database would enhance our understanding of irrigation water use, assist in local water management, and help to document changes in water use through time. Measurement of water diverted also could be used in conjunction with estimates of water consumed (as described in the paragraph above) to estimate irrigation system efficiencies and return flows.

LIVESTOCK WATER USE

Current Water Use

The number of livestock (cattle, sheep, hogs and pigs) was derived from NASS data for 2010. Water withdrawn for stock was estimated using the assumptions applied in the USGS 2000 Water Use report (USGS, 2004), and all water withdrawn for livestock was assumed to be consumed.

Beef Cattle: 15 gallons per day (gpd)/head

Dairy Cattle: 23 gpd/head

Hogs and Pigs: 5 gpd/head

Sheep: 2 gpd/head

Assignment of source was based on county percentages of groundwater and surface water originally assigned in the 1986 DNRC water use document. These percentages originated from water rights permits issued at the time of the report.

As shown in Table V-2, stock water use In the Clark Fork and Kootenai Basins, was estimated to be 2,521 acre-feet annually from surface water and 973 acre-feet annually from groundwater.

Opportunities for Research and Investment

Although estimates are available on per-animal consumption by livestock, these amounts do not include all water that is diverted from streams or pumped from aquifers for livestock use. On-the-ground surveys would be needed to determine these diverted amounts.

Table V-2 Surface and Ground Water consumed by Stock.

HUC	**Stock Water Consumed (Acre-feet) per year**	
	Surface Water	Ground Water
Upper Kootenai River	17	12
Fisher River	8	8
Yaak River	5	3
Upper Clark Fork	383	63
Flint-Rock Creeks	170	199
Blackfoot River	440	50
Middle Clark Fork	53	7
Bitterroot River	510	160
North Fork Flathead River	14	29
Middle Fork Flathead River	17	35
Flathead Lake	166	57
South Fork Flathead River	153	44
Stillwater River (Flathead R)	11	22
Swan River	158	33
Lower Flathead River	353	123
Lower Clark Fork	65	130
Total	2,521	973

MUNICIPAL AND DOMESTIC WATER USE

Current Water Use

Public Water Supply

Public water supply (PWS) systems supply drinking and industrial water to the communities of the Clark Fork and Kootenai basins. PWS water use is presented in table V-3. Methods used to estimate water diverted and consumed by PWS is explained in Appendix V-1. HUCs with no PWS are reported as zero withdrawal and consumption.

The highest use of water by PWS is the major population centers of Missoula, Butte, Hamilton and Kalispell. The largest PWS system in the basin is operated for the city of Missoula. PWS typically consume 37% of the diverted volume, the non-consumed water is treated and typically returned to a nearby surface water source.

Approximately 97 percent of public water supply in the basin is from groundwater. The communities of Butte*, Seeley Lake and Whitefish are the largest users of surface water for municipal supply.

Table V-3 Surface water and groundwater consumed by public water supply systems.

Public Water Supply Withdrawn and Consumed in Acre-Feet per Year				
	Water Withdrawn		Water Consumed	
HUC	Surface water	Ground Water	Surface Water	Ground Water
Upper Kootenai River	449	598	166	221
Fisher River	0	19	0	7
Yaak River	0	8	0	3
* Upper Clark Fork	0	7,852	0	2,905
Flint-Rock Creeks	38	73	14	27
Blackfoot River	644	114	238	42
Middle Clark Fork	0	31,516	0	11,661
Bitterroot River	0	4,913	0	1,818
North Fork Flathead River	0	0	0	0
Middle Fork Flathead River	0	6	0	2
Flathead Lake	35	5,873	13	2,173
South Fork Flathead River	0	0	0	0
Stillwater River (Flathead R)	843	1,740	312	644
Swan River	0	23	0	9
Lower Flathead River	0	1,299	0	481
Lower Clark Fork	48	581	18	215
Total	2,056	54,615	761	20,207

**Note: Surface water is transferred across the Continental divide by the Butte-Silver Bow public water supply system. The Butte-Silver Bow water treatment system imports 5,918 acre-feet per year from the Big Hole watershed. The imported water is not reflected in the amount of surface water consumed shown in Table V-3.*

Self-Supplied Domestic

Drinking water for rural residents of the Clark Fork and Kootenai basins are typically supplied by single user ground water wells. Self-supplied domestic water used is presented in Table V-4. Household use of domestic

water typically consumes a small fraction (5 to 10 percent) of water diverted. However when irrigation of lawn and garden is factored into domestic use the consumed fraction is estimated at 50 percent.

Domestic use of groundwater in the basin is highest in the populated rural areas including the Bitterroot, Flathead, and Missoula Valleys. Methods used to estimate water diverted and consumed by Self-Supplied Domestic is explained in Appendix V-1.

Table V-4 Groundwater consumed by self-supplied domestic wells.

Domestic Water Supply in Acre-Feet per Year		
	Ground Water	
HUC	Withdrawn	Consumed
Upper Kootenai River	1,077	539
Fisher River	26	13
Yaak River	28	14
Upper Clark Fork	58	29
Flint-Rock Creeks	437	219
Blackfoot River	354	177
Middle Clark Fork	1,306	653
Bitterroot River	3,464	1,732
North Fork Flathead River	16	8
Middle Fork Flathead River	28	14
Flathead Lake	2,554	1,277
South Fork Flathead River	17	8
Stillwater River (Flathead R)	214	107
Swan River	338	169
Lower Flathead River	1,156	578
Lower Clark Fork	476	238
Total	11,550	5,775

Opportunities for Research and Investment
Larger municipalities generally record water diversions and returns of treated water to the source. For smaller municipalities and domestic users, water use estimates are based on what might be considered "typical" per capita water use, which may not accurately reflect the actual use at a particular location. More site-specific surveys would be needed to better characterize water use for smaller municipal system and for domestic users.

INDUSTRIAL WATER USE

Current Water Use
Water supplies for industry in Clark Fork and Kootenai basins are obtained from PWS or are self-supplied. Methods used to estimate water diverted and consumed by industrial use is explained in Appendix V-1

Self-supplied industrial uses in the basins are estimated to consume 2,766 acre-feet and 5,193 acre-feet of surface and groundwater annually. Table V-5 presents surface water and groundwater consumed by industrial water use.   These amounts do not include industrial water used from public water supply systems.

Table V-5 Surface and Groundwater consumed by industrial water use.

HUC	Industrial Water Consumed (Acre-feet) per year	
	Surface Water	Ground Water
Upper Kootenai River	2,216	22
Fisher River	0	0
Yaak River	0	0
Upper Clark Fork	0	414
Flint-Rock Creeks	0	2
Blackfoot River	0	0
Middle Clark Fork	541	3,516
Bitterroot River	0	20
North Fork Flathead River	0	0
Middle Fork Flathead River	0	0
Flathead Lake	10	1,183
South Fork Flathead River	0	0
Stillwater River (Flathead R)	0	0
Swan River	0	0
Lower Flathead River	0	0
Lower Clark Fork	0	35
Total	2,766	5,193

Thermoelectric

Thermoelectric generators were identified from Energy Information Administration reporting (EIA923–Power Plant Operations Report, Schedule 8D: Cooling System information). Six projects were identified in the report, three of which reported withdrawals and consumptive use for cooling in 2010. No water was reported withdrawn in the Clark Fork and Kootenai Basins for thermoelectric cooling in 2010. This does not necessarily imply that thermoelectric generation is not occurring in the Clark Fork and Kootenai Basins.

Oil and Gas Development, Mining

To date, no oil and gas development has occurred in the basin west of the Continental Divide. USGS quantified water use associated with mining as recently as 2005. Minor amounts of mining-related water consumption were reported in Butte-Silver Bow and Lincoln Counties.

Opportunities for Research and Investment

At present, industrial water use in the Clark Fork and Kootenai Basins is dependent on the industry. A more comprehensive investigation would be needed to better quantify water diverted and consumed for industrial use for both self-supplied and industrial use within public water supply systems.

Inventory of Non-Consumptive Water Use in the Clark Fork and Kootenai Basins Associated with Existing Water Rights.

Non-consumptive water use is defined in MCA 85-2-342 as a beneficial use of water that does not cause a reduction in the source of supply and all the water is returned to the source without delay or causing little or no disruption to stream conditions.

Hydropower generation and instream flow rights for fisheries are the primary non-consumptive water uses in the Clark Fork and Kootenai Basins. Major hydropower facilities are located on the South Fork of the Flathead, Flathead, Swan and Clark Fork Rivers. Water rights for non-consumptive uses by hydropower typically meets or exceeds flows in the source of supply and is a limiting factor on new appropriation of water in the basin.

Instream flow water rights are typically junior to most water uses and are focused primarily on maintaining adequate flows levels to promote fisheries habitat. Instream flow rights in the basin further limit new appropriations of water in the basin.

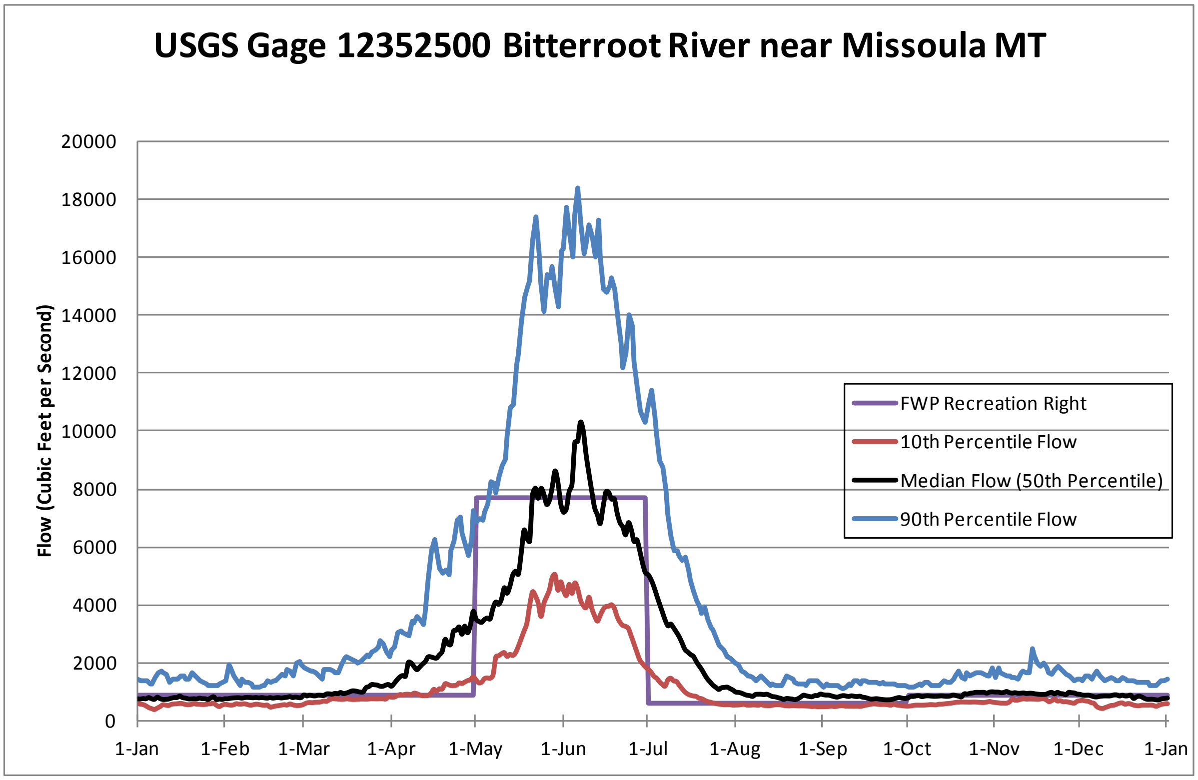
RECREATIONAL WATER USE

Current Water Use

Recreational water rights in the Clark Fork and Kootenai Basins are held by Montana Fish, Wildlife and Parks (FWP). Recreational water rights are linked to flows and water levels needed to maintain aquatic life habitat and floater passage. Recreational water rights are limited to the Bitterroot River and several lakes in the Clearwater and Blackfoot drainages. Recreation right claims on the Bitterroot River are broken, into three reaches and are listed in Appendix V-2.

The hydrograph in Figure V-11 shows the variable flow rights of the July 1, 1970 recreation water right for Reach 1 of the Bitterroot River as it relates to the flows measured at the USGS Gage 12352500 on the Bitterroot River near Missoula.

Figure V-11 FWP recreation right on the Bitterroot River.



ENVIRONMENTAL WATER USE

Current Water Use

Instream flow water rights, temporary leases and storage contracts are used in the Clark Fork and Kootenai basin for the purpose of fish and wildlife. FWP is the largest holder of water rights, leases and contracts for environmental uses. Conservation groups and private citizens also hold water rights, leases and contracts for environmental uses.

Murphy Rights

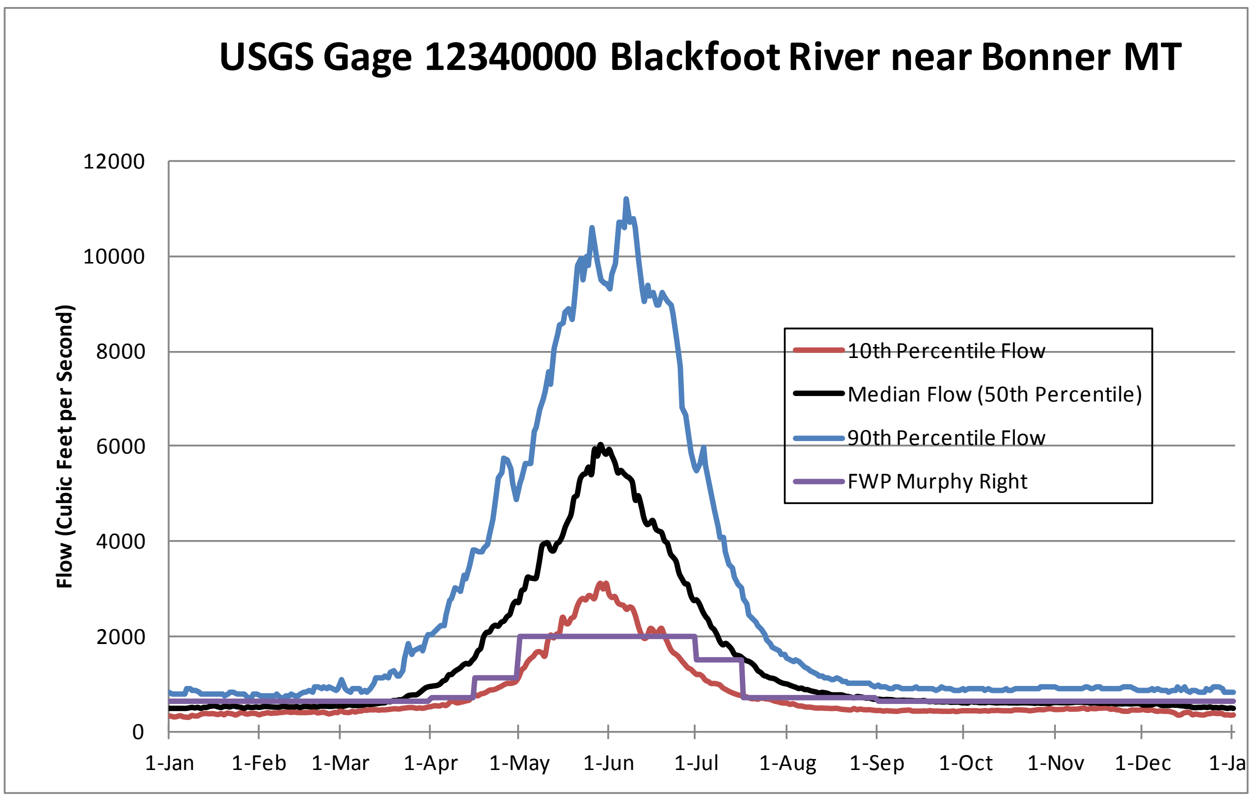
The most notable instream flow rights are "Murphy Rights," named after Montana Legislator James E. Murphy. Murphy rights are associated with the instream flow protections bill (89-901, MCA RCM) that became law in 1969 and placed protections on unappropriated waters on twelve blue ribbon trout streams in Montana. Table V-6 lists rivers in the Clark Fork and Kootenai Basins with Murphy rights.

Table V-6 List of Rivers and Stream in the Clark Fork River with Instream Flow Murphy Rights.

River	County	Description
Blackfoot River	Missoula and Powell	From its mouth to the mouth of its North Fork
Flathead River	Flathead County	From Flathead Lake to the South Fork
Rock Creek	Granite and Missoula	From its mouth to the junction of the East and West Forks of Rock Creek
North Fork Flathead River	Flathead	From its mouth to the mouth to Canadian Border
Middle Fork Flathead River	Flathead	From its mouth to the mouth of Cox Creek
South Fork Flathead River	Flathead and Powell Counties	From its mouth at Hungry Horse Reservoir to its source at the junction of Danaher and Youngs Creeks

Instream flow Murphy rights typically change with the hydrograph throughout the water year to reflect increased instream flow rights during runoff and decreased rights during base flows. The hydrograph in Figure V-12 shows FWP's Murphy right on the Blackfoot River.

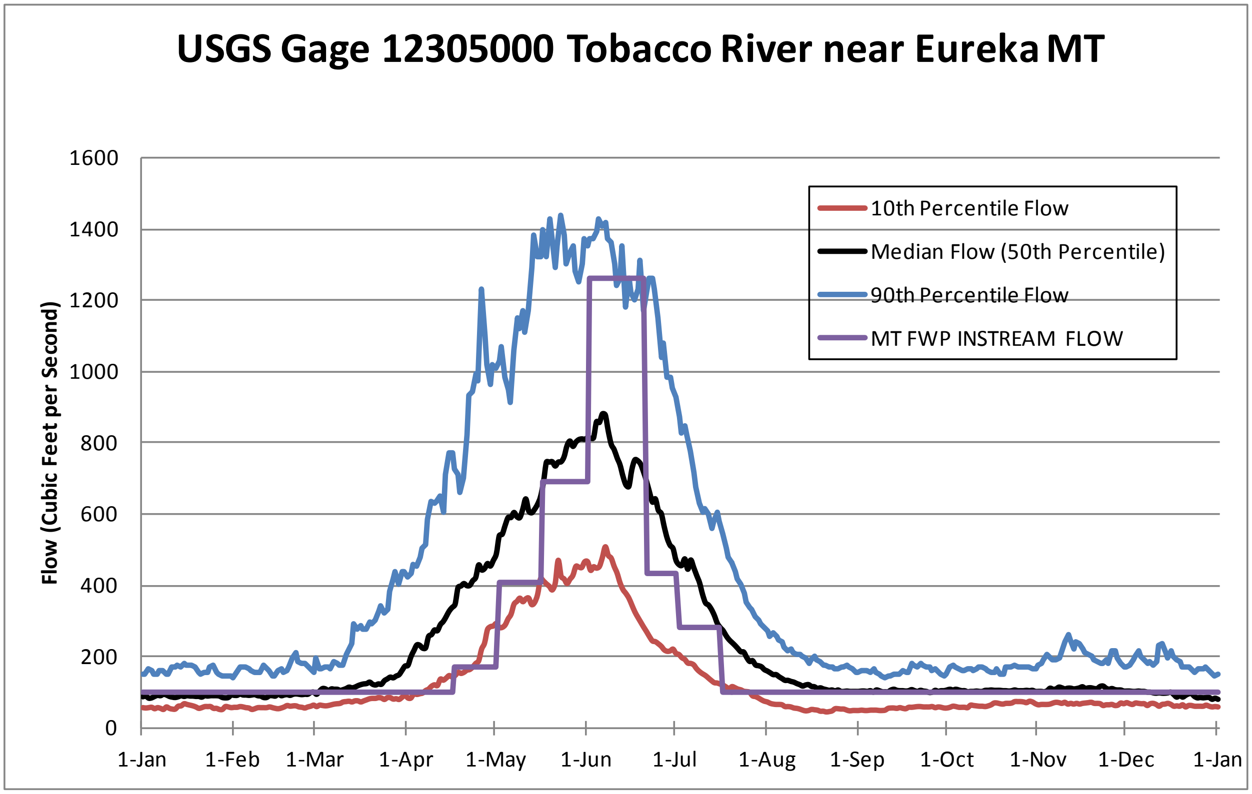
Figure V-12 FWP Murphy Right on the Blackfoot River



Judicially Recognized Rights

FWP holds judicially recognized instream flow and fisheries use rights in the Clark Fork Basin on Ashley Creek, and in the Kootenai Basin on the Tobacco River and Young Creek. These water rights predate the Montana Water Use Act of 1973. Figure V-13 presents a hydrograph of the FWP judicially recognized water right on the Tobacco River.

Figure V-13 FWP judicially recognized instream flow right on the Tobacco River.



Water Reservations
FWP does not hold and water reservations in the Clark Fork and Kootenai Basins.

Leasing/Conservation
FWP and conservation groups enter into voluntary agreements with water right holders to lease water to meet specific instream flow needs. The beneficial use of the water is typically changed from a use such as irrigation to instream flow or the user agrees to water conservation and the conserved water is used to meet instream flow needs. The DNRC change process is used to accomplish the goals of these leasing and conservation programs. FWP currently has leases in the Blackfoot and Upper Clark for drainages.

Private Instream Flow Rights
Private Citizens throughout the basin have chosen to change the existing beneficial use of their water right to instream flow. The DNRC change process is used to accomplish the goal of converting the existing beneficial use of the water to instream flow.

Storage
FWP holds storage rights to Ashley Lake and contracts for water in Lake Como and Painted Rocks Reservoir for the purpose of augmenting stream flows during low water periods. Storage water volumes held by FWP are listed in table V-7.

Table V-7 Storage water contracts held by FWP

Reservoir	Watershed	Storage Volume (acre feet)
Painted Rocks Reservoir	Bitterroot	15,000
Lake Como	Bitterroot	3,000
Ashley Lake	Flathead Lake	11,448

Milltown Water right

The former Milltown Dam water right for hydropower generation has a priority date of December 11, 1904, and a maximum flow rate of 2,000 cfs. Milltown dam was removed in 2008 and the Montana Department of Justice took ownership of the hydropower water right in 2010. The current purpose of the water right is listed as unknown.

The Milltown water right is included in the proposed water rights compact entered into by the Confederated Salish & Kootenai Tribes, State of Montana, and United States of America. http://www.dnrc.mt.gov/rwrcc/Compacts/CSKT/

The future of the water right is unknown as the CKST compact is unresolved.

Opportunities for Research and Investment

Water for recreational use generally includes maintaining sufficient streamflow and lake levels to maintain recreational needs. Recreational claims in the Clark Fork Basin have not been fully evaluated in Montana general stream adjudication.

The water needs for environmental uses are generally associated with those needed for fish and wildlife and for water quality purposes. In the Clark Fork and Kootenai Basins, this would include FWP Murphy, Judicially Recognized Rights and Water Leasing/Conservation. These instream rights typically are for what is considered to be near the minimum flow needed to protect these resources. Higher flows that might also have environmental and ecological values typically are not protected. More detailed analysis is needed to determine what high flows are needed to protect these resources. This could include flushing and channel maintenance flows.

LAKES AND RESERVOIRS

Lakes

The Clark Fork and Kootenai Basins contain approximately 8,600 lakes and ponds ranging in surface area from 0.04 to 191 square miles. The largest lake in western Montana is Flathead Lake with a volume of 18.4 million acre-feet, which is the largest freshwater lake west of the Mississippi River (Flathead Biological Station).

Reservoirs

The Clark Fork and Kootenai River Basins contain 23 reservoir storage projects that are greater than 5,000 acre-feet (Figure V-14 and Table V-8). Numerous projects (primarily private) in the basin are less than 5,000 acre-feet and are used for irrigation, stock water, and recreation. These smaller projects range in location from high alpine basins to low-elevation coulees.

The largest projects in the basin are for flood control and hydropower and include Libby, Hungry Horse, Kerr and Noxon Dams. Irrigation projects in the basin are primarily less than 30,000 acre-feet and are located in the headwaters of the Clark Fork Basin (Bitterroot, Upper Clark Fork and Blackfoot drainages) and the Mission Valley. Irrigation storage projects are combinations of private, state, and federal ownership and are usually associated with an irrigation district and associated distribution infrastructure. Warm Springs Ponds, located near Anaconda, stores water for the purpose of remediating heavy metals from historic mine practices in the area.

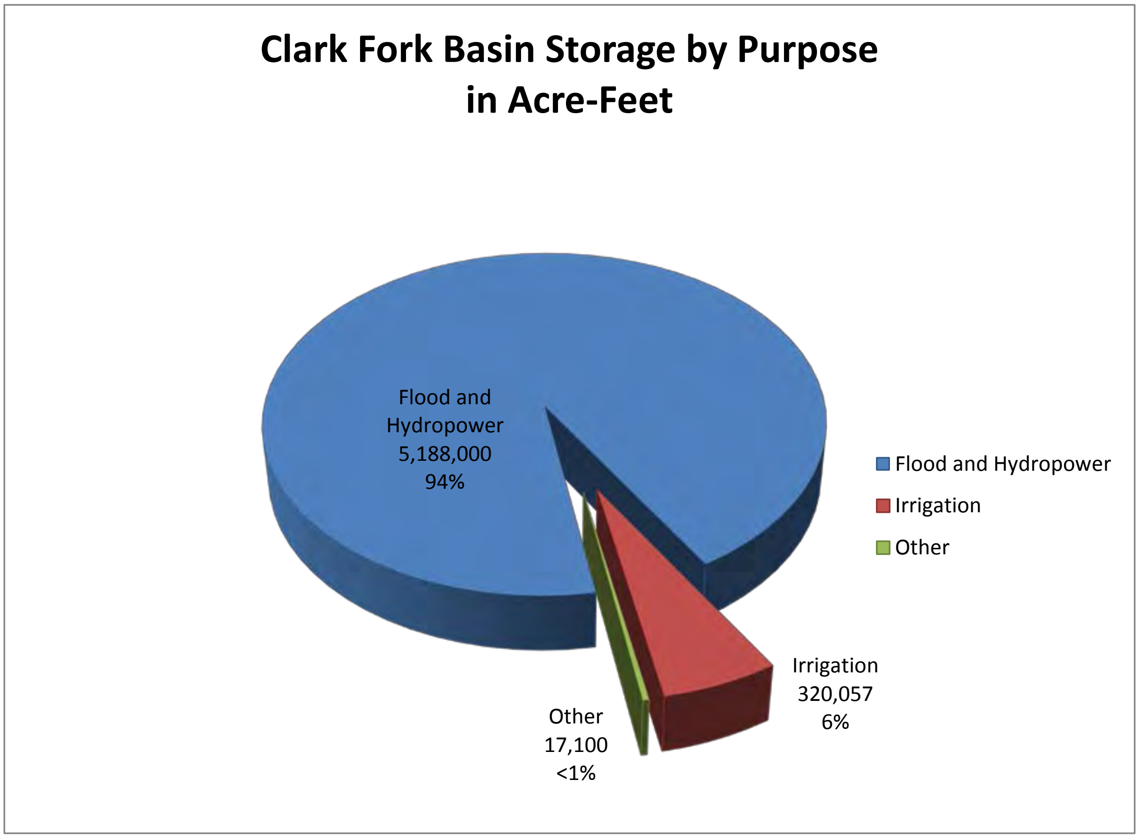
Figure V-14 Storage projects in the Clark Fork and Kootenai basins greater than 5,000 acre-feet.

Table V-8 List of Storage Projects with a Capacity greater than 5,000 acre-feet.

NAME	OWNER	COUNTY	PRIMARY PURPOSE	RIVER	STORAGE (Acre-Feet)
LIBBY DAM	US ARMY CORPS OF ENGINEERS	LINCOLN	HYDROPOWER,FLOOD CONTROLL	KOOTENAI RIVER	6,027,000
HUNGRY HORSE	US BUREAU OF RECLAMATION	FLATHEAD	HYDROPOWER,FLOOD CONTROLL	SOUTH FORK FLATHEAD RIVER	3,588,000
KERR DAM	PPL MONTANA & SALISH/KOOTENAI TRIBE	LAKE	HYDROPOWER,RECREATION	FLATHEAD RIVER	1,200,000
NOXON RAPIDS	AVISTA CORP	SANDERS	HYDROPOWER,FLOOD CONTROLL	CLARK FK,PEND OREILLE R	400,000
LAKE COMO	US BUREAU OF RECLAMATION	RAVALLI	IRRIGATION	ROCK CREEK (Bitterroot)	38,495
PAINTED ROCKS	STATE OF MONTANA	RAVALLI	IRRIGATION	WEST FORK BITTERROOT	32,000
GEORGE TOWN (FLINT CREEK)	GRANITE COUNTY	DEER LODGE	WATER SUPPLY	FLINT CREEK	32,362
PABLO	FLATHEAD INDIAN IRRIGATION PROJECT	LAKE	IRRIGATION	MULTIPLE SOURCES	28,400
LITTLE BITTERROOT LAKE	FLATHEAD INDIAN IRRIGATION PROJECT	SANDERS	IRRIGATION	LITTLE BITTERROOT	26,400
ST MARYS	FLATHEAD INDIAN IRRIGATION PROJECT	LAKE	IRRIGATION	JOCKO/DRY CREEK	23,500
ASHLEY DAM	STATE OF MONTANA, D.F.W.P.	FLATHEAD	IRRIGATION	ASHLEY CREEK	20,400
SILVER LAKE	BUTTE-SILVER BOW	DEER LODGE	IRRIGATION	WARM SPRINGS CREEK	17,100
EAST FORK	STATE OF MONTANA	Granite	IRRIGATION	EAST FORK ROCK CREEK	16,000
WARMSPRINGS PONDS (1,2,3)	Alantic Richfied Company	DEER LODGE	REMEDIATION	SILVERBOW CREEK	15,135
NINEPIPE	FLATHEAD INDIAN IRRIGATION PROJECT	LAKE	IRRIGATION	MULTIPLE SOURCES	15,000
HUBBART	FLATHEAD INDIAN IRRIGATION PROJECT	SANDERS	IRRIGATION	LITTLE BITTERROOT	12,125
NEVADA CREEK	STATE OF MONTANA, D.N.R.C., W.R.D.	POWELL	IRRIGATION	NEVADA CREEK	11,000
LOWER CROW	FLATHEAD INDIAN IRRIGATION PROJECT	LAKE	IRRIGATION	CROW CREEK	10,350
KICKING HORSE	FLATHEAD INDIAN IRRIGATION PROJECT	LAKE	IRRIGATION	MULTIPLE SOURCES	9,000
THOMPSON FALLS	PPL MONTANA	SANDERS	HYDROPOWER	CLARK FORK	8,300
MISSION	FLATHEAD INDIAN IRRIGATION PROJECT	LAKE	IRRIGATION	MISSION CREEK	8,135
MCDONALD	FLATHEAD INDIAN IRRIGATION PROJECT	LAKE	IRRIGATION	POST CREEK	7,225
LOWER WILLOW CREEK	LOWER WILLOW CREEK DRAINAGE DISTRICT	GRANITE	IRRIGATION	LOWER WILLOW CREEK	6,230

The majority of reservoir storage in the Clark Fork Basin (94 percent or 5.1 million acre-feet) is for flood control and hydropower, and 6 percent (320,000 acre-feet) is for irrigation (Figure V-15). Nearly 100 percent (6 million acre-feet) of the storage in the Kootenai Basin is for flood control and hydropower.

Figure V-15 Pie Chart of Clark Fork Basin Storage Project by Use.



MANAGEMENT AND OPERATION

Management of the river systems below major storage projects has come to the attention of regulators and stakeholders. The potential for minimizing biological impacts through more naturalized regulation have been adopted for the Hungry Horse, Kerr, and Libby Dam projects. VARQ (Variable Discharge) Flood Risk management has been introduced to the operations of both Hungry Horse and Libby Dams in 2003. VARQ allows dam operators to keep reservoir levels higher during the summer and winter months during mid-range flows (80 to 125 percent of average runoff), benefitting resident aquatic systems and allowing for more reliable spring and summer flows for downstream aquatic species. VARQ management responds to runoff forecasting and observed reservoir inflows. More information can be found at the U.S. Bureau of Reclamation (USBR) and U.S. Army Corps of Engineers web sites. Figures V-16 and V-17 show VARQ changes to the managed flows below Libby Dam and Hungry Horse Reservoirs, respectively.

Figure V-16 Hydrograph showing regulation of the Kootenai River and changes in management of Libby Dam releases.

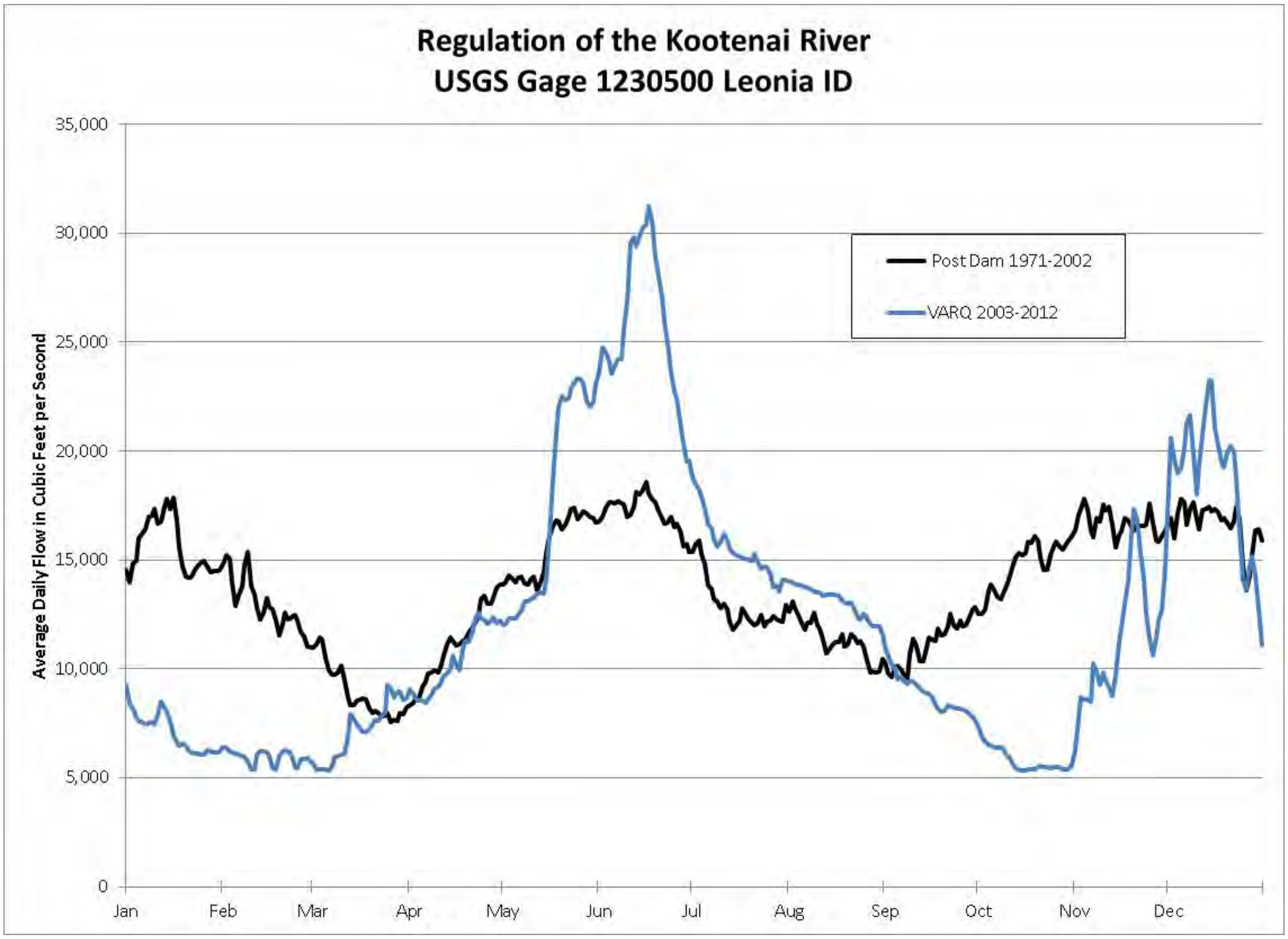
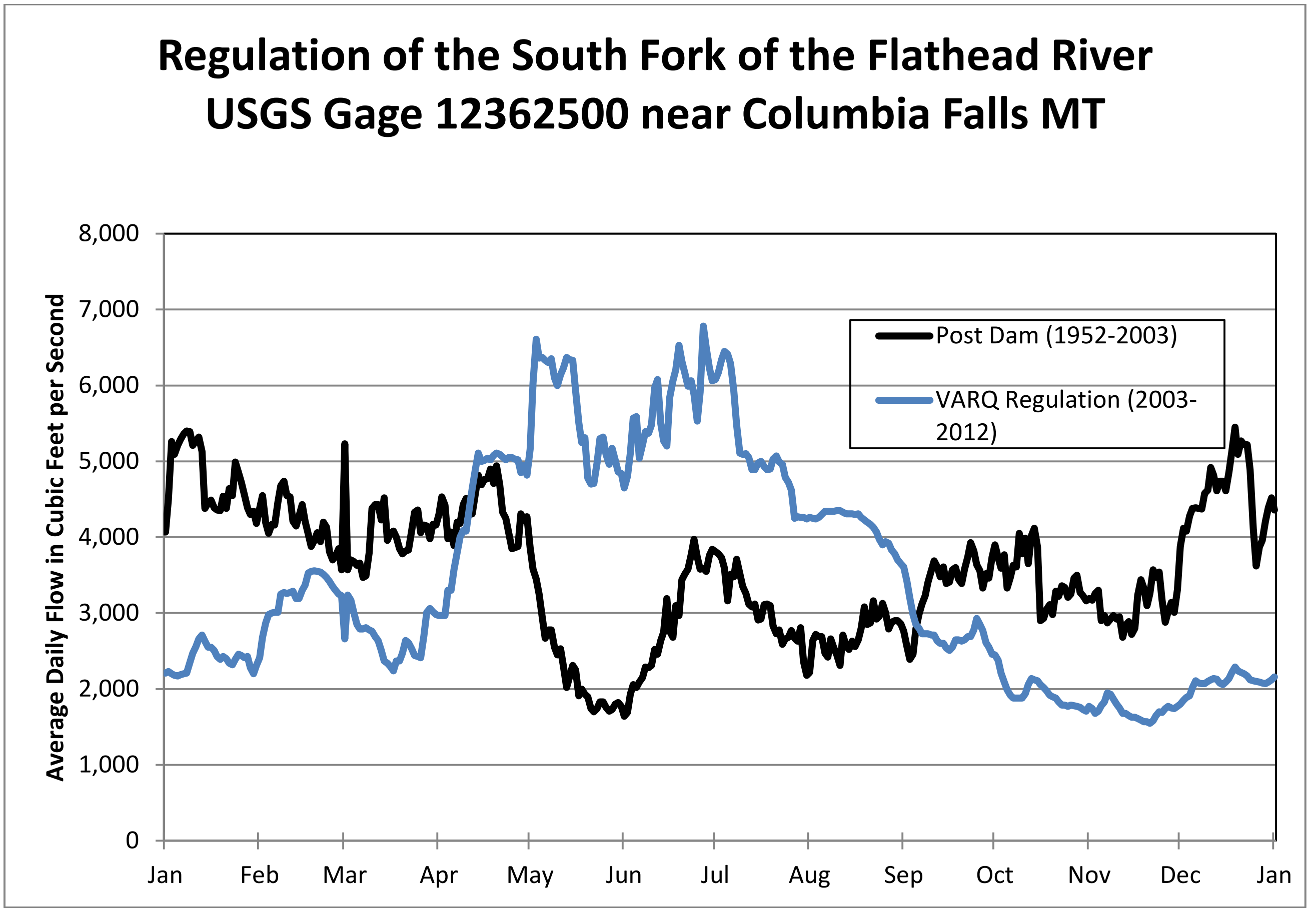


Figure V-17 Hydrograph showing the regulation of the South Fork of the Flathead River and changes in the management of Hungry Horse Reservoir releases.



Reservoir Minimum Pools (water quality and sedimentation)

Reservoir drawdown is limited physically by the elevation of the penstock within the dam. The water within the reservoir that is below the elevation of the penstock is referred to as the dead pool. Reservoirs in the Clark Fork and Kootenai Basins are owned by federal, state, and private entities. How those projects are managed depends on the ownership and purpose of the project. Large federal and private hydropower projects are subject to Federal Energy Regulatory Commission (FERC) licensing that regulates minimum reservoir elevations. State-owned and some private dams are regulated by the DNRC Dam Safety Program, which regulates dam construction, operation, and maintenance.

In general, minimum pools are unique to the individual dams and the purpose of the project and other interests such as recreation and fish and wildlife.

Deposition of sediment occurs in all reservoirs in Montana. The rate of sediment deposition depends on many factors including local geology, land use and reservoir size. Currently the amount of storage lost due to sedimentation is unknown and warrants further study.

Consumptive Use (Evaporation)

Reservoir evaporation was calculated using the surface area of the reservoir at normal capacity, the free water surface evaporation rate based on the local climate, and average annual precipitation for the reservoir location. No net evaporation occurred in the Upper Clark Fork, Flint-Rock Creeks, and South Fork Flathead HUCS because the evaporation rate was less than or equal to the precipitation received at that location. Table V-9 presents net annual evaporation of stored water in reservoirs and lakes as estimated by USGS (2004).

Table V-9 Reservoir Evaporation in the Clark Fork and Kootenai Basins.

HUC	HUC Name	Primary Reservoir or Lake	Reservoir Evaporation (Acre-Feet)
17010101	Upper Kootenai River	Koocanusa (Libby Dam)	24,042
17010102	Fisher River		0
17010103	Yaak River		0
17010201	Upper Clark Fork		0*
17010202	Flint-Rock Creeks	East Fork Rock Creek	368
17010203	Blackfoot River	Nevada Cr Reservoir	313
17010204	Middle Clark Fork		0
17010205	Bitterroot River	Painted Rocks Reservoir and Lake Como	390
17010206	North Fork Flathead River		0
17010207	Middle Fork Flathead River		0
17010208	Flathead Lake	Flathead Lake	149,250
17010209	South Fork Flathead River	Hungry Horse	0*
17010210	Stillwater River (Flathead R)		0
17010211	Swan River	Swan Lake	0*
17010212	Lower Flathead River	Little Bitterroot Lake,Pablo Reservoir	6,029
17010213	Lower Clark Fork	Noxon Rapids and Thompson Falls Reservoirs	1,208
* Indicates that no net evaporation occurred since the evaporated rate was less than or equal to the precipition revieved			

HYDROPOWER

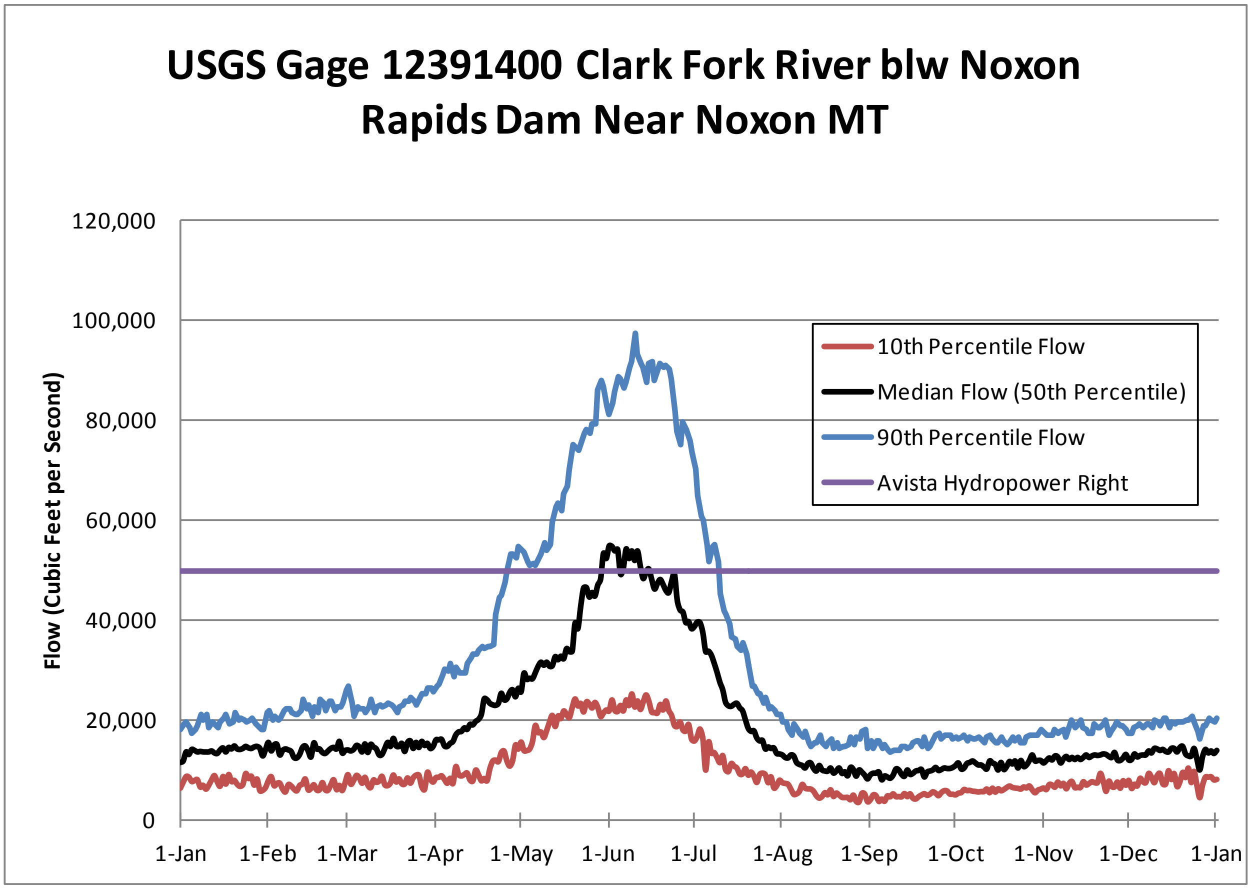
Six major hydropower facilities exist in the Clark Fork and Kootenai Basins under a mix of private and federal ownership. Hydropower generation ranges from 535 Megawatts (MW) at Noxon Rapids Dam to 5 MW at Bigfork Dam. Table V-10 lists the major facilities. Other smaller hydropower projects in the basin were not included in DNRC's analysis.

Table V-10 Major hydropower facilities in the Clark Fork and Kootenai Basins.

						Hydro Electric Facility Capacity				
HUC	County	Plant Name	River	Ownership	State	MW		flow (cfs)		KW/cfs
17010101	Lincoln	Libby	Kootenai	Federal	MT	525		27,000		19.4
17010209	Flathead	Hungry Horse	S.Fork Flathead	Federal	MT	428		12,600		34.0
17010212	Lake	Kerr	Flathead	Private	MT	206		14,540		14.2
17010211	Flathead	Big Fork	Swan	Private	MT	5		671		7.5
17010213	Sanders	Noxon Rapids	Clark Fork	Private	MT	535		50,000		10.9
17010213	Sanders	Thompson Falls	Clark Fork	Private	MT	94		15,250		6.2

The water rights held by the Avista Corporation at the Noxon Rapids Dam near the Idaho border are the most significant in terms of flow rate. The 50,000 cfs flow rate shown in Figure V-18 represents Avista's water rights and the short window they are satisfied during runoff in median flow years. When flows are below 50,000 cfs, the Avista water right is not satisfied and therefore has standing on future development of water in the basin.

Figure V-18 Hydrograph showing the water right held by Avista on the Clark Fork River at Noxon.



OPPORTUNITIES FOR RESEARCH AND INVESTMENT

Physical characteristics of storage facilities in the Clark Fork basin are well understood. Changes in storage capacity due to siltation may warrant additional study to better understand the current storage capacity in the basin. A more current and detailed study of evaporative losses should be undertaken to better quantify these losses. Current hydropower uses generally are well defined as the turbine flow capacities at the various facilities.

Existing Water Quality Impairments in the Clark Fork and Kootenai Basins

MONTANA WATER QUALITY LAW

Numerous laws and regulatory programs in Montana control activities to protect water quality. There are laws that regulate discharges to surface water, discharges to groundwater, streambed disturbance, mining operations, hazardous waste, underground storage tanks, septic systems, and almost every other activity that poses a threat to water quality. Most of these laws are administered by DEQ, with a handful administered by other state and local entities.

The Montana Water Quality Act (75-5-101, MCA) is the primary water pollution control authority in Montana. The act states that it is public policy to:

Conserve water by protecting, maintaining, and improving the quality and potability of water for public water supplies, wildlife, fish and aquatic life, agriculture, industry, recreation, and other beneficial uses; [and] provide a comprehensive program for the prevention, abatement, and control of water pollution; and balance the inalienable rights to pursue life's basic necessities and possess and use property in lawful ways with the policy of preventing, abating, and controlling water pollution.

Water quality standards, adopted by the Montana Board of Environmental Review, establish the level of water quality necessary to support existing and future beneficial uses of rivers, lakes, and groundwater resources. The standards establish a basis for limiting discharges of pollutants.

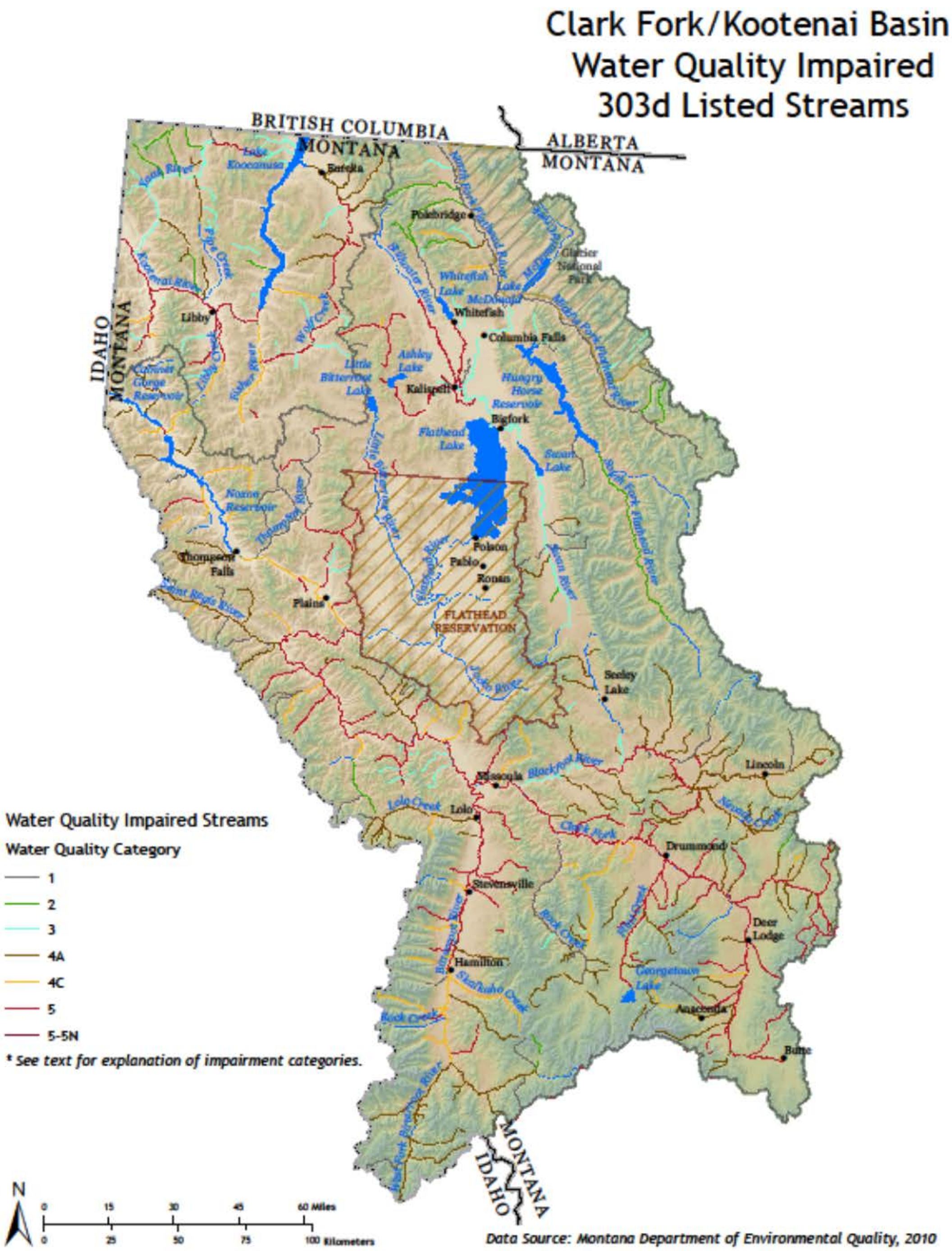
The 1972 federal Clean Water Act (CWA) established a national framework for protecting and improving water quality. Sections of CWA passed in 1987 (303(d) and 305(b)), require states to monitor and assess statewide water quality conditions, identify and list water bodies that fail to meet water quality standards, and prepare Water Quality Improvement Plans (WQIPs) for restoring water quality. These WQIPs must include quantitative limits, known as Total Maximum Daily Loads (TMDLs), for each of the pollutants of concern. Most of Montana’s water quality impairments reflected on the 303(d) list are a result of nonpoint source (NPS) pollution.

SURFACE WATER QUALITY PROTECTION

Nonpoint water pollution comes from contaminants (originating from a variety of land-use activities over generally large areas) that are transported to streams, lakes, wetlands, and groundwater by precipitation, snowmelt, and stormwater runoff. Nonpoint pollution also comes from substances that erode directly into surface waters or from aerially transported substances deposited on land and water. Common nonpoint pollutants include sediment, nutrients (nitrogen and phosphorus), temperature changes, metals, pesticides, pathogens, and salt.

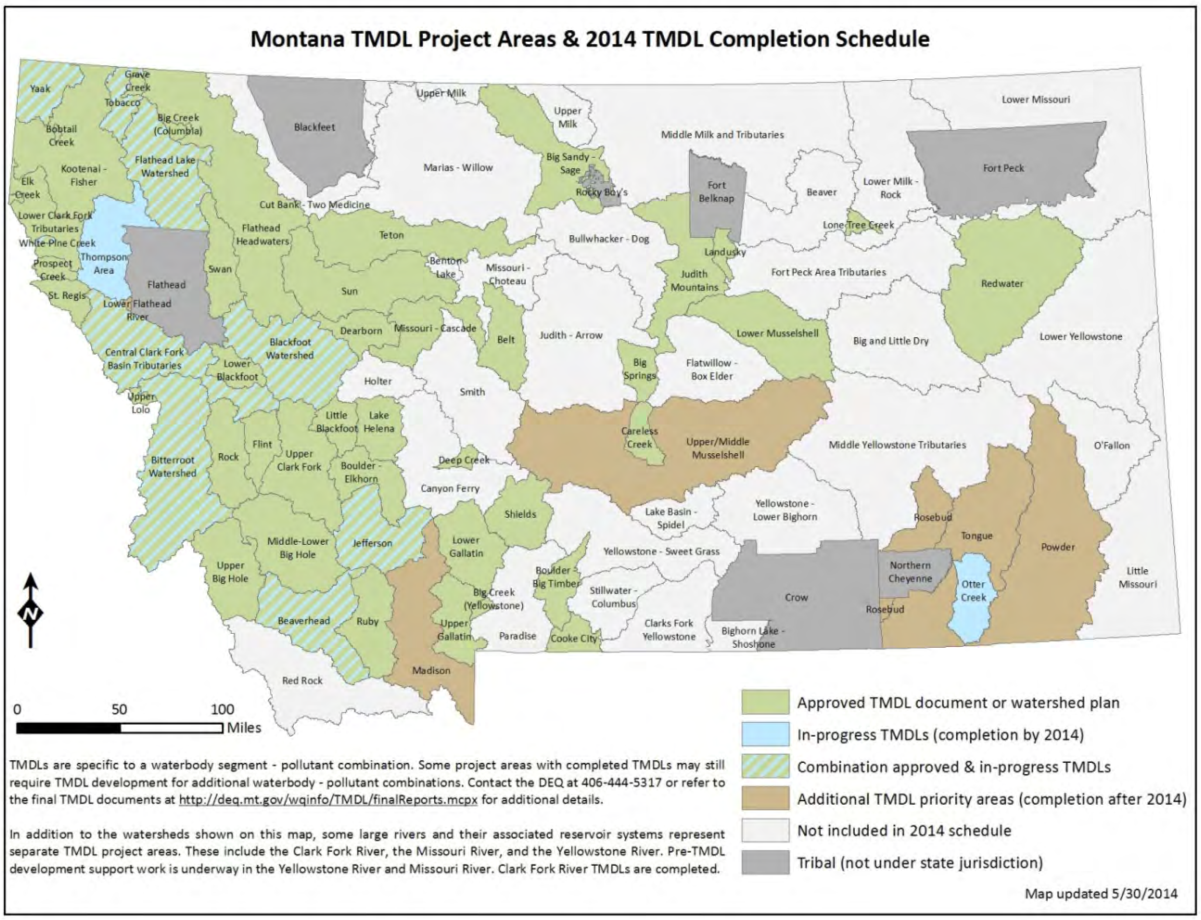
Nonpoint pollution is a significant problem in Montana, constituting the single largest cause of water quality impairment on a statewide basis (Figure V-24). More than 75 percent of Montana’s assessed rivers and streams and 45 percent of its lakes, reservoirs, and wetlands fail to meet state water quality standards largely as a result of the effects of NPS pollution (from Table 4-1, DEQ, 2012). DEQ estimates that 37 percent of the state’s perennial river and stream miles, and 72 percent of lake and reservoir acres have been assessed.

Figure V-19 Water quality impaired streams.



The NPS management program is a voluntary program of land, soil, and water conservation practices designed to prevent pollution from land-use activities. DEQ works with conservation districts, watershed groups, nonprofit organizations, local/state/federal agencies, and individual Montanans to provide training, monitoring support, and project funding. For those waters not meeting standards, TMDLs are developed, followed by voluntary implementation of best management practices for nonpoint sources, and potentially, point source permit waste load allocations (Figure V-20). The TMDL program establishes the maximum amount of a pollutant that a water body may receive and still be expected to achieve applicable water quality standards. TMDLs are designed to achieve and protect designated beneficial uses.

Figure V-20 TMDL completion schedule and project areas.



Besides nonpoint pollution, there is point source pollution. Point source pollution comes from a single point, commonly thought of as an end-of-pipe discharge. DEQ maintains a point source pollution control program, known as the Montana Pollutant Discharge Elimination System (MPDES), which is aimed at protecting water quality in water bodies receiving point source discharges from sewage, industrial, or other wastes.

Other water quality protection laws include Section 310 of the Montana Stream Protection Act, which requires conservation districts to regulate private activities that disturb the bed or banks of rivers and streams. Similarly, government activities that disturb the bed or banks of streams are regulated by FWP. Such activities include temporary disturbances, such as construction or maintenance activities for irrigation diversions. In addition, the legislature provided for creation of local water quality protection districts. Such districts have limited regulatory authority, and are primarily intended to provide funding to locally monitor and plan for the protection of water quality resources of particular concern to the people within the district.

Figure V-21 Dewatered streams

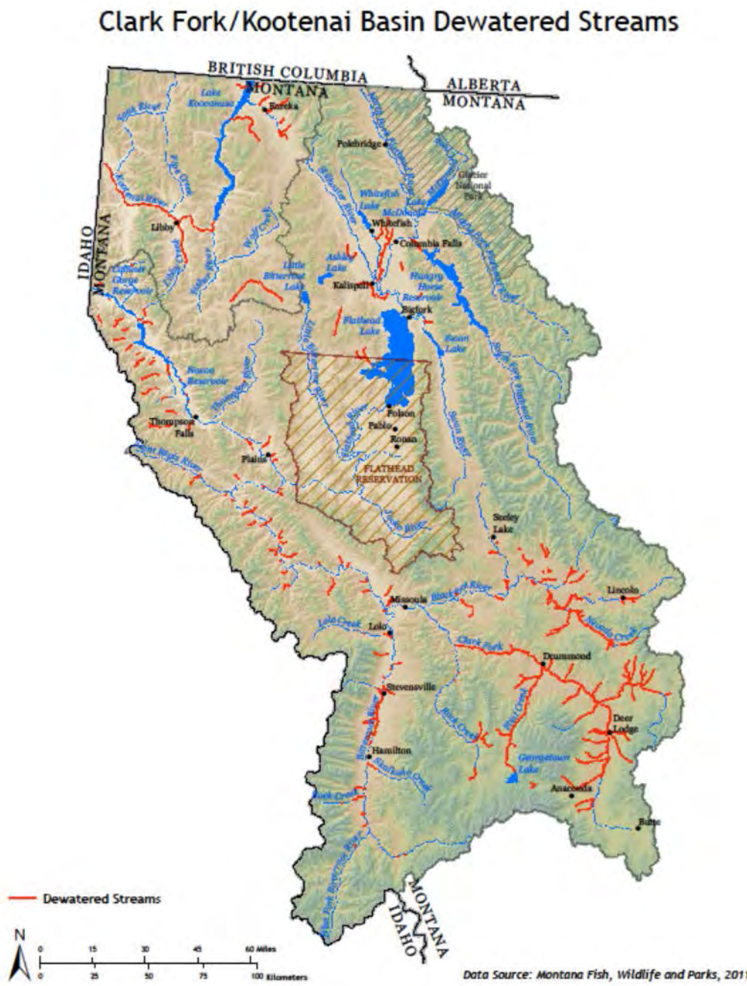


Figure V-21 above provides a map showing perennial streams in the Clark Fork and Kootenai Basins that Montana Dept. of Fish Wildlife and Parks has identified as chronically dewatered during a portion of the year on an average annual basis.

GROUNDWATER QUALITY PROTECTION

The Montana Ground Water Pollutant Control System (MGWPCS) (Chapter 17.30, subchapter 10, ARM) is a regulatory program to control all otherwise unregulated sources of groundwater pollution. Important aspects of the MGWPCS rules are groundwater quality standards, a non-degradation requirement, and a discharge permit system. A wide variety of activities are exempt from having to obtain MGWPCS permits (see 75-5-401 MCA and 17.30.1022, ARM). Discharges from the exempted activities are typically covered under other permitting programs or regulations.

Groundwater quality is also addressed in the Agricultural Chemical Ground Water Protection Act. Under this act, DEQ is responsible for developing and enforcing groundwater quality standards for agricultural chemicals. DEQ is also charged under this act with monitoring, promoting research, and providing public education in cooperation with universities and other state agencies. The Montana Department of Agriculture (DOA) is charged with developing and enforcing agricultural chemical groundwater management plans aimed at preventing groundwater contamination from agricultural chemicals. Both DEQ and DOA have rules to implement their respective responsibilities under this act.

VI. Administration

Institutional and Legal Framework for Water Use in Montana

PRIOR APPROPRIATION DOCTRINE AND THE MONTANA WATER USE ACT

In order to legally put water to a beneficial use in Montana, a person must have a water right. The elements of a Montana based water right - the right to the beneficial use of water – are dictated by the prior appropriation doctrine. In its simplest form, the prior appropriation doctrine provides that a person's right to use a specific quantity of water depends upon when that use began – the first in time, is the first in right. A water right consists of a priority date, a purpose of use, point of diversion, a source, place of use, period of use, and a quantity reflected in a flow rate, volume or both. There are no preferences among beneficial uses other than priority date. A water right does not create ownership in the water itself. Rather, it creates a property interest in the right to beneficially use a quantity of water for a specific purpose. Accordingly, actual historical beneficial use constitutes the basis, measure, and the limit of a water right.

Prior to July 1, 1973, Montana's prior appropriation system provided two primary methods for acquiring a water right: 1) a water user could simply construct a diversion and put the water to beneficial use (known as a use right); or 2) a water user could comply with the statutory notice of appropriation requirements (known as a statutory right). No prior authorization was required and the state had no control over use of this state-owned natural resource. As demands and conflicts over water increased, it became increasingly difficult to administer water rights because the rights were not recorded in a central location.

The 1972 Montana Constitutional Convention sought to remedy Montana's antiquated system while at the same time preserving the fundamental prior appropriation principles of first in time, first in right and beneficial use as the basis, measure and limit of a water right. To accomplish this goal the Article IX Section 3(1) of the Montana Constitution recognized and confirmed "existing rights" to the "use of any waters for useful or beneficial purpose." The Constitution also confirmed, in Article IX Section 3(3), that all waters within Montana are the property of the state for the use of its people and are subject to appropriation for beneficial uses as provided by law. Finally, in order to provide the necessary tools to better manage use of Montana's water resources, Article IX Section 3(4) of the Constitution charged the legislature with providing for the administration, control, and regulation of water rights and establishing a system of centralized records.

The Legislature responded to these constitutional charges by passing the Montana Water Use Act (Act), effective July 1, 1973. In order to fulfill the constitutional mandates of Article IX, the Act established an adjudication system to adjudicate pre-July 1, 1973 water rights, a permit system to control and regulate post-July 1, 1973 water appropriations, changes in use of existing water rights, and a centralized system of recording water rights.

The Act confirmed the fundamental principles of Montana's prior appropriation doctrine, including the following:

1. Montana's water belongs to the state for the beneficial use of its people. Therefore, water right holders do not own the water; they possess the right to use the water.
2. Doctrine of Prior Appropriation (first in time, first in right).
3. "Use it or lose it." A water right holder must use the water or risk losing the right to it.
4. The water diverted must be for a beneficial use, and all beneficial uses are equal under the law.
5. A water right is a property right and can be separated from the land.

6. One must have a water right to beneficially use water, and after July 1, 1973, new water rights can be obtained only from the DNRC, generally through the permitting process.
7. Any change in the purpose, place of use, place of storage, or point of diversion of a water right may not adversely affect other water rights and must first be approved by the DNRC

Over time the Act has refined elements of the permitting and change process to reflect increased understanding of water use and resources in the state. The Act has also evolved to provide for state-based water reservations, temporary changes and leases including for instream flows, and permits and change authorizations for marketing and mitigation. However, these refinements continue to be subject to the fundamental principles of the prior appropriation doctrine.

WATER RIGHTS ADJUDICATION AND THE WATER COURT

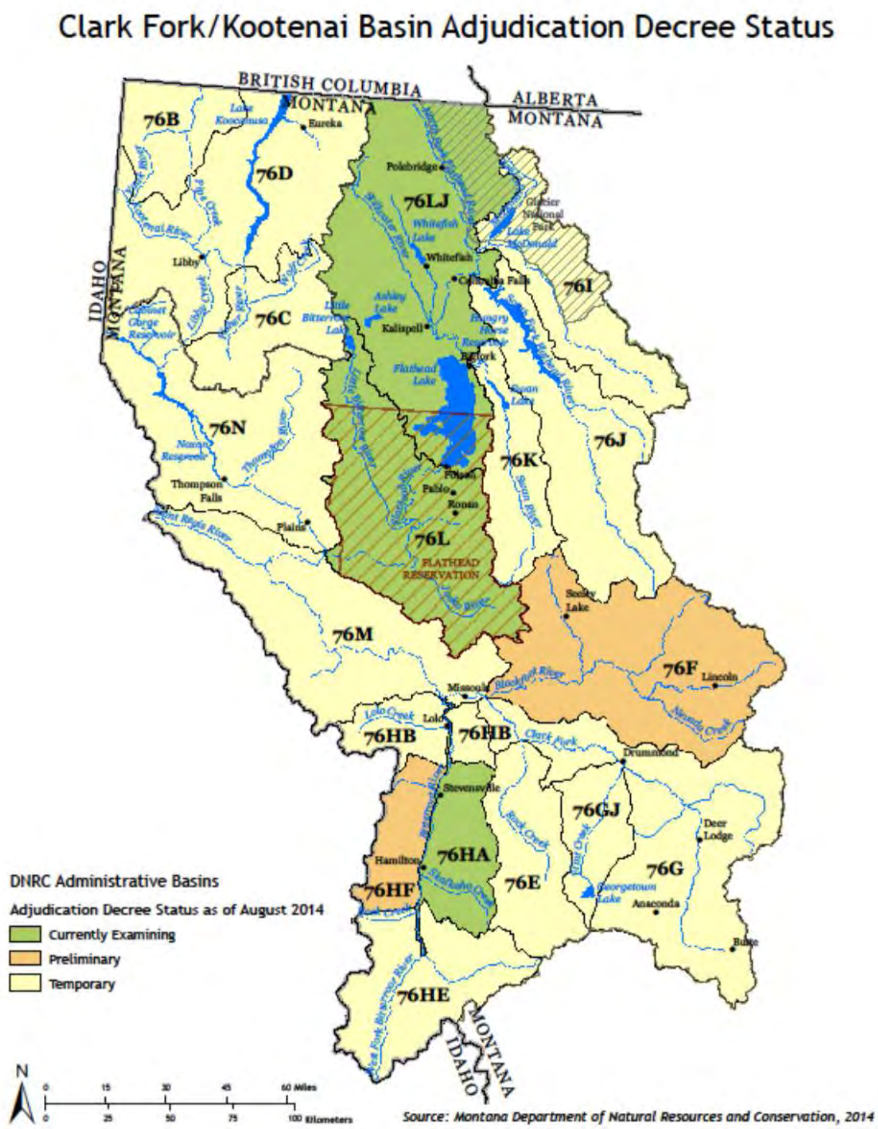
The Act set forth the framework for Montana to embark upon a state-wide general stream adjudication of pre-July 1, 1973, existing water rights. The adjudication serves to recognize and confirm existing water rights as required by the Constitution (Figure VI-1). The adjudication involves examining, litigating and decreeing claims to water with priority dates prior to July 1, 1973 through the Water Court (§85-2-2 MCA).

The first phase of the adjudication process involved the examination of each water right claim for factual and legal issues in accordance with Montana Supreme Court Claim Examination Rules. Over 220,000 claims for pre-1973 water use were received. This phase of examination was performed by the DNRC and completed in 2014. Additionally, the Water Court issued an order for DNRC to re-examine certain elements of claims in 45 basins that were not examined according to the current and more rigorous Montana Supreme Court Claim Examination Rules. The second phase of the adjudication involves issuance of temporary and/or preliminary decree, public notice, litigation of objections, and resolution of issue remarks. Following the resolution of objections and issue remarks, the Water Court will issue final decrees for each of Montana's 85 river basins which will define pre-July 1, 1973 water rights by owner, purpose, priority date, source, place of use and other elements of the water right. The current target date for the Water Court to issue final decrees is 2028.

Montana's water rights adjudication process will not be complete until all Federal and Tribal reserved water right compacts have been decreed by the Water Court. Prior to review by the Water Court, all compacts must be ratified by the Montana Legislature, approved by appropriate federal authorities, and in the case of Tribal compacts approved by Tribes. Where federal authorization or federal appropriations are needed to implement provisions of the settlement, congressional approval is required.

To date seventeen compacts have been negotiated and approved by the Montana Legislature. A negotiated compact with the Confederated Salish and Kootenai Tribes (CSKT) is awaiting approval by the Montana Legislature. If the legislature does approve not the proposed CSKT compact, the Tribes must file their claims with the Water Court prior to July 1, 2015.

Figure VI-1 Adjudication Decree Status map



NEW BENEFICIAL WATER USE PERMITS, CHANGE IN USE AUTHORIZATIONS, AND THE DNRC

Under the Act, the DNRC has jurisdiction over all changes in use and new appropriations occurring after July 1, 1973. The DNRC has the authority to enforce against illegal water use, and performs a number of other responsibilities related to post July 1, 1973 water use, planning and management in Montana.

In exercising its jurisdiction over new appropriations, the DNRC evaluates the proposed use pursuant to the §85-2-311, MCA, permit criteria. These criteria require the applicant prove that water for a proposed appropriation is both physically and legally available, and that existing appropriators will not be adversely affected, The applicant must also prove that the proposed use is a recognized beneficial use of water, that the proposed diversion is adequate, and that the applicant has a possessory interest in the place of use.

Similarly, DNRC exercises its jurisdiction over changes in use for existing water rights pursuant to the Act's change criteria found at §85-2-402, MCA. A water user can change the place of use, purpose of use, point of diversion, and place of storage for a water right. While these elements of a water right are subject to being changed, a water user may not expand the extent of the underlying water right. Therefore, evaluation of the change criteria focuses on the historic beneficial use of the underlying water right, alteration of return flows, and a determination of whether the change in use will adversely affect other water users (senior and junior) on the source. The change provisions of the Act are discussed in more detail under Section IX of this plan.

The permit and change provisions of the Act reflect a fundamental shift from pre-July 1, 1973, water appropriation in that they require prior approval from the DNRC before water is appropriated or a change in use occurs. The Act provides the DNRC with the authority to condition, revoke, or modify permits and change authorizations as necessary to ensure compliance with the Act through administrative proceedings. §85-2-311, 312, and 314, MCA.

Over the past 40 years, DNRC has developed and refined the permit and change procedures in an effort to maintain the balance between authorizing new water uses and changes while at the same time protecting water users from adverse effects. The DNRC has developed specialized expertise and adopted rules on various aspects of water availability and water use throughout the state. See Title 36, Chapter 12, Mont. Rules Admin. For example, DNRC's rules include information regarding accepted methods for measuring water availability in gauged and un-gauged sources, estimating historic consumptive use, and modeling groundwater aquifer characteristics and properties.

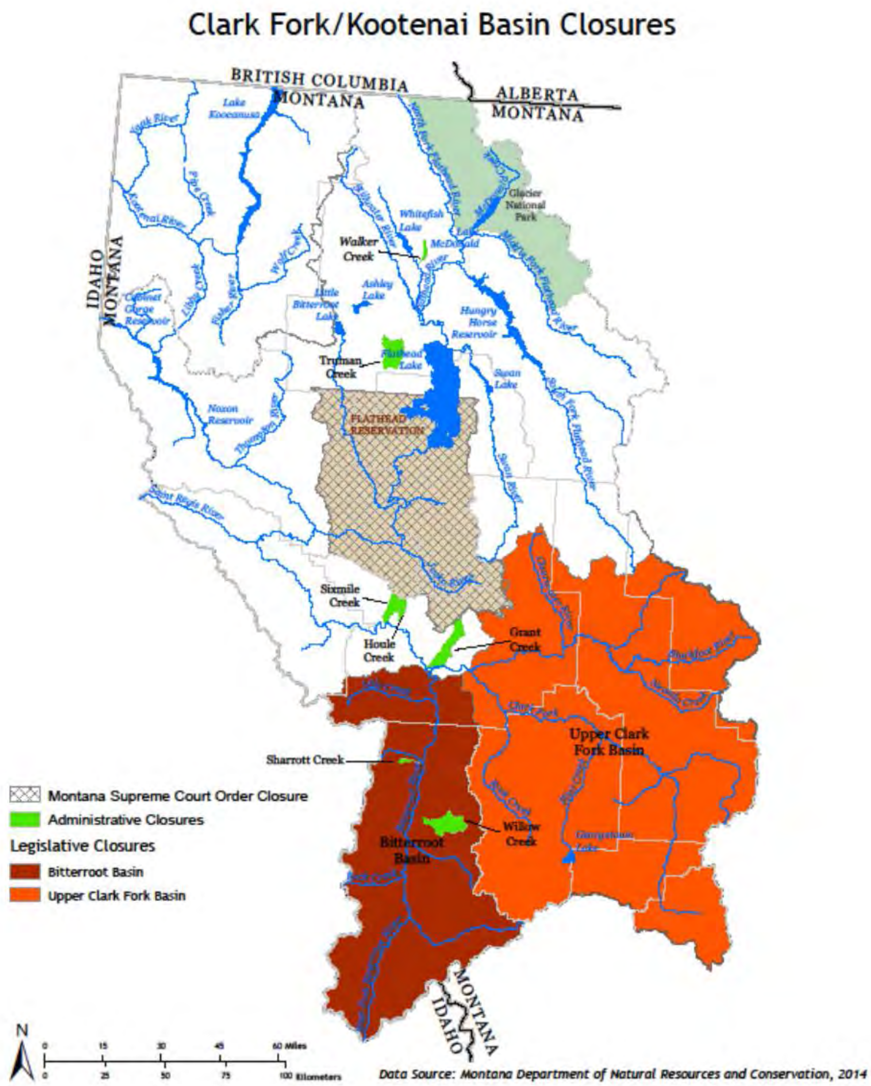
BASIN CLOSURES IN THE CLARK FORK BASIN

Montana has closed some of its river basins to certain types of new water appropriations because of water availability problems, over-appropriation, and a concern for protecting existing water rights. Section 85-2-319, MCA, legislatively authorizes the closure of basins to certain new appropriations through the adoption of administrative rules and negotiation of reserved water rights compacts. The law also provides for the closure of highly appropriated basins through the adoption of administrative rules.

A person wanting to appropriate groundwater in a closed basin must complete a hydrogeologic assessment and must meet the requirements of 85-2-360, 85-2-361, and 85-2-362, MCA. If the hydrogeologic assessment predicts that the appropriation would have no net depletion of surface water, the application moves through the permitting process. If the assessment predicts net depletion of surface water, it must be determined if net depletion would have an adverse effect on prior appropriators. If not, the application moves through the permitting process. If there would be an adverse effect, the applicant must submit a plan for mitigation or aquifer recharge.

Closed basins in the Clark Fork Basin include the Bitterroot River and Upper Clark Fork River drainages as well as smaller closures in Sharrott Creek, Willow Creek, Grant Creek, Sixmile Creek, Houle Creek, Walker Creek, and Truman Creek. The Upper Clark Fork River closure includes the drainage area of the Clark Fork River and its tributaries upstream of the location of the Milltown Dam removed in 2010. DNRC may not process or grant permits in the Upper Clark Fork River closure except for stock, water storage, hydroelectric power generation, or groundwater. The Bitterroot River closure extends upstream from the confluence of the Bitterroot with the Clark Fork River including tributaries. Exceptions to permitting in the Bitterroot River closure include appropriations for municipal water supplies, groundwater, temporary emergency appropriations, and storage of high spring flows. Applicants for groundwater greater than 35gpm up to 10 acre-feet annually in any basin closure area must prove criteria for issuance of a permit under §85-2-311, MCA and are subject to the requirements of HB-831 found in §85-2-360, §85-2-361, and §85-2-362, MCA.

Figure VI-2 Closures to new appropriations of water in the basin



CONTROLLED GROUNDWATER AREAS IN THE CLARK FORK BASIN

In addition to basin closures for surface water, controlled groundwater areas may be designated to protect water quality or quantity (§85-2-506, MCA). An area for designation may be proposed by DNRC on its own motion, or by petition of a state or local public health agency, municipality, county, conservation district, or local water quality district. An area also may be proposed upon petition of at least one-third of the water rights holders in the proposed controlled groundwater area.

Controlled groundwater areas include Bitterroot Valley Landfill, BNSF Paradise Rail Yard, BNSF Somers, Warm Springs Ponds, Butte Alluvial and Bedrock, Old Butte Landfill, Clark Tailings, Rocker, Larson Creek, and Hayes Creek. All the controlled groundwater areas within the basin are closed because of water quality concerns with the exception of Larson Creek and Hayes Creek. New wells in Larson Creek must be completed to greater than

70 feet and sealed to prohibit leakage in order to prevent depletion to Larson Creek unless an applicant obtains a permit by proving with clear and convincing evidence or submits a plan to augment impacts to Larson Creek. The Hayes Creek controlled groundwater area established controls for both the shallow alluvial and fractured bedrock aquifers that require permits for all new wells with approval subject to the capacity of the aquifers, that set a limit of one well per lot, and that allow for limiting future withdrawals if deemed necessary.

Figure VI-3 Controlled groundwater areas

Federal Agencies with a Role in Managing Montana's Water Resources

Below is a list of Federal Agencies with a Role in Managing Montana's Water Resources

DEPARTMENT OF AGRICULTURE

Farm Service Agency – administers cost share programs for farmers that improve water quality, soil stabilization, and irrigation systems. www.fsa.gov

Natural Resources Conservation Service – assists private landowners with watershed protection, flood prevention, soil and water conservation, snow surveys and soil inventories; conducts land-use inventories, cropland studies, and wetland assessments. www.nrcs.gov

Forest Service – conducts watershed management within ten national forests in Montana, and manages three wild and scenic river reaches within its forest boundaries. www.usfs.gov

DEPARTMENT OF THE ARMY

Corps of Engineers – authorizes permits for private projects affecting navigable waters; administers large multipurpose reservoirs for navigation, flood control, hydroelectric generation, and flood damage reduction. www.usace .army .mil

DEPARTMENT OF COMMERCE

Economic Development Administration – provides public works grants for community water development. www.eda.gov

National Oceanic and Atmospheric Administration – issues information on weather, river, and climactic conditions; maintains a flood warning system. The National Weather Service at NOAA forecasts weather and issues weather warning and watches. www.noaa.gov

DEPARTMENT OF ENERGY

Bonneville Power Administration – markets electric power for the 31 hydroelectric projects of the federal Columbia River Power System, including the Libby and Hungry Horse dams in Montana, and mitigates loss of fish and wildlife caused by this system; operates transmission systems. www.bpa.gov

Western Area Power Administration – distributes and markets hydro power from federal facilities outside of the Columbia River basin in a 15 state region, including Montana; operates transmission lines. www.wapa.gov

DEPARTMENT OF HOMELAND SECURITY

Federal Emergency Management Agency – delineates flood plains, publishes maps, and administers the National Flood Insurance Program, a Federal program enabling property owners in participating communities to purchase insurance protection against losses from flooding. www.fema.gov

Department of Housing and Human Development – Provides financial aid for local water resource projects such as water and wastewater improvements through Community Development Block Grants for "entitlement communities" with populations of over 50,000. www.hud.gov

DEPARTMENT OF INTERIOR

Bureau of Indian Affairs – protects water rights of Indian tribes and promotes productive water use. www.bia.gov

Bureau of Land Management – administers federally-owned lands and use of natural resources, including water, on these lands. www.blm.gov

Bureau of Reclamation – designs, constructs, and operates water projects; conducts river basin water management studies; coordinates water conservation efforts. www.bor.gov

National Park Service – protects water resources (reserved water rights) and conducts water resource studies in Montana's national monuments, battlefields, and national parks. www.nps.gov

U.S. Fish and Wildlife Service – reviews comprehensive water plans and projects for impacts on fish and wildlife habitat and populations; works to recover endangered fish and wildlife species; manages hatcheries; studies fish disease. www.fws.gov

U.S. Geological Survey – researches the source, quantity, distribution, movement, and availability of surface and ground water for national water data network and technical reports. www.usgs.gov

Environmental Protection Agency – Works with states to establish and enforce standards for water quality and drinking water; provides grants for drinking water and water pollution control facilities. www.epa.gov

Federal Energy Regulatory Commission – Issues licenses for hydroelectric projects and transmission lines. www.ferc.gov

State Agencies with a Role in Managing Montana's Water Resources

Below is a list of State Agencies with a Role in Managing Montana's Water Resources

Montana Department of Natural Resources and Conservation -

- Administers the portions of the Act that relate to water uses after June 30, 1973 such as Permits and Change Authorizations;
- Provides training for court appointed water commissioners;
- Provides technical information and assistance to the Water Court on water rights claims (pre-July 1, 1973) including examining those claims;
- Maintains a central water rights record system;
- Investigates complaints of illegal water use; and
- Other duties related to Water Operations, Water Management, and State Water Projects.

Montana Water Court –

- Adjudicates water rights as they were protected under the laws pre- July 1, 1973;
- Decides any legal issues referred from the District Court on pre- July 1, 1973 water rights; and
- Assists District Courts with enforcement.

District Courts –

- Can issue injunctive relief while it certifies water rights issues to the Water Court;
- Appoints Water Commissioners for enforcement; and
- Manages the enforcement of water rights and handles complaints by dissatisfied water users.

Reserved Water Rights Compact Commission (Commission) –

- Negotiates settlements with federal agencies and Indian tribes claiming federal reserved water rights within the State of Montana; and
- Negotiates on behalf of the Governor's Office and represents the interests of the State water users.

Attorney General –The Water Court may join the Attorney General to intervene, on behalf of the state, in the adjudication of water right claims that are being decreed by the Water Court.

Legislature – Provides policy direction and laws for the administration of waters. When the Legislature is not in Session, two interim committees have oversight of water related issues:

- ***Water Policy Interim Committee (WPIC)*** – permanent, joint bipartisan committee that studies water issues in order to develop a clear policy direction and necessary legislation to guide Montana's water policy.
- ***Environmental Quality Council*** – contributes policy oversight to the administration of state water rights by advising and updating the legislature and overseeing institutions dealing with water, and communicates with the public on matters of water policy.

Local Government and Non-Governmental Organizations with a Role in Managing Montana's Water Resources

Montana's geography and communities are diverse. No uniform approach to water management dictated from above would be appropriate across the state. Consequently a large number of decisions that directly or indirectly affect water resources have devolved to local government. Some are legal requirements; for example, conservation district boards review proposals for activities that would affect streams, and issue "310 permits" under state law. Other local actions are more discretionary. In adopting their growth policies, for example, county commissions can choose to incorporate various kinds of measures to protect water resources in the development process. Water management is an important responsibility for local governments. The information below is a synopsis of local government or local group responsibilities over water.

Local Health Departments are responsible for protecting public health from communicable disease, including water-borne disease that can be transmitted through surface and groundwater. Local health departments assess potential public health problems, adopt policies and practices to prevent pollution, and clean up contamination. They enforce public health standards, including some regarding drinking water and wastewater.

City & County Commissions and Boards direct local water management through shaping and administering county growth policies, subdivision regulations, and other land-use and protection measures.

Conservation Districts (CD) exist in all Montana counties to address local water resource needs. Guided by locally elected boards of directors, conservation districts address special water problems, regulate stream management, issue 310 Permits, and educate citizens about land-use practices and pollution prevention (http://www.macdnet.org).

Local Water Quality Districts (LWQDs) serve to protect, preserve, and improve the quality of surface and groundwater within the district. LWQDs operate with a board of directors and funding from county fees. LWQD's research local water quality, answer citizen inquiries, and conduct public outreach programs. Under some circumstances, they can take on regulatory authority.

County Water and Sewer Districts have taxing authority, operate under the authority of county government, and are established for the purpose of developing and operating public water or sewer systems, or both.

Water Commissioners ensure that daily water allocations in the basin occur in accordance with the water users' rights. Local water users can petition for a water commissioner after the water rights in a basin have been decreed by the Montana Water Court. The local district court appoints the commissioner, and oversees his work.

Irrigation Districts are subdivisions of government that supply water to irrigators within a specified region. Citizens may establish one by petitioning the court. Members of the district elect a board of directors to make policy, hire, and manage based on legal regulations and self-adopted bylaws. All district members pay taxes to construct and maintain the water project, usually a storage reservoir or canal system, supplying their district. Most federal irrigation projects are managed by irrigation districts.

Water User Associations are non-profit corporations that manage mostly state or local irrigation projects. If they manage state-owned projects, they are bound to terms of water-use contracts prepared by DNRC. The State of Montana holds the water rights of these projects. If not associated with state-owned projects, water user associations (sometimes called ditch or canal companies) develop their own operating rules.

Ditch or Canal Companies are private companies set up by local irrigators to share the cost and maintenance of the ditch system servicing their collective lands. Ditch companies vary greatly in membership and acreage, and often address the water needs of many individual water rights holders.

NON-GOVERNMENTAL ORGANIZATIONS

In addition to legal processes and government agencies, less formal efforts bring a variety of people together to resolve conflicts over water and to explore creative solutions to problems of quality and flow.

Coalitions for Local Watershed Planning: People across Montana have created coalitions of local governments, state and federal agencies, businesses, and local citizens to deal with water quality and quantity issues. One example is The Blackfoot Challenge, a forum that promotes cooperative resource management of the Blackfoot River, its tributaries, and adjoining lands.

Watershed Groups: These citizen groups are as diverse as the communities they serve, and they participate directly in watershed-level decision-making and problem solving, as well as initiating local cleanups, conservation and watershed education, and data gathering and ecosystem research projects.

- Montana Watershed Coordination Council: This council serves to build and unite watershed communities by bringing people and information together. The council is comprised of private organizations and staff from many local, state, and federal natural resource agencies http://www.mtwatersheds.org
- Montana Wetland Council: This advisory group, whose membership is open to the public, agencies, and interest groups, seeks to direct the development and implementation of a Montana wetlands strategy. Its mission is to conserve and restore Montana's wetlands and riparian ecosystems through the cooperation of public and private interests http://www.deq.mt.gov/wqinfo/wetlands/wetlandscouncil.mcpx
- Special Interest Groups: Agriculture, recreation, industry, and fisheries have a stake in how water is managed. Reflecting this diversity, a variety of special interest groups develop creative solutions related to issues that affect Montana's water.

Federal and Tribal Reserved Water Rights

The doctrine of reserved water rights evolved to ensure that Indian reservations and public lands set aside by the federal government would have sufficient water to fulfill the purposes for which they were established. Whereas most western water rights (state-based appropriative rights) have a priority date based on when water was first put to beneficial use, federal reserved water rights have a priority date that goes back at least as far as the date on which the lands were set aside.

The reserved water rights doctrine is rooted in a number of judicial decisions, beginning with a U.S. Supreme Court decision now known as the Winters Doctrine. The case of *Winters vs United States* involved a dispute between Native Americans of the Fort Belknap Reservation and homesteaders over the use of the Milk River. When the water use of the settlers upstream from the reservation interfered with the Indians' water need for large irrigation diversions, the U.S. government filed a lawsuit on the reservation's behalf.

The Winters decision held that when Congress created the Fort Belknap Reservation, sufficient water to serve the purposes of the reservation was implicitly set aside. Therefore, although the homesteaders had perfected their water rights under Montana state law, the water right of the Indians of the Fort Belknap Reservation was prior, or senior in use.

The rationale used in the Winters decision on behalf of Native Americans also applies to public lands held by the federal government for national parks, wildlife refuges, national forests, military bases, wilderness areas, or other public purposes. It holds that when Congress authorized the establishment of federal land, it implicitly intended to reserve enough water to fulfill congressional purposes. This idea of "implied rights" serves as the basis and foundation for tribal and federal claims to state waters embodied in the many compacts negotiated by the state of Montana and its many tribal and federal partners.

TRIBAL COMPACTS IN THE CLARK FORK / KOOTENAI RIVER BASINS

Confederated Salish and Kootenai Tribes

The Confederated Salish and Kootenai Tribes (Tribes), the State of Montana and the United States (collectively the Parties) are currently engaged in compact negotiations. The negotiation process has been ongoing over many years to reach a proposed water rights settlement. The Parties hope to reach a settlement in late 2014. Current Compact related documents are available on the Montana Reserved Water Rights Compact Commission's website http://www.dnrc.mt.gov/mwsi.

Following the 2013 legislative session, the Reserved Water Rights Compact Commission, under the direction of the Governor's office, and the other Parties agreed to a limited reopening of negotiations to address the relationship between Flathead Indian Irrigation Project (FIIP) water rights and CSKT instream flow (ISF) rights, which were the subject of the previously negotiated Water Use Agreement (WUA) http://www.dnrc.mt.gov/mwsi. In the event the Parties are unable to reach a satisfactory agreement that receives the necessary support of the Legislature in the 2015 legislative session, the Tribes will have until June 30, 2015, to file water right claims in the Montana Water Court. Those claims would then be adjudicated individually under the ongoing Water Rights Adjudication Process administered by the Montana Water Court. For a summary of the CSKT Compact Provisions follow this http://www.dnrc.mt.gov/mwsi.

FEDERAL COMPACTS IN THE CLARK FORK AND KOOTENAI RIVER BASINS

National Park Service

A water rights compact with the National Park Service for Yellowstone and Glacier Parks, and the Big Hole Battlefield was finalized in 1993. The 1995 Legislature ratified a compact for the remaining two Park Service units: Little Bighorn Battlefield National Monument and Bighorn Canyon National Recreation Area, completing Park Service negotiations in Montana. The compact does not require congressional approval. The Montana Water Court issued a final decree for this compact in April 2005 (Case # WC-94-1) http://www.dnrc.mt.gov/mwsi.

Forest Service

The water compact between the State of Montana and the U.S. Forest Service, which took more than 15 years to negotiate, was approved by the Montana Legislature and signed by the Governor in 2007, followed by Federal agency approval. The compact recognizes reserved water rights for the Forest Service for administrative and emergency firefighting, and for instream flows for the South Fork Flathead Wild and Scenic River. The compact uses state law to create state-based water rights for instream flow on the National Forest System lands. The Montana Water Court issued a final decree for this compact in October 2012 (Case # WC-2007-03). http://leg.mt.gov/bills/mca_toc/85_20_14.htm

Discrete Administrative Uses: These reserved water rights to divert or withdraw water are to serve administrative sites on the National Forest System Lands. These rights typically are for water used at ranger stations, guard stations, and work centers, water for permanent tree nurseries and seed orchards, and water for riding and pack stock used for administrative purposes. These uses are in discrete (site specific) places and the priority date is creation of the national forest[i]. Each Discrete Administrative Use that is currently in place has an Abstract of Water Right. 88% of the 264 current discrete administrative uses have a volume of 1.5 acre-feet per year or less. Total volume for current discrete administrative uses in each water basin is set out in Table 1 below.[ii] An amount of water to develop future permanent administrative sites in each water basin is also set out in Table 1.

Dispersed Administrative Uses: These reserved water rights to divert or withdraw water are for administrative uses that are not site specific nor permanent but are occasional uses in varying places within the national forests, such as, road watering, prescribed fire management, and temporary tree nurseries. The priority date is the creation of the national forest.

Emergency Fire Suppression: The Compact recognizes a reserved water right with a priority date of the creation of the national forest to divert or withdraw water for emergency fire suppression.

South Fork Flathead Wild and Scenic River: The Compact recognizes one reserved water right for instream flows. The South Fork of the Flathead River from the headwaters to where it enters Hungry Horse Reservoir is a Congressionally designated Wild and Scenic River. The reserved water right is for the entire flow subject to any water rights developed prior to the approval of the Compact. The priority date is October 12, 1976.

INTERSTATE COMPACTS AND INTERNATIONAL TREATIES, THE COLUMBIA RIVER BASIN TREATY

Overview

The Columbia River, the fourth largest river on the continent as measured by average annual flow, generates more power than any other river in North America. In the 1940s, officials from the United States and Canada began a long process to seek a joint solution to the flooding caused by the unregulated Columbia River and to the postwar demand for greater energy resources. That effort culminated in the Columbia River Treaty, an international agreement between Canada and the United States. The treaty provides for the cooperative development of water resources regulation in the Upper Columbia River Basin. It was signed in 1961 and implemented in 1964.

Treaty Governance

The Treaty called for two “entities” to implement the Treaty — a U.S. Entity and a Canadian Entity. The U.S. Entity, created by the President, consists of the Administrator of the Bonneville Power Administration (chair) and the Northwestern Division Engineer of the U.S. Army Corps of Engineers. The Canadian Entity, appointed by the Canadian Federal Cabinet, is the British Columbia Hydro and Power Authority (B.C. Hydro). The Treaty also established the Permanent Engineering Board (PEB), set up by the two governments to monitor and report on the results being achieved under the Treaty.

Treaty Implementation

A main component of the Treaty called for Canada to develop reservoirs in the higher reaches of the Columbia Basin sufficient to provide 15.5 million acre-feet of water storage. To do this, Canada built three dams: Duncan (1968), Hugh Keenleyside (also referred to as Arrow) (1969) and Mica (1973). The Treaty also allowed the United States an option to build Libby Dam on the Kootenai River, a tributary of the Columbia River, in Montana. Construction on Libby Dam began in 1966 and was completed in 1973. The reservoir named Lake Koocanusa backs 42 miles into Canada. Together, these four dams more than doubled the storage capacity of the Columbia River Basin at the time.

Future of the Treaty

Either Canada or the United States can terminate most of the provisions of the Treaty any time on or after Sept. 16, 2024, with a minimum 10 years' written advance notice. Unless it is terminated, most of the provisions of the Treaty continue indefinitely. The terms for flood control under the Treaty, however, will change automatically in 2024.

After 2024, Canada will still be required to provide some operations for flood control in the United States whether or not the Treaty is terminated. However, the United States will be required to provide additional reimbursement to Canada for their lost power benefits and operational costs due to the requested flood control operations. If the Treaty is terminated, the United States will no longer be obligated to pay Canada its entitlement to one-half of the downstream power benefits realized in the United States.

2014/2024 Columbia River Treaty Review

As part of this process, the U.S. Entity has committed to directly consult with tribal interests through the federal government's tribal trust responsibility. In addition, BPA and the Corps of Engineers, through the Columbia Basin Fish Accords, have agreed with certain tribes to coordinate on the review to ensure that tribal rights and concerns are brought to the U.S. Entity for consideration.

The overarching challenge in the review will be to adequately consider the ecosystem, environmental, irrigation, navigation, and other issues that were not addressed in the original treaty, and balance those interests with the continuing need for flood control and power benefits. The U.S. Entity's goal is to forge a regional consensus, if possible, regarding post 2024 Columbia River treaty operations.

For a more complete discussion of the Columbia River Treaty and the review that is currently underway follow this http://www.dnrc.mt.gov/mwsi.

VII. Potential Future Demands for Water in the Clark Fork and Kootenai Basins

Demand Projections

AGRICULTURE DEMAND PROJECTIONS

Irrigated Agriculture Development Trends
General trends in irrigated agriculture over the last twenty years in the Basins can be surmised by utilizing data from the Montana Department of Revenue Final Lands Unit (FLU), National Agricultural Statistics Service (NASS), Agricultural Census and permits granted by DNRC for irrigation.

Agricultural Census data, NASS statistics and FLU data indicate that irrigated acres have been static or on the decline in the Clark Fork and Kootenai Basins for the last twenty years. The utility of using trend data for future predictions is limited.

A review of irrigation water use permits granted by DNRC over the last twenty years indicates that very limited development has occurred. Minor development (1,893 acres) has occurred in the Clark Fork and Kootenai basins. The majority of the development has occurred in the Flathead watershed above Kerr Dam.

Improvement of Service to Existing Irrigated Lands
Full service irrigation is simply defined as applying water to meet the full crop demand. Remote sensing data was used to identify irrigated land that met or exceeded the basin average net irrigation requirement. These acres were assumed to be approaching the practical limits of full service irrigation in the Clark Fork and Kootenai Basins. The basins contain 234,717 acres or 52 percent of irrigated lands that are considered full service.

This review provides an estimate of the amount of irrigated acres that could benefit from additional water resources.

Potential Sources of Water for Development
Future development of irrigation in the Clark Fork Basin is limited by Basin closures in the Upper Clark Fork and Bitterroot, senior irrigation rights, instream and hydropower flow rights and economic feasibility. In addition, unlike the Missouri and Yellowstone Basins, there are no water reservations held by Conservation Districts for development of irrigated agriculture.

Unallocated water is limited to a few sources in the Clark Fork basin, including the Flathead River and Flathead Lake. The Kootenai River contains unallocated water. Development of additional irrigated lands would likely be near an available source, limiting development to Northwest Montana.

Modeled Future Evapotranspiration
The effects of future climate change on agriculture in Montana are unknown. Growing seasons, precipitation, crops types and global markets are just the tip of the iceberg when it comes to the uncertainties of the effects of climate change.

One example of a possible change is, with expected warming temperatures predicted in the future. Evapotranspiration by irrigated crops is expected to increase. Modeled potential evapotranspiration for vegetation for the Flathead Valley agricultural area south of Polson is presented in Figure VII-1 as an example of potential future increases in the Basins.

When compared to the 1950-1999 historic period, potential evapotranspiration is projected to increase during the 2010-2059 period under all but one of the 112 scenarios modeled. Table VII-1 compares projected increases in ET and agricultural water consumption by 2035 for the following three future-climate scenario groupings: (1) lower range warming with wetter conditions, (2) middle range of warming with a small precipitation increase, and (3) higher range warming with drier conditions.

Increased evapotranspiration would result in increased demand and increased diversion requirements for irrigated crops to maintain existing levels of crop production.

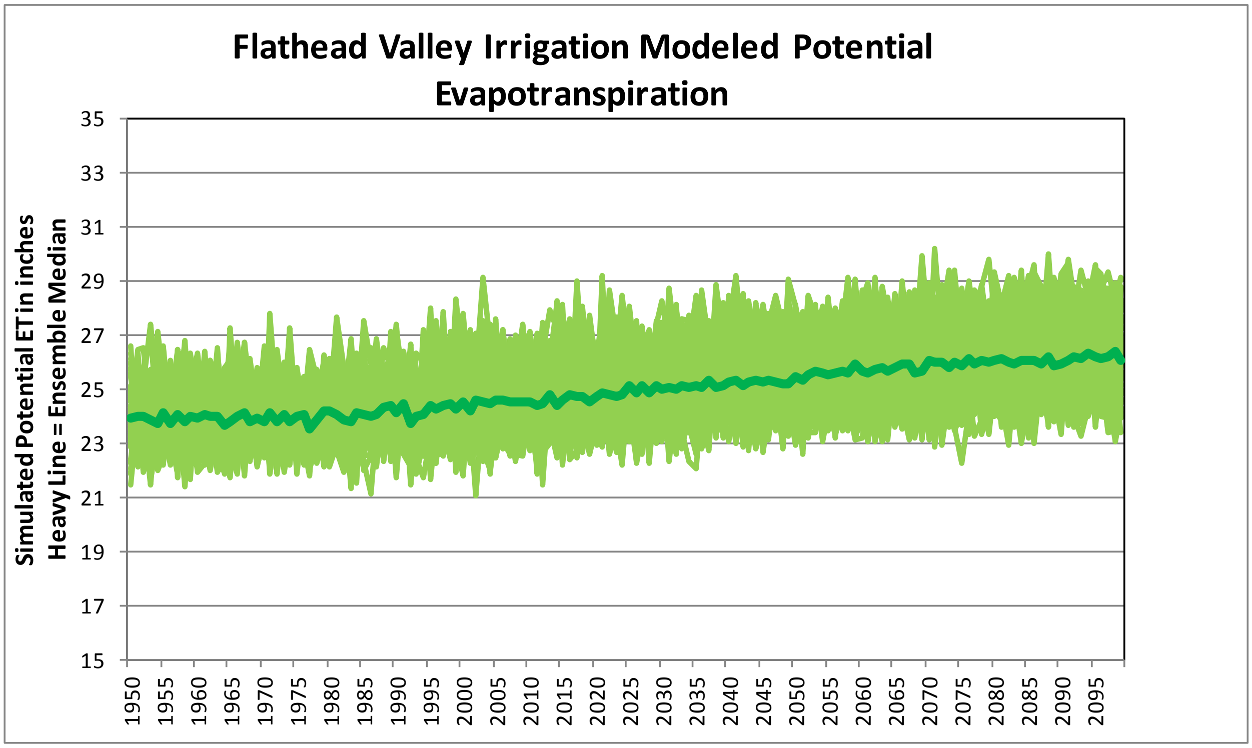
Table VII-1 Potential increases in evapotranspiration on existing irrigated lands in the basins.

HUC	Acres of Irrigation	Scenarios of Potential Evapotranspiration Increases		
		Scenario 1 2.7 % ET Increase	Scenario 2 4.6% ET Increase	Scenario 3 5.1 % ET Increase
Upper Kootenai River	4,246	4,125	4,201	4,221
Fisher River	2,704	2,848	2,901	2,914
Yaak River	0	0	0	0
Upper Clark Fork	56,036	52,384	53,353	53,608
Flint-Rock Creeks	59,941	62,964	64,128	64,435
Blackfoot River	37,029	37,041	37,727	37,907
Middle Clark Fork	13,231	11,670	11,886	11,943
Bitterroot River	85,875	102,042	103,930	104,427
North Fork Flathead River	135	130	133	133
Middle Fork Flathead River	0	0	0	0
Flathead Lake	30,153	28,018	28,536	28,673
South Fork Flathead River	0	0	0	0
Stillwater River (Flathead R)	12,764	12,371	12,600	12,660
Swan River	547	538	548	551
Lower Flathead River	149,792	143,511	146,166	146,864
Lower Clark Fork	4,002	3,157	3,215	3,230
Total	456,455	460,799	469,324	471,568

Although evaporation from open water surfaces, such as reservoirs and stream channels, was not modeled, it also is expected to increase some with warming temperatures. The wetter conditions projected for some climate change scenarios would at least partially offset the effects of more warming on evaporation rates.

Projections of future evapotranspiration were obtained from the Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections archive site maintained by USBR (see the Climate Change section below).

Figure VII-1 Simulated annual potential evapotranspiration for vegetation in the Flathead Valley Agricultural Area south of Polson.



Summary of Future Irrigation Demands

Over the past twenty years agriculture statistics indicate that irrigated acres are static or declining in the Clark Fork and Kootenai Basins. DNRC has granted permits for irrigation that have increased the irrigated acres by 0.05 percent since 1990.

The population of the Clark Fork Basin has increased over the last twenty years by 36 percent (90,000 people). New development has been primarily located in the Missoula, Bitterroot and Flathead Valleys. Development has displaced irrigated lands in some locations, the quantity of irrigated land that have been lost is unknown.

The DNRC has identified that 52 percent of the acres in the basin are irrigated to the practical limits of full service. It is likely that if new irrigation water were developed or existing water were to become available (change of use or marketing) that it would be used on existing developed irrigated lands that could be made more productive with additional water. Climate modeling suggests that potential increases of evapotranspiration on existing lands are also possible.

MUNICIPAL AND DOMESTIC DEMAND PROJECTIONS

Methods

Projected public water supply (PWS) and self-supplied domestic water use in 2035 assumes that the percentages of population in each HUC using PWS and domestic supplies in 2010 remains the same. The 2035: PWS source, water withdrawn and water consumed was assumed to remain the same as the values used by USGS (2004).

Current and Projected Population Estimates

Future water demand for public water supply was estimated for the year 2035 by extrapolating population growth from census data. Trends were extrapolated in each HUC based on changes in population between 1990 and 2010. In the Clark Fork and Kootenai Basins, no negative growth was observed except for the Upper Clark Fork HUC that contains Butte. For the purpose of this planning process, stable populations were assumed in HUCs where negative growth was observed.

The population of the Clark Fork basin is projected to increase from 340,000 people to 510,000 and the Kootenai is projected to increase from 20,000 people to 23,000 people in 2035. The Flathead Lake, Stillwater River, Bitterroot and Middle Clark Fork HUCs are expected to have the largest growth in population.

Municipal

Public water supply in the basin relies primarily on groundwater. In general, groundwater resources in the basin are assumed to be sufficient to meet the projected PWS demands in 2035. Public water supply users in the basins are projected to increase by 103,914 people in the next 20 years (Table VII-2). Population growth and water demand are expected in all areas of the basin except the North and South Forks of the Flathead.

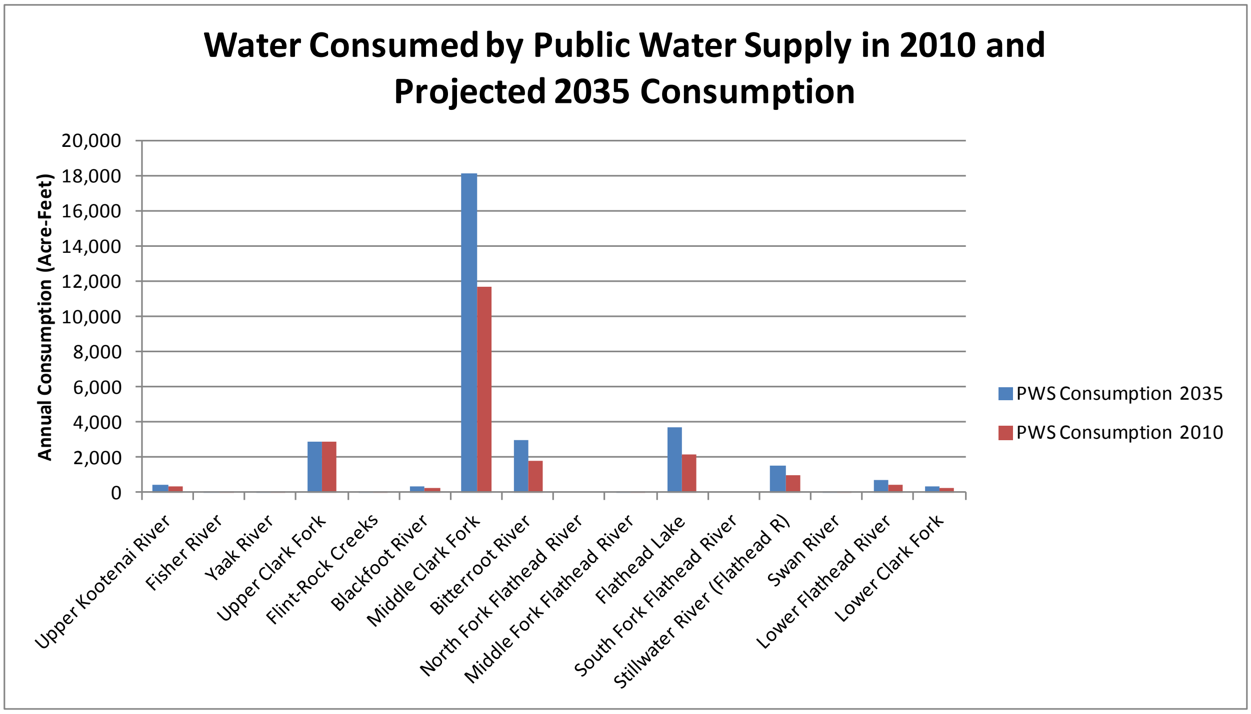
The largest PWS systems in the basin are near the major population centers (Missoula, Butte, Hamilton, Kalispell, etc.). The annual volume of groundwater withdrawn for PWS use is projected to range from 0 (HUCS with no PWS system) to 49,000 acre-feet per year in 2035. Surface water withdrawn is projected to range from 0 to 1,300 acre-feet per year in 2035. Water consumed by municipalities in the Clark Fork and Kootenai basins is projected to increase by 10,270 acre feet over the next 20 years.

Table VII-2 Projected withdrawal and consumption of surface and groundwater by public water supply systems in 2035.

2035 Projected Public Water Supply Withdrawn and Consumed in Acre-Fee per Year						
HUC	2035 Population Served by PWS	Population Increase	Water Withdrawn		Water Consumed	
			Surface water	Ground Water	Surface Water	Ground Water
Upper Kootenai River	4,254	933	511	685	189	254
Fisher River	204	74	0	29	0	11
Yaak River	71	21	0	11	0	4
Upper Clark Fork	15,307	0	0	7,852	0	2,905
Flint-Rock Creeks	279	569	60	114	22	42
Blackfoot River	356	526	827	147	306	54
Middle Clark Fork	121,309	43,452	0	49,101	0	18,167
Bitterroot River	21,358	8,210	0	7,979	0	2,952
North Fork Flathead River	0	0	0	0	0	0
Middle Fork Flathead River	33	3	0	6	0	2
Flathead Lake	75,314	31,303	59	9,965	22	3,687
South Fork Flathead River	0	0	0	0	0	0
Stillwater River (Flathead R)	20,972	12,005	1,367	2,807	506	1,039
Swan River	182	57	0	34	0	13
Lower Flathead River	14,437	4,850	0	1,949	0	721
Lower Clark Fork	5,540	1,912	71	852	26	315
Total	279,616	103,914	2,894	81,532	1,071	30,167

Figure VII-2 shows the total projected consumption (surface and groundwater) in 2035 plotted by HUC against the 2010 consumption estimates. Public water supply use in the Middle Clark Fork HUC (Missoula) dominates the graph. Most HUCs where public water supply systems exist are projected to see increases in use. PWS use in the Upper Clark Fork HUC (Butte) is projected to remain steady because of population trends.

Figure VII-2 Projected consumption of surface and groundwater by public water supplies in 2035. Domestic



Domestic
Self-supplied domestic users are projected to increase by 71,000 people in the next 20 years in the Clark Fork and Kootenai basins. Population and domestic water demands are projected to increase in all areas of the basin over the next 20 years.

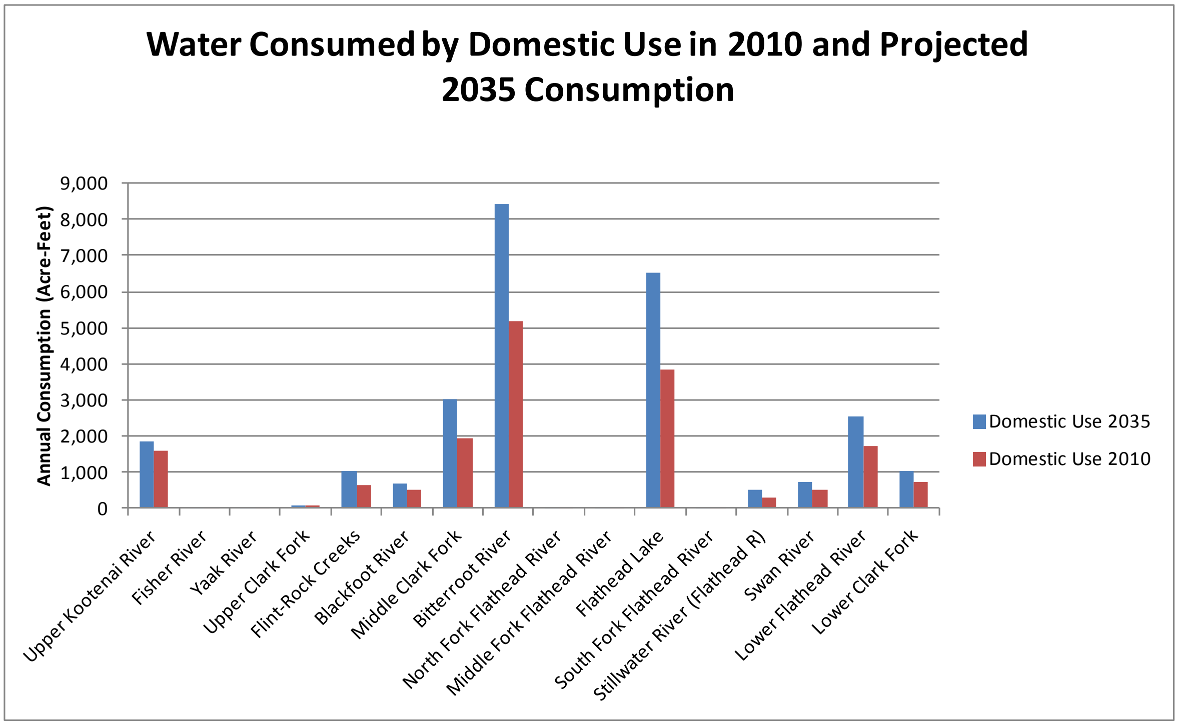
Projected increases in domestic use of groundwater in the basin are highest in the populated rural areas, including the Bitterroot, Flathead, and Missoula Valleys. Groundwater withdrawn for domestic use ranges from 17 to 3,400 acre-feet per year. Table VII-3 shows projected groundwater consumed by self-supplied domestic wells. Water consumed by domestic use in the Clark Fork and Kootenai basins are projected to increase by 3,122 acre-feet over the next 20 years.

Table VII-3 Projected groundwater withdrawn and consumed by domestic use in 2035

2035 Domestic Water Supply in Acre-Feet per Year				
			Ground Water	
HUC	2035 Population Served by Domestic	Population Increase	Withdrawn	Consumed
Upper Kootenai River	14,103	1,809	1,236	618
Fisher River	473	172	41	21
Yaak River	457	133	40	20
Upper Clark Fork	667	0	58	29
Flint-Rock Creeks	7,830	2,842	686	343
Blackfoot River	5,195	1,149	455	228
Middle Clark Fork	22,846	7,937	2,002	1,001
Bitterroot River	64,224	24,688	5,627	2,813
North Fork Flathead River	281	98	25	12
Middle Fork Flathead River	359	35	31	16
Flathead Lake	49,659	20,512	4,351	2,175
South Fork Flathead River	198	9	17	9
Stillwater River (Flathead R)	3,956	1,518	347	173
Swan River	5,608	1,747	491	246
Lower Flathead River	19,260	6,070	1,687	844
Lower Clark Fork	7,980	2,545	699	350
Total	203,096	71,264	17,793	8,897

Figure VII-3 plots domestic use consumption projected for 2035 by HUC against 2010 consumption estimates. Increases in use were observed in most other HUCs in the basin, with the highest use in the Flathead Lake and Bitterroot HUCs.

Figure VII-3 Projected consumption of ground water by domestic use in 2035



INDUSTRIAL DEMAND PROJECTIONS

Water demand for construction and other urban industrial water uses generally are expected to grow in proportion to population and are reflected in projections of future water demands for public water supplies. Other industrial uses, such as mining, are not served by public water supplies and do not follow predictable trends. Hydrocarbon extraction and coal resources are not present and the basin and water use associated with these industries are not expected.

RECREATION AND ENVIRONMENTAL DEMAND PROJECTIONS

Demand for instream flow and recreation takes many forms including stream fisheries, aquatic habitat, wildlife, wetlands, boating and flat water recreation. Population growth, demographic trends, trends in hunting and fishing licenses, and the potential for endangered species listing all may affect the magnitude and regional pattern of demand for instream flows.

Translating the effects of trends in population data, angling pressure and endangered species listing on future demand for instream flow protections or other water management actions is difficult and has not been investigated. The relationship is likely to be greater or lesser pressure on state agencies, in the case of endangered species listing and decisions at the federal level.

EFFECTS OF NEW OR INCREASED DEPLETIONS ON THE AVAILABILITY OF FUTURE SURFACE WATER SUPPLIES.

Agricultural

Agricultural demand of water over the next 20 years in the Clark Fork and Kootenai basins are expected to remain near current levels. Trends in agriculture and water rights permitting suggest that expansion of irrigated

agriculture is not likely. Climate modeling indicates the potential for minor increases in evapotranspiration in the basin.

Water resources for new agricultural development in the Clark Fork basin are limited by senior irrigation rights, hydropower water rights, instream flow rights and basin closures. Water resources for development of agriculture are available in the Kootenai basin.

Municipal and Domestic

Projected increases in municipal and domestic demand in the Clark Fork and Kootenai Basins are primarily from groundwater resources. Municipal and self-supplied domestic use for water in the Clark Fork Basin is predicted to increase by 13,328 acre-feet and 153 acre-feet in the Kootenai.

Increases in municipal and self-supplied domestic demands are likely to be fulfilled within existing water rights, through reallocation of water rights, mitigation or aquifer recharge.

Climate Variability and Drought in the Clark Fork and Kootenai Basins

EFFECTS OF DROUGHT AND CLIMATE VARIABILITY ON FUTURE WATER AVAILABILITY

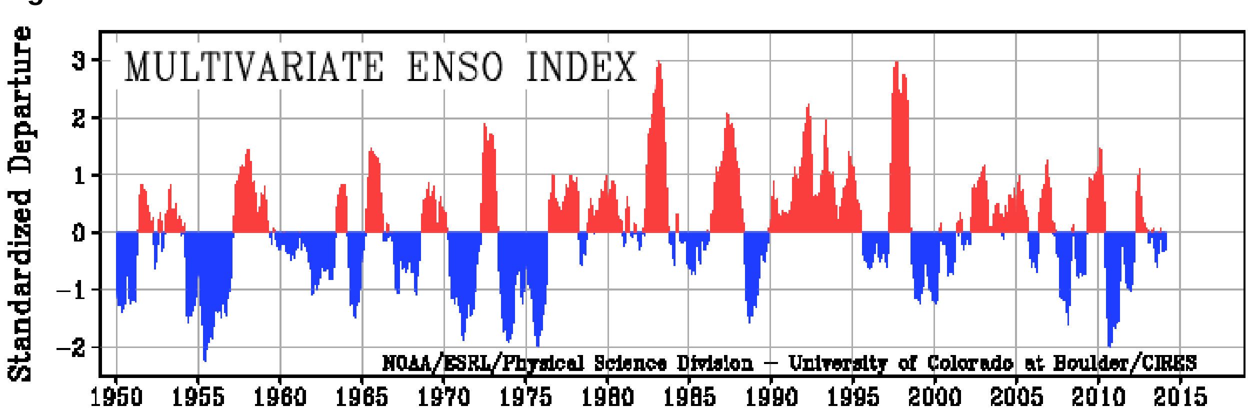
Climate Variability

Climate in the Clark Fork and Kootenai Basins varies over time and space. Climate variability includes micro-scale events (localized thunderstorms) to global-scale weather phenomenon (the jet stream). Climatic conditions such as the El Niño Southern Oscillation (ENSO) (El Niño and La Niña) and the Pacific Decadal Oscillation (PDO) result from interactions between the Pacific Ocean and the atmosphere above. El Niño, La Niña, and the PDO can have short-term and long-term effects on the water supply in the Clark Fork and Kootenai Basins.

ENSO is described as changes in surface temperature of Pacific Ocean off the coast of South America. The range of ENSO includes a warm phase (El Niño), cold phase (La Niña), and neutral conditions. In general, for Montana, El Niño results in below average precipitation and La Niña results in above average precipitation. ENSO neutral conditions result in equal chance of above or below average precipitation. El Niño and La Niña conditions occur every 3 to 5 years. Typically El Niño conditions last less than a year and La Niña conditions last 1 to 3 years.

The Multivariate ENSO Index (NOAA) in Figure VII-4 uses several oceanic parameters to create an index of El Niño, La Niña, or natural conditions. In general, red positive numbers represent warm (El Niño) conditions and blue negative numbers represent cold (La Niña conditions). The strength of the El Niño or La Niña is indicated by a greater positive or negative number. Neutral conditions are indicated by values near zero.

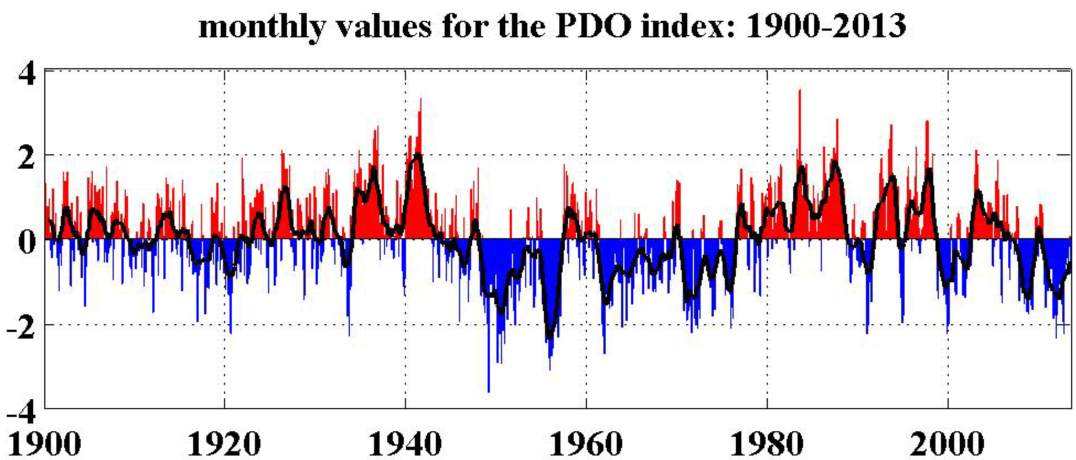
Figure VII-4 NOAA Multivariate ENSO Index



The Pacific Decadal Oscillation (PDO) is described as changes to the temperature of water in the North Pacific Ocean. The warm and cool phases of the PDO occur on an inter-decadal time scale and typically last 20 to 30 years. Figure VII-5 shows the PDO index (JISAO). The strength of the warm or cool phase is indicated by the value of the positive or negative index.

In the PDO affects Montana as follows: the warm phase (positive) of the PDO results in drier conditions and the cool (negative) phase results in wetter conditions. The data indicate that the PDO recently changed to the cool negative phase.

Figure VII-5 PDO index from 1900 to 2013 (JISAO)



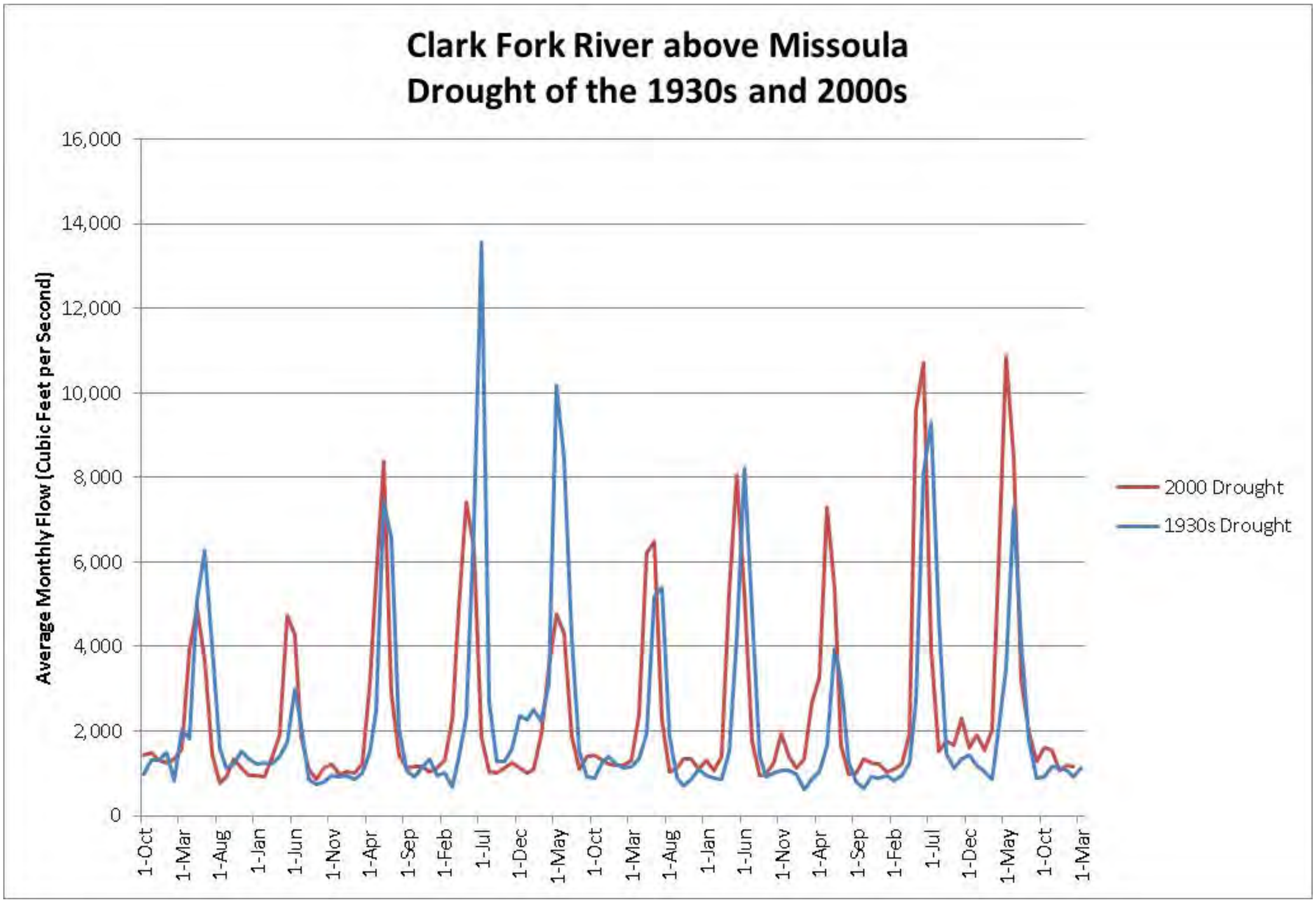
Prolonged Drought

Drought by definition is an extended period when a region is deficient in water supply. Drought in Montana varies in time and space. In is not uncommon for portions of the state to be in drought conditions and others to have excess water supply. The most significant drought in recent history occurred in the 1930s. A comparison of water supply conditions in the Clark Fork Basin was made between the 1930s and the recent drought of the 2000s. The goal is to provide reference conditions to historic drought conditions and examine how current management (storage) may minimize drought impacts.

Quantitative analysis between the two droughts is not presented because several storage projects have been added since the 1930s, and depletions during the 1930s are unknown. In general large storage projects do have the ability to ease low flow drought conditions in the Flathead and lower Clark Fork River.

The hydrograph of the Clark Fork River above Missoula (Figure VII-6) includes flows from the Upper Clark Fork and the Blackfoot River watersheds. No major storage projects exist in these watersheds that alter flows at this scale. The decade-long hydrograph indicates that, in general, flows in the 1930s were lower than during the 2000s, including peak and low flows. Table VII-4 reveals that average annual flow volumes during the 1930s were lower than during the 2000s.

Figure VII-6 Monthly average flow over the decades 1930-1940 and 2000-2010

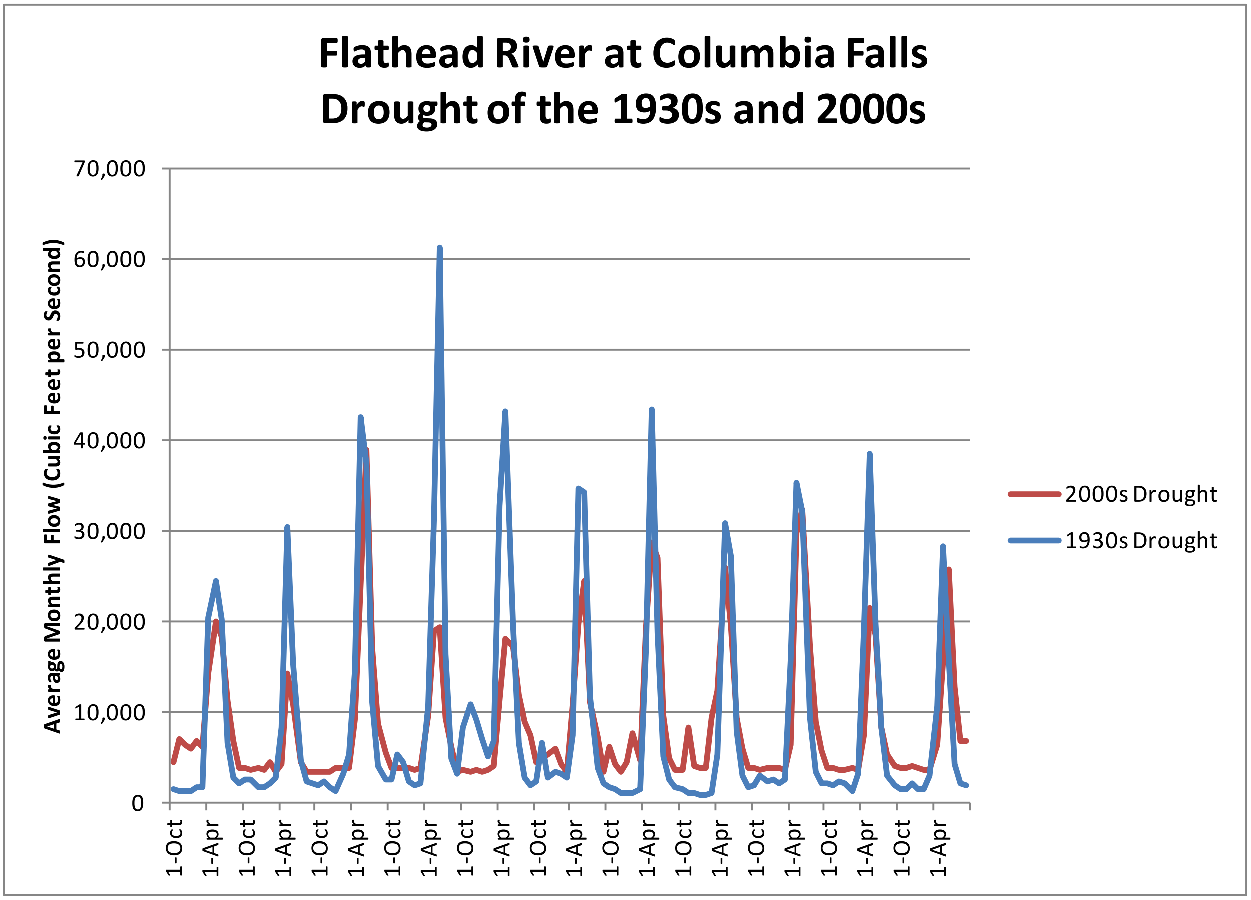


The hydrograph of the Flathead River at Columbia Falls (Figure VII-7) for the 2000s is affected by the construction of Hungry Horse Dam in 1952. The hydrograph indicates that during the 1930s high flows were higher and low flows were lower as compared to the 2000s. The regulation of the South Fork of the Flathead River by Hungry Horse Dam is likely responsible for reducing the peak flows and increasing the low flows.

Annual flows during the 1930s were higher than during the 2000s. The carryover storage in Hungry Horse likely reduced annual flows in the 2000s, as depletions from the system above Columbia falls are minimal. Hungry Horse Reservoir can store more than 100 percent of the annual flow of the South Fork of the Flathead.

The influence of storage on river flows is evident in the comparison between the Upper Clark Fork and Flathead systems during drought conditions. The hydrograph indicates that, during a prolonged drought in the 2000s, stored water in Hungry Horse Reservoir helped to mitigate low flow conditions.

Figure VII-7 Monthly average flow over the decades 1930-1940 and 2000-2010



The hydrograph of the Clark Fork River near Plains (Figure VII-8) has also been is affected by Hungry Horse Reservoir and Kerr Dam. The hydrograph indicates that, during the 1930s, high flows were higher and low flows were lower compared to the 2000s. Annual flow volumes were higher in the 1930s.

The regulation of the South Fork of the Flathead River by Hungry Horse Dam and the Flathead main stem by Kerr Dam is likely responsible for the reducing the peak flows and increasing the low flows. The hydrograph indicates that, during a prolonged drought in the 2000s, stored water in Hungry Horse and Flathead Lake was able to mitigate low flow conditions. The regulation and storage of water (Hungry Horse and Kerr Dams) and increases in depletions since the 1930s have likely reduced annual flows.

Figure VII-8 Monthly average flow over the decades 1930-1940 and 2000-2010

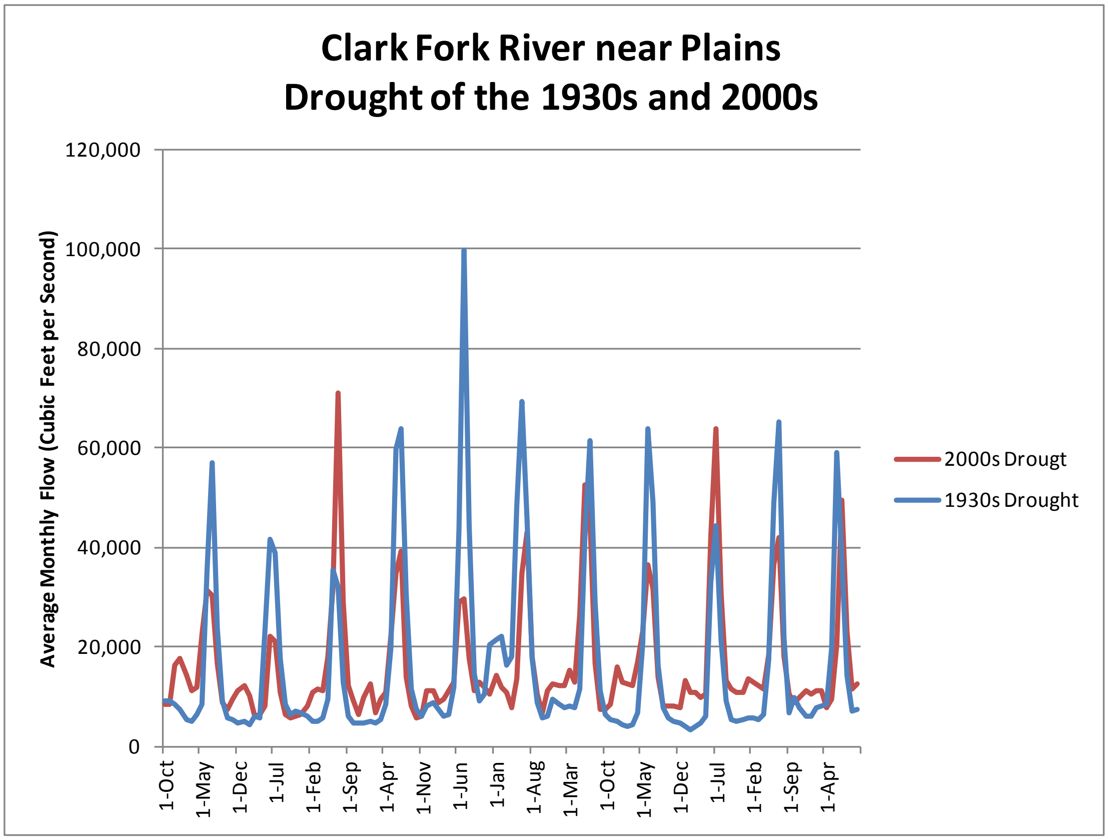


Table VII-4 Annual flow during 1930s and 2000s drought and over the period of record of the gage. Climate Change

USGS Gage	1930's Avg Annual Flow (AF)	2000's Avg Annual Flow (AF)	Period of Record Avg Annual Flow (AF)
Clark Fork abv Missoula	1,647,701	1,780,589	2,121,923
Clark Fork Plains	12,243,083	11,856,452	13,514,499
Flathead Columbia Falls	6,659,622	6,238,151	* 7,089,677
* Period of record 1952 to present refects post Hungy Horse construction			

POTENTIAL EFFECTS OF CLIMATE CHANGE ON FUTURE WATER SUPPLIES AND DEMANDS

Introduction

Traditionally, water planning assessments have assumed that future water supply conditions will be similar to what they have been in the past, recognizing that the exact sequencing of past flow patterns will not be repeated. Recent information suggests that the future envelope of streamflow variability may differ from historic. Warming has occurred over much of the United States during the 20th century and is likely to continue in the 21st century. This warming, in turn, will affect the amount and distribution of precipitation, and whether that precipitation occurs as rain or snow. It also will affect the rate of evaporation, and evapotranspiration by natural vegetation and irrigated crops. An important water-resources implication is that streamflow is likely to change in amount, timing, and distribution.

This section discusses climate change in the Clark Fork and Kootenai Basins, with a focus on how these projected changes in climate might affect water supplies and demands. This information can be used to evaluate the ability to meet future water demands within the basin and to identify adaptation strategies.

Methods

The general procedures used in this section are explained in Appendix VII-1.

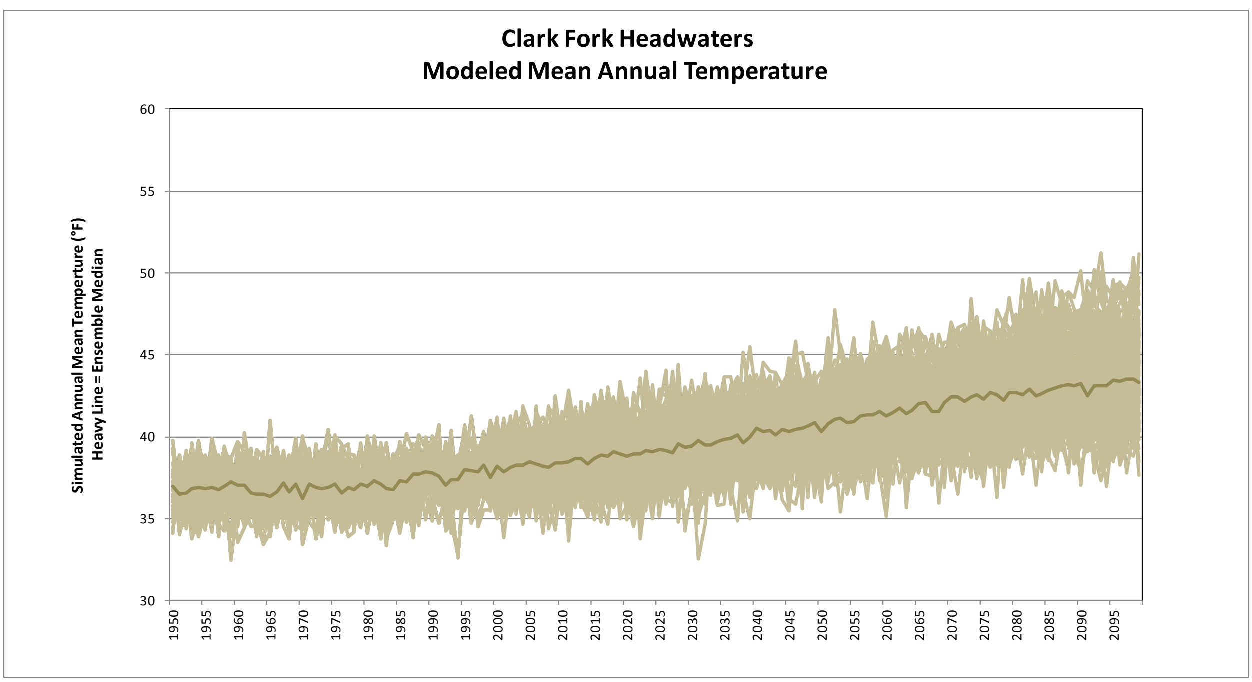
Previous work in the basin has been completed in 2010 by the Climate Impact Group (CIG) as part of the Hydrologic Climate Change Scenarios for the Pacific Northwest Columbia River Basin and Coastal Drainages (CIG 2010).

Climate in the Clark Fork and Kootenai Basins vary widely. Instead of modeling the entire basin, data for temperature, precipitation, snow water equivalent (snowpack), and evapotranspiration are presented for the Upper Clark Fork Basin, including the Blackfoot and Bitterroot watersheds. The headwaters of the Clark Fork Basin would be one of the areas more sensitive to climate change because water demands are high and water supply conditions are limited.

Temperature

Figure VII-9 graphs simulated Upper Clark Fork (Upper Clark Fork, Blackfoot, and Bitterroot watersheds) mean annual temperatures. The solid line represents the median change, while the shaded band represents the variability for the 112 climate projections. The consensus of all these projections is that temperatures in the Upper Clark Fork will continue a warming trend into the future, although the rate of warming projected varies among the models and scenarios. Average annual temperature increases for the 2010-2059 period over those for 1950-1999 period ranged from 1.1°F to 4.8°F, with the median increase being 2.8°F

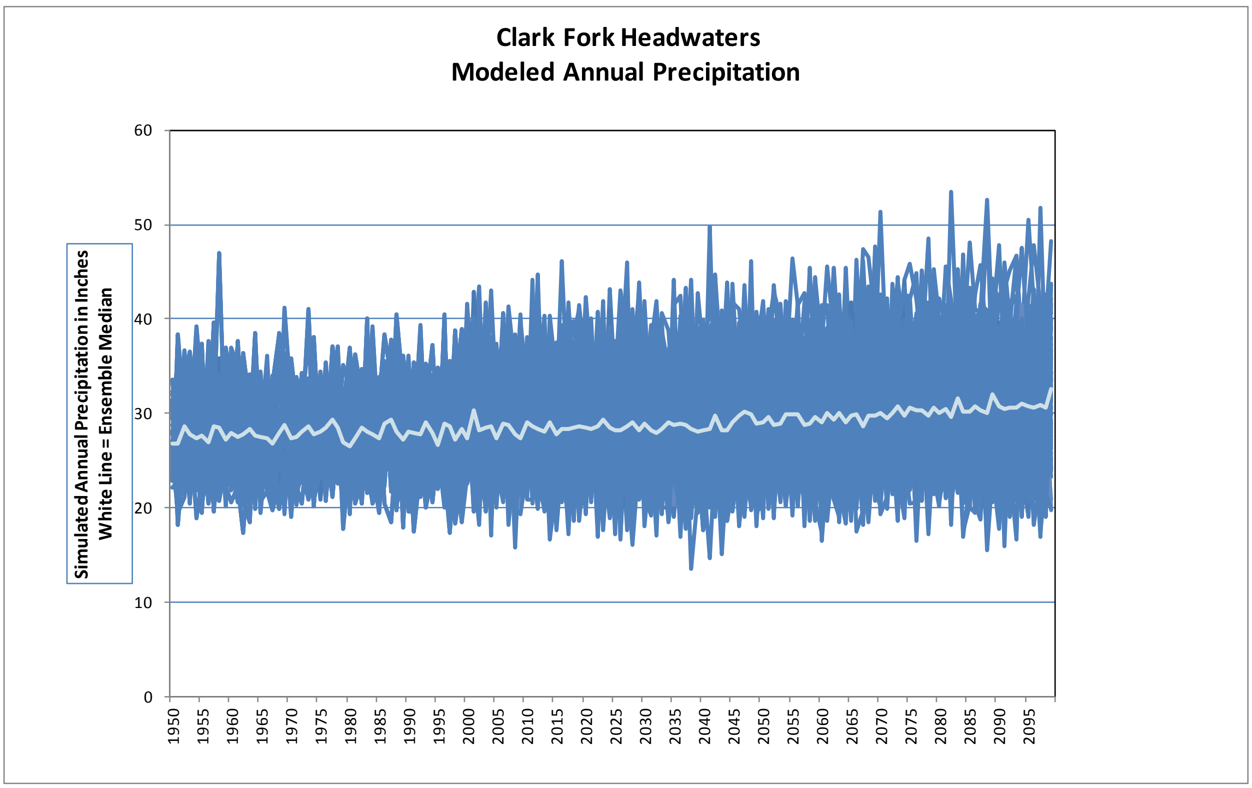
Figure VII-9 Mean annual temperature simulations based on downscaled projections from 112 GCM models.



Precipitation

The projections for precipitation are more mixed, with scenario trends varying from somewhat wetter to somewhat drier, with most depicting a nominal wetting trend but perhaps increased variability over time (Figure VII-10). For the Upper Clark Fork, the maximum projected increase for the 2010-2059 period relative to the 1950-1999 period was 6.0 inches (21.6 percent), and the minimum was for a decrease of 1.7 inches (6 percent), with a median projected increase of 0.8 inch (2.8 percent).

Figure VII-10 Annual precipitation simulations for the Clark Fork and Kootenai Basins based on downscaled projections from 112 GCM models.



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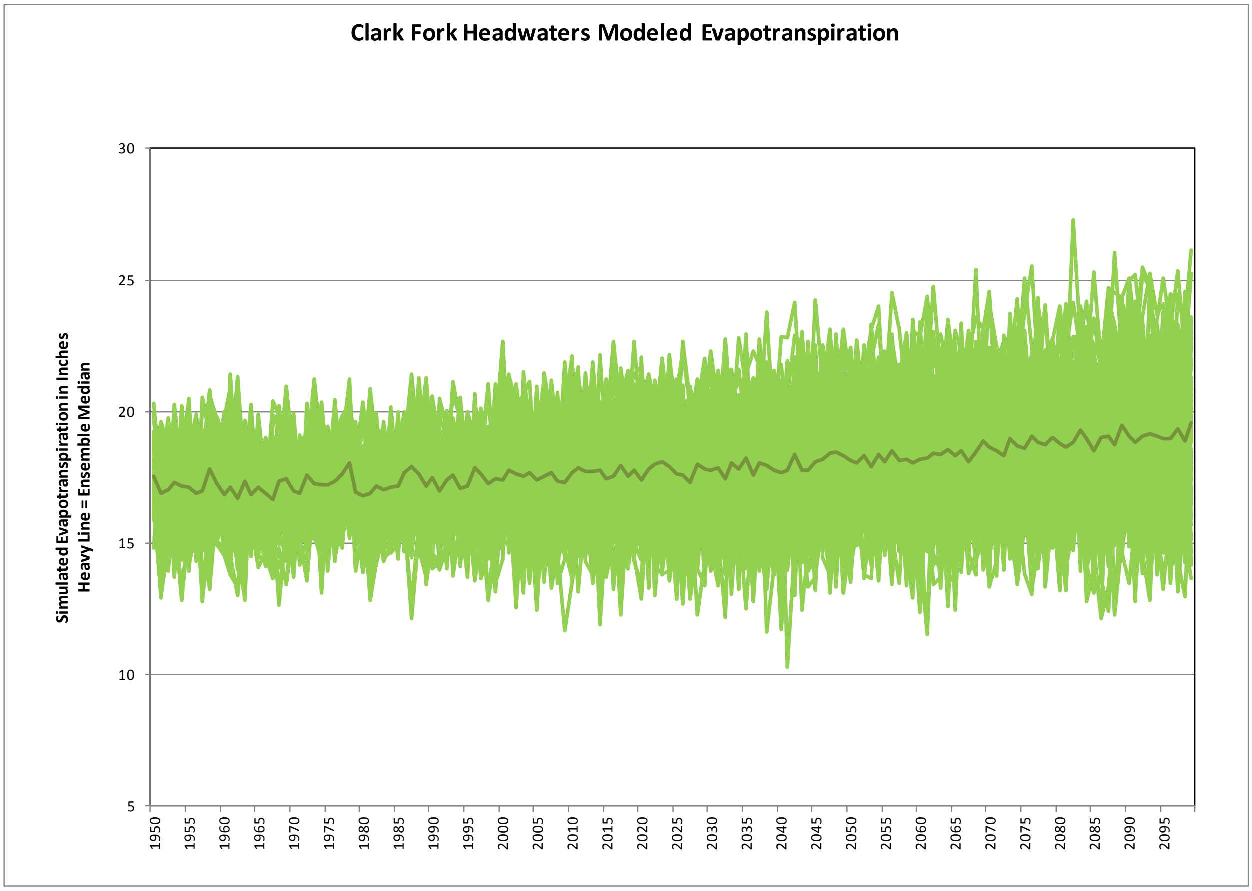
Evapotranspiration (ET)

Evapotranspiration in the Upper Clark Fork basin is projected to increase under most scenarios as temperatures warm and the growing season increases, although some of the modeled scenarios show a decrease in evapotranspiration due to projected drier conditions. Although most scenarios project modest increases in precipitation, evapotranspiration increases could offset these, leading to little change in the water balance. Figure VII-11 depicts modeled evapotranspiration by natural vegetation for the 1950-2099 period. Compared to the 1950-1999 period, evapotranspiration is projected to increase under most modeled scenarios for the 2010-2059 period. The maximum modeled increase was 2.8 inches (16 percent), the maximum decrease 0.6 inch (3.5 percent), and the median increase was 0.5 inch (3.4 percent).

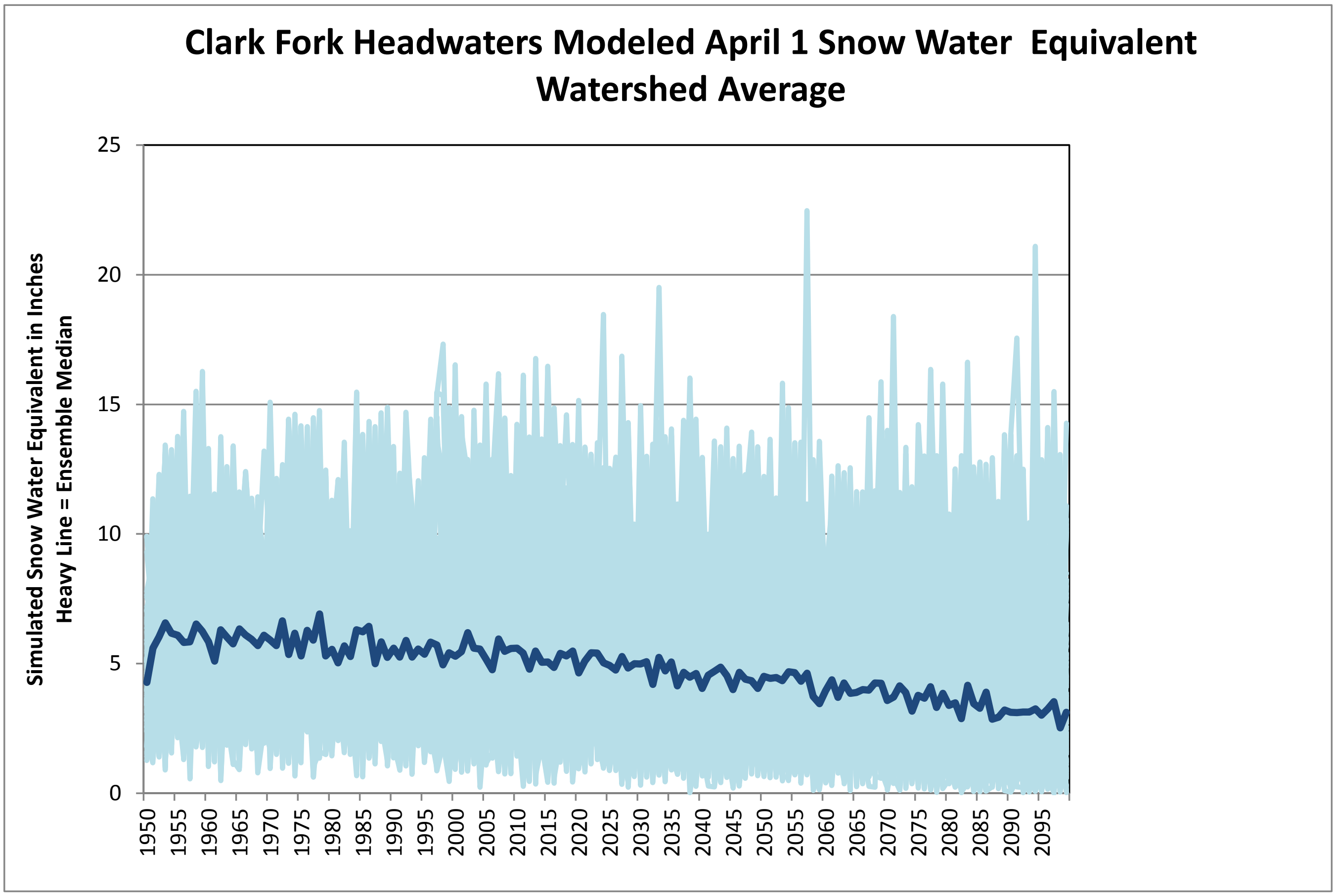
Figure VII-11 Annual evapotranspiration by natural vegetation simulations for the Clark Fork and Kootenai Basins based on VIC model results and downscaled projections from 112 GCM model



Snow

Warmer temperatures would affect the accumulation of snow in the mountains during the cooler months and the availability of melting snow to sustain runoff during the spring and summer. The hydrology of much of the Upper Clark Fork basin is snowmelt dominated, and warming temperatures likely would lead to proportionally more rain and less snow. Snow water equivalent (SWE) on April 1 is a measure for assessing snowpack and subsequent spring–summer runoff conditions in the snowmelt dominated basins. SWE is a variable computed and used by the VIC hydrology model for each grid cell. Figure VII-12 depicts modeled April 1 snowmelt conditions for the Clark Fork River headwaters area for the 112 simulations. This gridded SWE on April 1 was averaged over all the grid cells in the headwaters area to calculate the basin-wide April 1 SWE in each of the simulation years from 1950–2099. April 1 SWE shows a decreasing trend, although about 20 percent of the modeled scenarios show a trend of increasing April 1 SWE for the years 2010-2059 relative to the 1950-1999 base. The highest decrease for the 2010-2059 period relative to the 1950-1999 base was 2.6 inches SWE (21 percent decrease), while the largest increase was 1.22 inches (42.5 percent), and the median SWE decrease was 0.8 inch (13.7 percent). Under most modeled scenarios, increased overall precipitation--mostly in the form of rain--might somewhat offset decreases in snow.

Figure VII-12 Modeled April 1 snow water equivalents for the Clark Fork and Kootenai Basins based on VIC model results and downscaled projections from 112 GCM models.



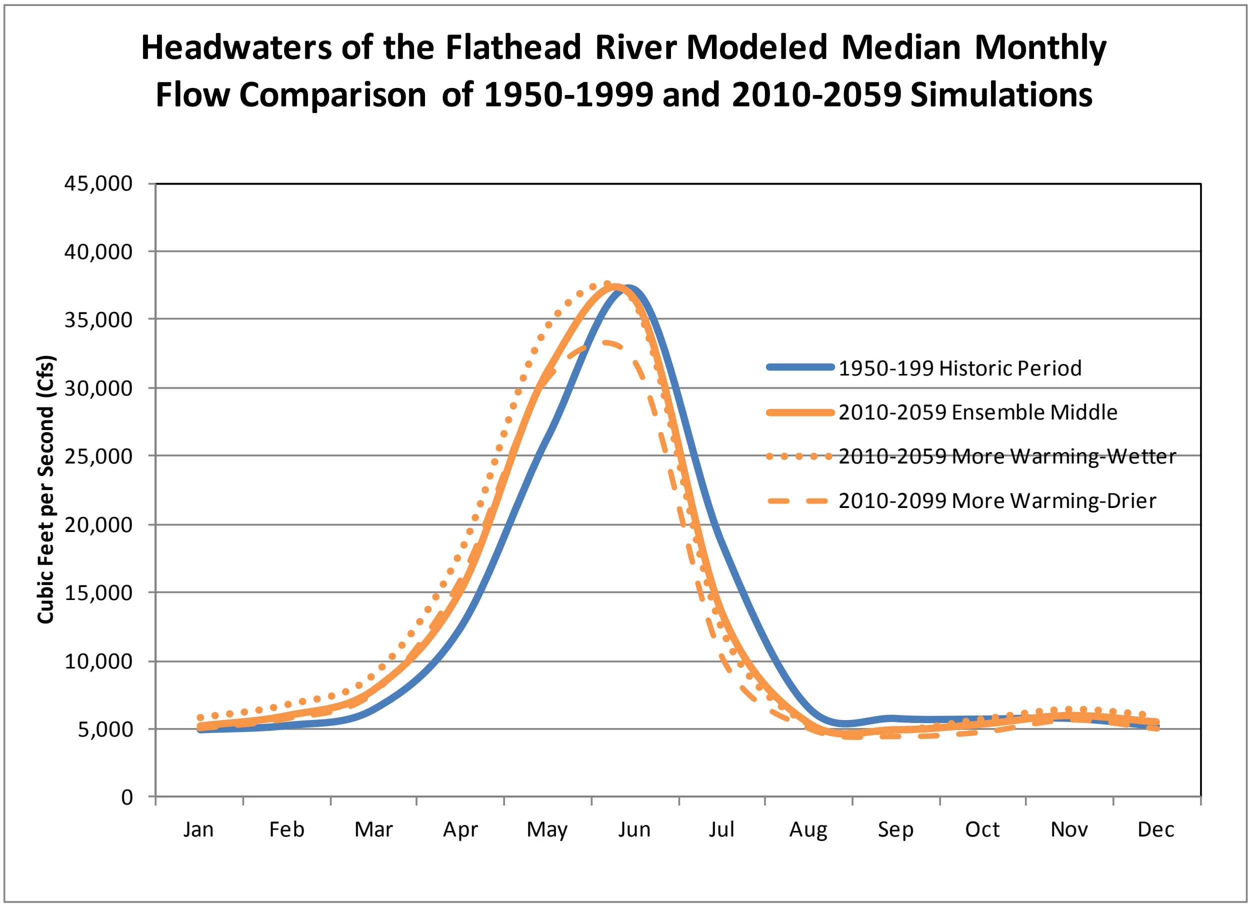
Streamflow

Figures VI-13, VI-14, and VI-15 compare simulated median streamflow for the future 2010-2059 period to the historic 1950-1999 period for the headwaters area of the Flathead (Flathead River at Columbia Falls), Clark Fork (Clark Fork River below Missoula), and the Kootenai River (above Libby Dam). The results depicted are for groupings (ensembles) of VIC modeled runoff based on the 112 CMIP3 climate scenarios using methods similar to those described by USBR (2010). The groupings partitioned the 112 scenarios into four quadrants that bracketed the climate-change scenario range based on relative changes in mean annual temperature and precipitation, with a fifth “central tendency” grouping. For simplicity, only the results for the quadrant scenario groupings that produce the highest and lowest runoff values, and the middle grouping, are graphed. Also note that these graphs are for the modeled “natural” flow produced by the basins; they do not include the effects of water development such as reservoirs and irrigation.

In the future, the flow produced in headwaters of the Flathead River might be of similar volume to what it has been produced in the past, with shifts in streamflow timing and the wetter scenarios showing a minor overall increase in runoff. The drier scenarios show a noticeable decrease in flow and a timing shift. The timing shifts would be due to an earlier snowmelt and an increase in the portion of precipitation falling as rain during later winter and early spring. Earlier runoff is projected, with December through March showing an increasing trend

while late season runoff (June through November) shows a decreasing trend. The earlier shift in runoff timing is more predominant for the warmer scenario groupings.

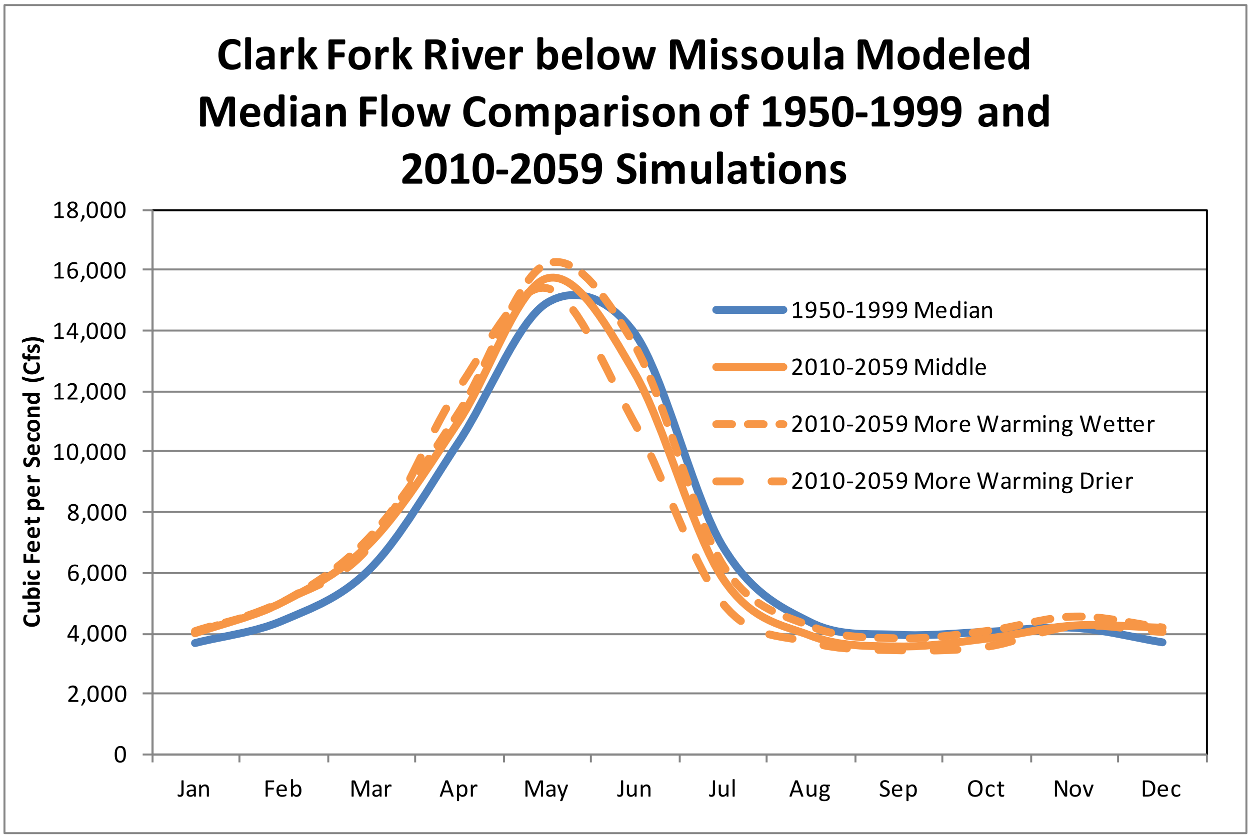
Figure VII-13 Modeled median monthly flow for the headwaters of the Flathead River under historic conditions and future climate scenarios.



In the future, the flow produced in headwaters of the Clark Fork River might increase in volume to what it has been produced in the past, with shifts in streamflow timing and the wetter scenarios showing an overall increase in runoff. The drier scenarios show a minor decrease in flow and a timing shift.

The timing shifts would be due to an earlier snowmelt and an increase in the portion of precipitation falling as rain during later winter and early spring. Earlier runoff is projected, with December through March showing an increasing trend while late season runoff (June through November) shows a decreasing trend. The earlier shift in runoff timing is more predominant for the warmer scenario groupings.

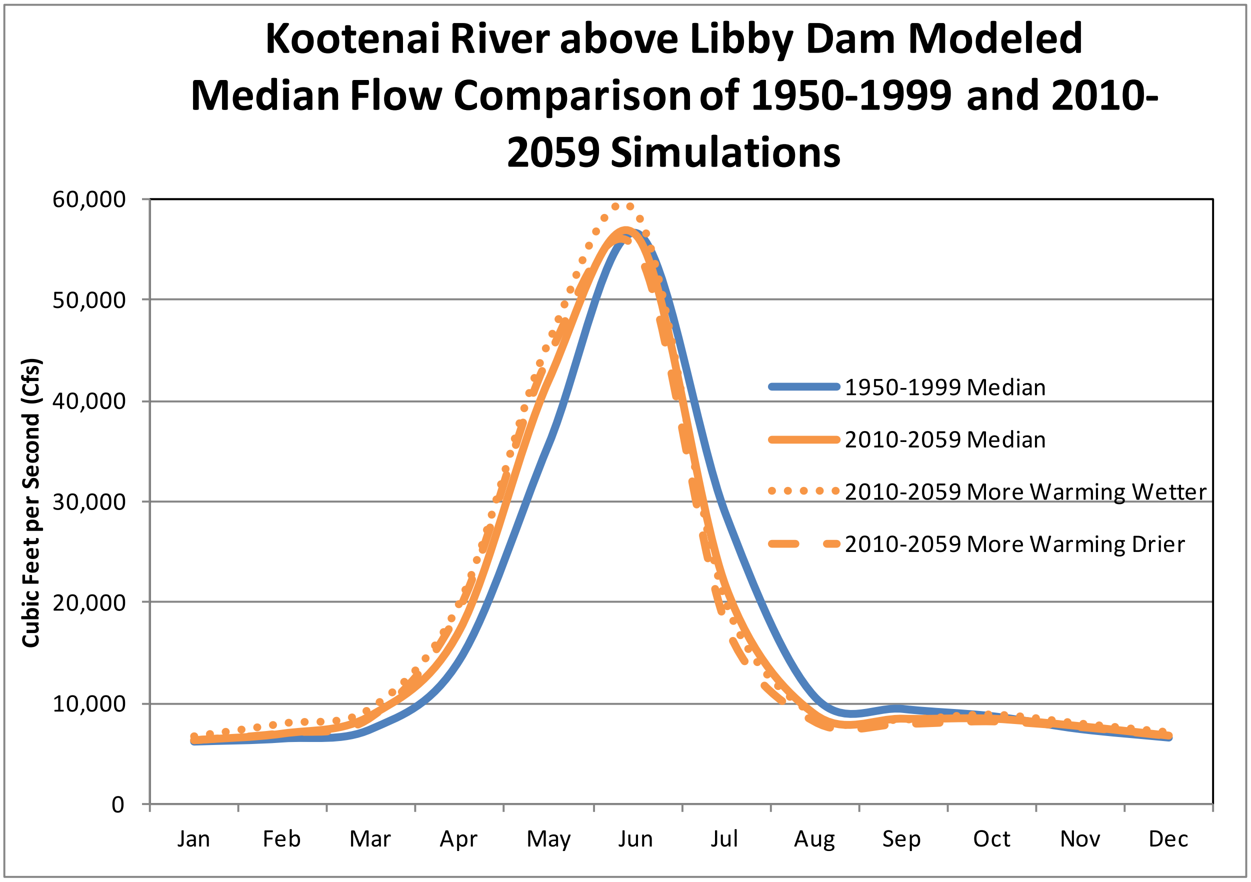
Figure VII-14 Modeled median monthly flow for the headwaters of the Clark Fork River under historic conditions and future climate scenarios.



In the future, the flow produced in headwaters of the Kootenai River might be similar in volume to what it has been produced in the past, with minor shifts in streamflow timing and the wetter scenarios showing an minor overall increase in runoff. The drier scenarios show a minor decrease in flow.

The timing shifts, though less pronounced in the Kootenai would be due to an earlier snowmelt and an increase in the portion of precipitation falling as rain during later winter and early spring. Earlier runoff is projected, with December through March showing an increasing trend while late season runoff (June through November) shows a decreasing trend.

Figure VII-15 Modeled median monthly flow for the Kootenai River above Libby dam under historic conditions and future climate scenarios.



Uncertainties

The current scientific understanding of physical processes that affect climate and how to model such processes is not complete. Atmospheric circulation, clouds, ocean circulation, deep ocean heat uptake, ice sheet dynamics, sea level, and land cover effects from water cycle, vegetative, and other biological changes are some of the important factors in climate modeling that are not fully understood. There are uncertainties relevant to the statistical downscaling of global-scale climate models to the finer scale used in basin planning. For this investigation, global-scale model results were downscaled using temperature and precipitation patterns from historic weather station data. Also, future projections assume that these historic local climate patterns at the finer scale and their relationships to the climate at the larger scale will still hold in the future, although that may not be the case.

EFFECTS OF DROUGHT ON GROUNDWATER SUPPLIES AND THE ROLE OF GROUNDWATER IN SUSTAINING BASE FLOW DURING DROUGHTS

In general, groundwater is an important storage reservoir that supports base flow during dry years and in the early years of extended droughts. Prolonged drought slows aquifer recharge, so less groundwater storage is available to support base flow and water levels decline.

Groundwater sensitivity to drought varies throughout the Clark Fork River Basin and is correlated to the groundwater systems' ability to transmit and store water, location to surface water (recharge), and depth below ground surface. The GWIC statewide monitoring network provides long-term water level records that show change in groundwater storage or pressure. Upward trends (increasing elevation and decreasing distance to water) show increased groundwater storage or pressure. Most hydrographs illustrate seasonal and long term trends. The frequent fluctuations are related to seasonal/annual trends, while the, slowly varying long term patterns are characteristic of climate-sensitive wells (Patton, 2014).

A monitoring well (GWIC # 130530) in the bedrock aquifer east of Kalispell shows a response to yearly changes superimposed on a large-amplitude, low-frequency cycle. Figure VII-16 shows groundwater levels responding to multi-year trends in climate variability. For example, water levels fell approximately 15 feet during the early 2000s drought period. Water levels rose during the mid-2000s only to fall 7 feet during the late 2000s. Another series of rising levels followed by decreasing groundwater levels has occurred for the start of the 2010s.

The Lonepine aquifer near Lonepine shows water levels responding to climate variability over 40 years (GWIC # 6283). Figure VII-17 shows numerous less than 10 year groundwater trend slope changes that are the result of alternating dry and wet periods. A declining long-term cyclic trend is also observed from the hydrograph.

The water levels in an alluvium well (GWIC # 136969) near Victor show 3- to 5-year trends that “stair step” to changes in precipitation over a 55 year period. Figure VII-18 shows the impact of annual water level fluctuations superimposed on a low-frequency cycle that is likely climate related.

The water levels in a Tertiary sediments well (GWIC # 128682) near Galen show water level responses to climate variability. Figure VII-19 shows water level changes in the Tertiary sediments that are related to periods of dry and wet cycles. The hydrograph shows a decreasing multi-year trend that correlates to the early 2000s drought period followed by an increasing trend equivalent to the wet period of the late 2000s and early 2010s.

Figure VII-16 Groundwater levels in the bedrock aquifer near Kalispell showing the effects of drought in the 2000s and recovery during wetter periods (GWIC # 130530).

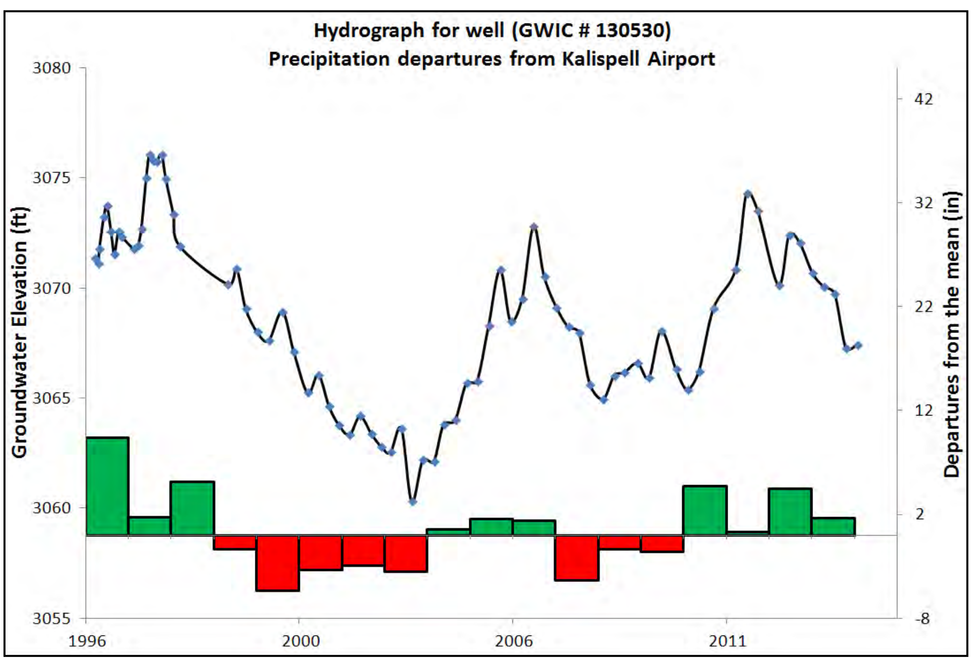


Figure VII-17 Long-term record of Lonepine aquifer levels in the Little Bitterroot valley showing the effects of wet periods, dry periods, and long-term cyclic decline (GWIC # 6283).

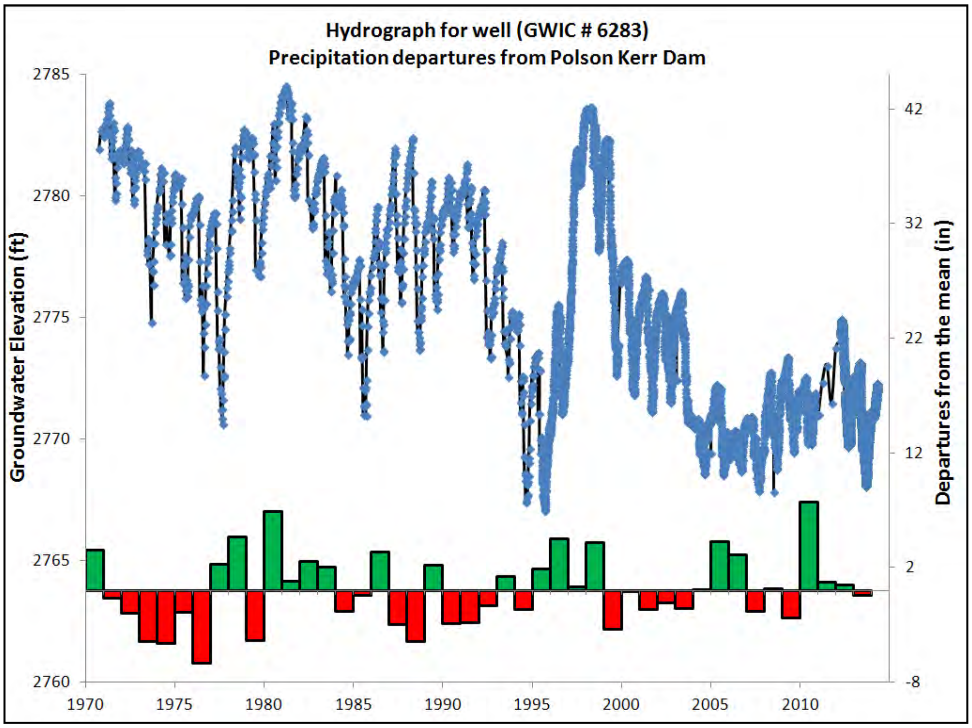


Figure VII-18 Alluvial aquifer groundwater levels near Victor showing annual fluctuations and responses to above/below average periods of precipitation (GWIC # 136969).

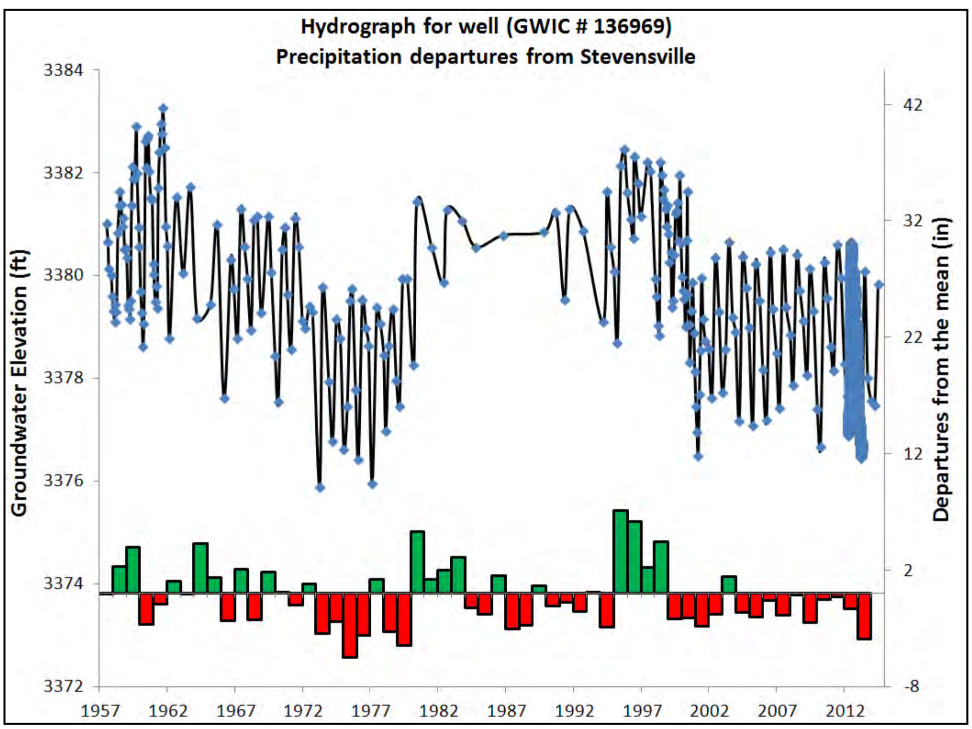
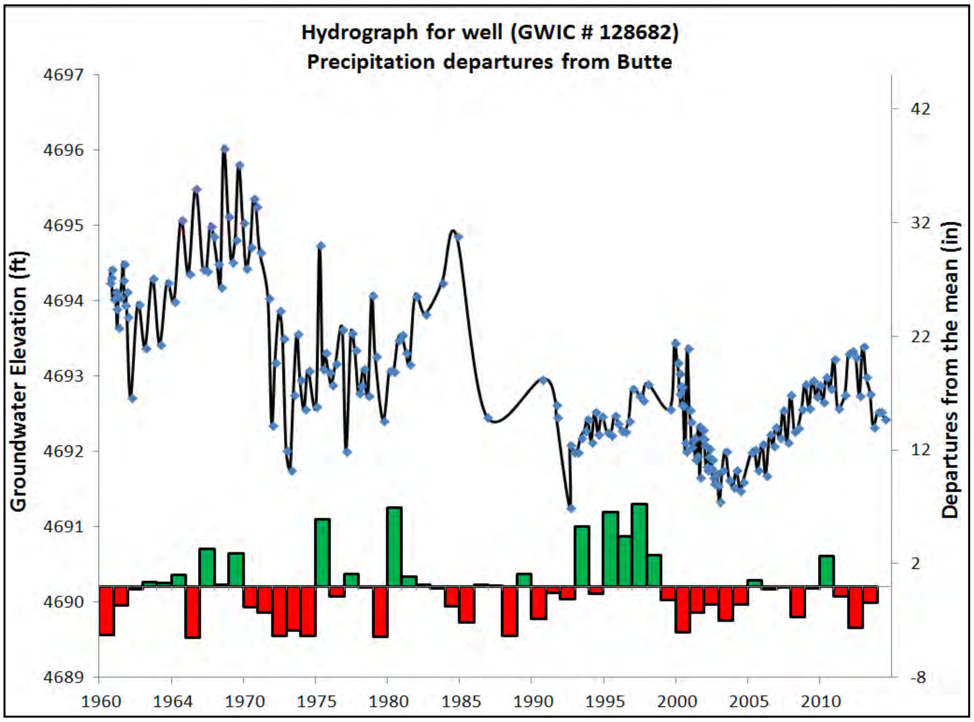


Figure VII-19 Long-term record of Tertiary aquifer levels near Galen showing the effects of wet periods, dry periods, and long-term cyclic decline (GWIC # 128682).



EFFECTS OF CHANGES IN TIMING AND MAGNITUDE OF PRECIPITATION AND SNOWPACK.
Water supply conditions in the Clark Fork and Kootenai Basins are directly related to the magnitude and timing of mountain precipitation and snowpack. Climate modeling for Western Montana suggests moderate increases in temperature and precipitation and a decrease in snowpack. Suggesting a greater amount of precipitation will fall as rain instead of snow.

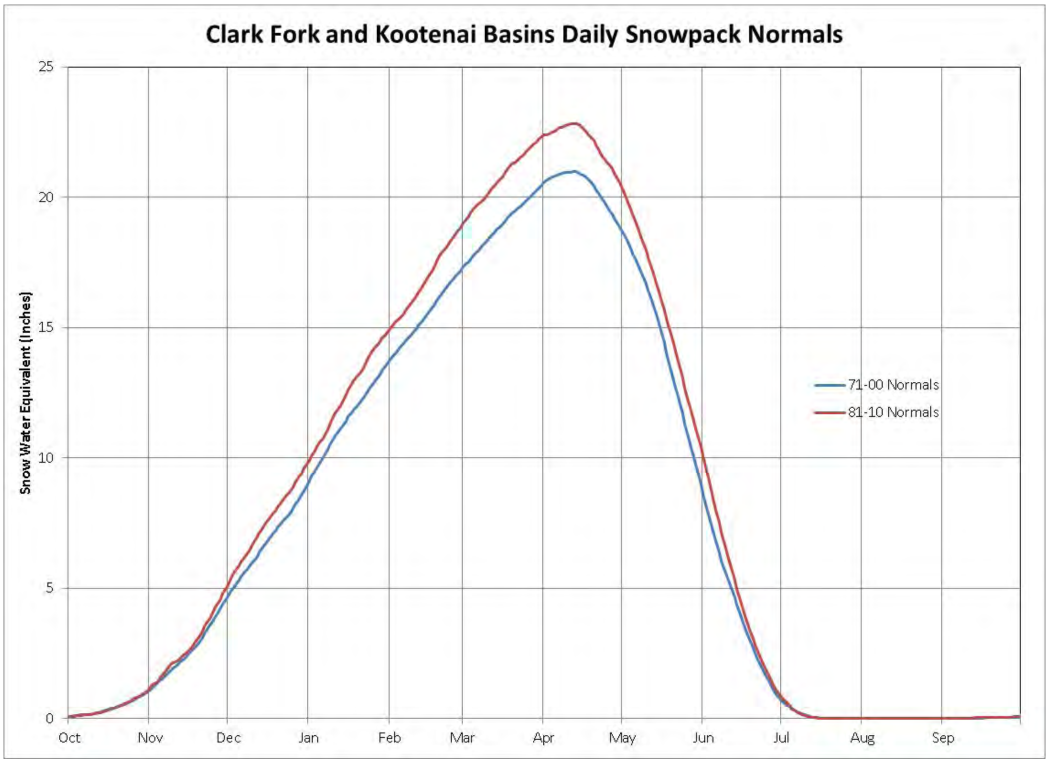
The NRCS SNOTEL system has recorded statewide data since approximately 1971. NRCS uses 30-Year climatic and hydrologic normals to characterize current water supply conditions. Currently, two 30-year periods exist 1971-2000 and 1981-2010.

Comparison of the two periods gives insight into changes in timing in magnitude of snowpack accumulation and mountain precipitation that have occurred. In general the data indicates that snowpack and precipitation were greater for the 71-00 period. Wet conditions in the 70's and the drought of in 2000 are part of the explanation. The data suggest we are currently in a drier climate pattern.

Snowpack
Snowpack accumulation (SWE) for the two periods (Figure VII-20) indicates that, in general, snowpack accumulation for the more recent period (1981-2010) is less from December to May than during the previous 30-year period. The timing of the peak snowpack and melt has not shifted dramatically. Peak snowpack occurs in late April and snowpack melt begins in May.

Continued monitoring by the NRCS and National Weather Service will help establish trends in the timing snowpack accumulation and melting.

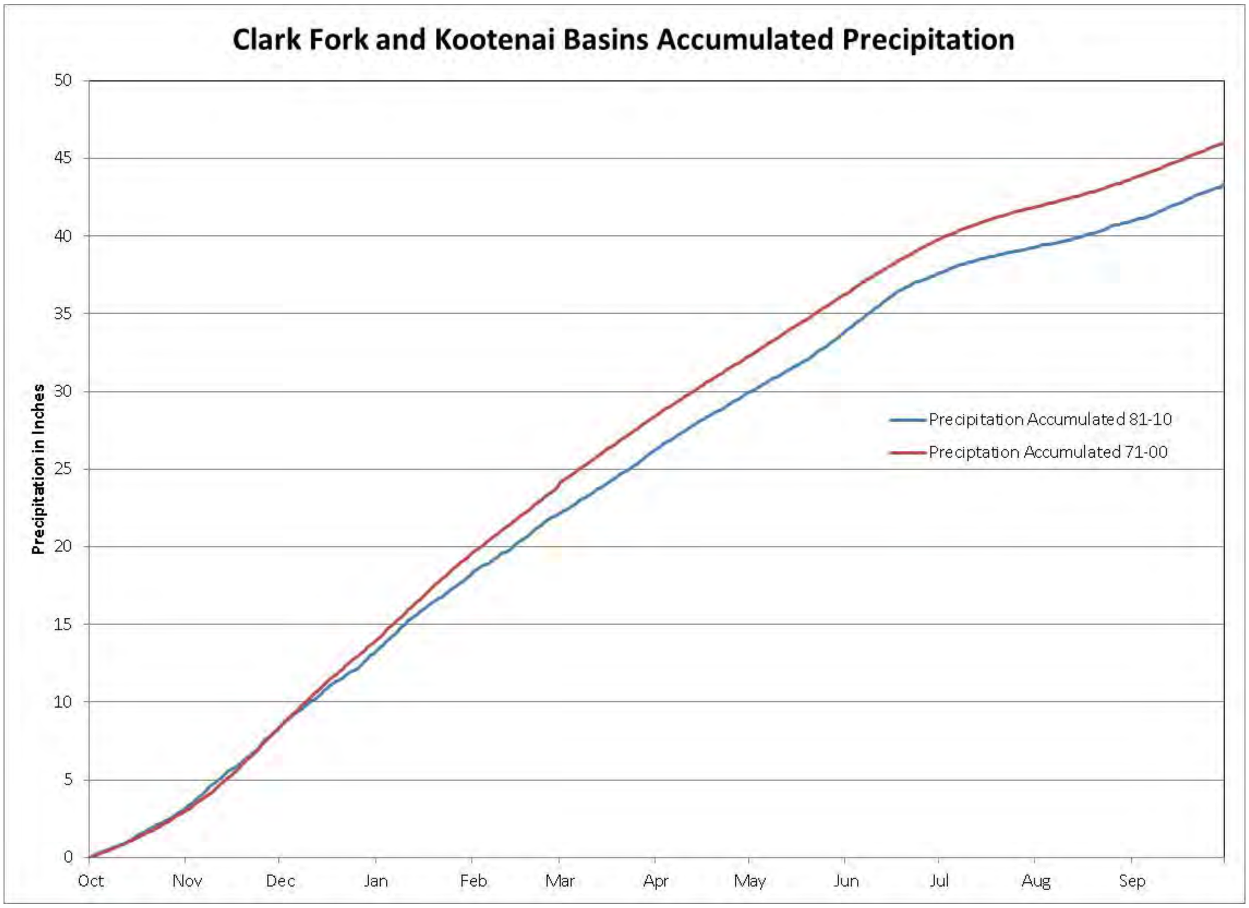
Figure VII-20 Clark Fork and Kootenai Basins average snowpack Normals as SWE for 1971-2000 and 1981-2010 (NRCS).



Precipitation

Precipitation in the basin shows a similar trend (Figure VII-21), as accumulated daily precipitation for the 1981-2010 period lags behind the 1971-2000 normals. Continued monitoring by the NRCS will help establish precipitation trends.

Figure VII-21 Clark Fork and Kootenai basin average accumulated precipitation normals for 1971-2000 and 1981-2010 (NRCS).



VIII. Options for Meeting New Water Demands – Opportunities, Strategies and Tools

Basins with Unallocated Water

Water availability and appropriation of water are very important, and often contentious, issues in Montana and other western states. Montana has the authority to restrict or close river basins and groundwater aquifers to future withdrawals, based on concerns to protect existing uses, water quality issues, and additional water shortages. Montana is a "prior appropriations" state, and must first protect existing senior water uses before allowing additional demands on water resources. Physical water availability, if any, is based on surplus water above and beyond existing, valid water uses. An applicant for water use must prove that their proposed future use of water does not impact existing users surface or groundwater uses.

In general unallocated water in the basin is limited to the Flathead Lake and the mainstem of the Flathead River above Kerr Dam and the Kootenai River. Water availability on many sources in the basin are subject to senior instream flow rights.

Table VII- summarizes the general legal availability of surface water for appropriation in the Clark Fork and Kootenai basins based on past permitting records and experience. New appropriations from aquifers hydraulically connected to these streams and rivers also may be subject to limitations.

Table VIII-1 Water sources where water is potentially available for new appropriations based on recent permitting by DNRC Regional Offices.

Kalispell Region			
Water Source	**Legally Available**	**Primary Limiting Water Rights or Closure**	**Comments**
Ashley Creek	No	Instream flow	Over appropriation largely because Irrigation claims have been divided and changed to various uses and instream fishery use.
Flathead River and Flathead Lake	Subject to hydropower water rights	Hydropower at Kerr Dam	Future restrictions possible due to hydropower and instream fishery rights. Permitting may be complicated by the complex operations of dams
Haskill Creek	No	Irrigation, municipal, and hydropower	Likely over appropriated due to irrigation and municipal rights to include a hydropower right
Little Bitterroot River and Lake	No	Irrigation and storage	Over appropriation of source largely due to irrigation rights and storage at Hubbard Dam.
Lower Clark Fork	Subject to hydropower water rights	Hydropower at Noxon dam	Over appropriation due to hydropower rights. Hydropower rights at Noxon Dam may make new appropriations difficult unless an existing water right is retired and changed to mitigation or aquifer recharge.

Kalispell Region Cont.

Water Source	Legally Available	Primary Limiting Water Rights or Closure	Comments
Lower Flathead River	Subject to hydropower water rights	Hydropower at Noxon and Kerr dams	Hydropower water right at Noxon Dam may make new appropriations difficult unless an existing water right is retired and changed to mitigation or aquifer recharge.
Kootenai	Yes		Libby Dam does not have a water right, yet the dam controls the flow in the river.
Middle Fork Flathead River	No	instream flow and GNPC compact	Restrictions due to instream flow fishery right, "Murphy right." Also limited by future consumptive use limits imposed by Glacier National Park Compact.
North Fork Flathead River	No	Instream flow and GNPC compact.	Restrictions due to instream flow fishery right, "Murphy right." Also limited by future consumptive use limits imposed by GNPC.
Stillwater River	No	Over appropriated	Apparent over appropriation on reach between crossing on Highway 93 north of Kalispell and Highway 93 north of Whitefish. Over appropriation possibly due to accounting error due to counting multiple water rights with shared PODs with same flow rate.
Tobacco River and tributaries	No	Instream flow and irrigation	Over appropriation due to instream fishery claim and irrigation rights held by the Glen Lake Irrigation District.
Stillwater River	No	Over appropriated	Apparent over appropriation on reach between crossing on Highway 93 north of Kalispell and Highway 93 north of Whitefish. Over appropriation possibly due to accounting error due to counting multiple water rights with shared PODs with same flow rate.
Swan River	Limited to spring months	Hydropower right at Bigfork	Over appropriation during most months due to hydropower right at the PPL power plant in Bigfork.
Young Creek	No	Instream flow	Over appropriation due to MFWP instream fishery claim.

Missoula Region

Water Source	Legal Availability	Primary Limiting Water Rights or Closure	Comments
Bitterroot River	No	Basin Closure and instream flow	Applications for storage of surface water >50 AF allowed, however a storage application in the Bitterroot would be extremely difficult due to large FWP instream flow water rights in the Bitterroot. Even during high water legal availability is an issue. Groundwater permits can be processed, but they may require the retirement of an existing water right that is changed to mitigation or aquifer recharge.

Missoula Region Cont.

Water Source	Legal Availability	Primary Limiting Water Rights or Closure	Comments
Blackfoot River	No	Basin Closure and instream flow	Groundwater permits can be processed, but they likely will require the retirement of an existing water right that is changed to mitigation or aquifer recharge. Surface water storage applications allowed but could be difficult to show legal availability due to hydropower water right at Noxon Dam.
Flint Creek	No	Basin Closure	No water rights issued since 1995
Lower Clark Fork River and tribs below old Milltown Dam site	Subject to hydropower water rights	Hydropower at Noxon Dam	Open to surface and groundwater water appropriations, however, new appropriations may require the retirement of an existing water right that is changed to mitigation or aquifer recharge due to hydropower water right at Noxon Dam. A marketing-for-mitigation change for the Grass Valley Irrigation District, if granted, would provide approximately 3,800 acre-feet of water for future development through reallocation.
Swan River and tribs in Missoula County	small domestic and lawn and garden uses	Hydropower right at Bigfork	Despite uncertain legal availability with respect to the hydropower facility in Big Fork, small domestic and lawn and garden permit applications are processed for surface water in the upper reaches of the Swan. The success of an application for irrigation or another large consumptive use right in the upper Swan is uncertain.
Rock Creek	No	Basin Closure, instream flow, and Noxon Dam	No water rights issued since 1995. Groundwater applications can be processed but may require mitigation or aquifer recharge. Surface water storage applications allowed but may be difficult to show legal availability due to hydropower water right at Noxon Dam.
Upper Clark Fork River	No	Basin Closure and Noxon Dam	Surface water storage applications allowed but may be difficult to show legal availability due to hydropower water right at Noxon Dam.

Change of Use Authorizations

Under a change authorization a water user may permanently reallocate water to a new purpose while preserving the priority date for the underlying water right. Because a change is doing something new on a source and other water rights exist on the source, a change in use is limited to the historic period of diversion, historic diverted volume, and historic consumptive use (collectively referred to as historic use). These limitations are important to ensure that a proposed change will not adversely affect other water users on the source. Increases in amount of consumption or changes in the pattern of use from the historic use of the right can affect other water right holders who depended on that historic pattern of use and amount in making their own use of water. One person's return flow is another's supply. Therefore, the historic use analysis also looks at the timing and location of return flows.

Over the past 40 years, the DNRC has developed an extensive set of data and rules to assist water users in identifying relevant evidence to establish the parameters of historic use. However, potential adverse effect to other water users is often a limiting factor in the ability to change a water right.

A traditional change is an effective means of permanently reallocating water to a new use.

Permanent changes also provide a means for mitigating new groundwater uses that deplete surface water and potentially cause adverse effect on over appropriated surface water sources and in closed basins. Changes for mitigation require identification of the specific water right for which mitigation is being provided. The applicant is typically required to demonstrate that the water right being changed will provide sufficient water in timing, location and amount to mitigate potential adverse effect either by leaving the water instream or through use of aquifer recharge.

Changing an existing groundwater right by stopping use of another well and eliminating its associated purpose may mitigate adverse effects outside the historic period of use of the existing right. This occurs because wells that are not very close to a stream typically have year-round depletion effects; therefore, eliminating an existing well is essence provides year-round mitigation effects. The feasibility of a mitigation plan involving a change of a ground water right depends on consumption of the historic and new uses and on whether the adverse effects of the new use are similar to the historic effects of the retired use.

An aquifer recharge plan or project accomplishes essentially the same thing as retiring use of a well by diverting surface water and allowing it to infiltrate ground water through a well or other means. Again, the viability of a plan depends on a comparison of the historic and new consumptive uses, and an evaluation that indicates whether mounding from aquifer recharge offsets drawdown from the new use. The existing water right may be relatively junior if recharge is conducted in early summer.

Mitigation (HB24)

In 2011, the Montana Legislature adopted an innovative approach to facilitate the reallocation of existing water rights for the purpose of mitigation or aquifer recharge to allow new uses of water in water short areas. Water for mitigation or aquifer recharge is used to offset depletions to surface water sources from new groundwater wells. Unlike the traditional change process discussed above, the new approach enables a water user to prospectively change all or a portion of a water right to mitigation and have that mitigation water available for lease or sale to applicants seeking new water rights from the DNRC. This process is similar to a water bank for mitigation uses. This new statutory tool provides greater predictability for new water users who need to mitigate depletions from a proposed use and provides existing water users with the opportunity to market water while preserving their existing use.

Applicants for a new groundwater appropriation that depletes surface water may need to implement a mitigation or aquifer recharge plan in order to obtain a new permit. "Mitigation" means the reallocation of surface water or ground water through a change in appropriation right or other means that does not result in surface water being introduced into an aquifer through aquifer recharge to offset adverse effects resulting from net depletion of surface water. "Aquifer recharge" means either the controlled subsurface addition of water directly to the aquifer or controlled application of water to the ground surface for the purpose of replenishing the aquifer to offset adverse effects resulting from net depletion of surface water.

The purpose of mitigation and aquifer recharge plans is to offset net depletion to surface water from a groundwater appropriation in order to provide water for legal demands by senior water users and to prevent

adverse effects. Mitigation plans involve a change of an existing surface water or groundwater right whereas aquifer recharge plans involve infiltration of surface water to groundwater in addition to a water use change. Mitigation by changing a surface water right is accomplished by stopping the existing use (for example, drying up irrigated acreage) and leaving water that was previously diverted instream and possibly protecting it through a depleted stream reach. This type of mitigation is appropriate where net depletion and adverse effects are predicted to occur within the period of historic use of the existing water right which may occur where a well is located very close to a stream or where water shortages are limited to the irrigation season. Simple mitigation with surface water generally requires a water right with an early priority date.

Current Reservoir Storage

EXISTING LEVEL OF STORAGE DEVELOPMENT BY SUB-BASIN

Existing storage in the Clark Fork and Kootenai Basins by sub-basin, along with estimated runoff for high, median, and low years is present in Table VII-2. The data indicates that the driest area of the watershed (the Upper Clark Fork River) has the lowest ability of store water. The Flathead River with Kerr Dam and Hungry Horse Reservoir has the highest water supply and the greatest ability to store water.

Storage facilities in the headwaters of the Clark Fork River on a median runoff year have the ability to store less than 10 percent of the annual runoff. The headwaters of the Flathead River (Hungry Horse reservoir) have the potential to store over 50 percent of the annual runoff from a median year. The Lower Flathead River including Kerr Dam (Flathead Lake) to the mouth has the ability to store 17 percent of the runoff. Storage associated with the Flathead Indian Irrigation Project has the ability to store 2 percent of the runoff of the Flathead River.

Storage in the lower Clark Fork River below the confluence with the Flathead is minor compared to the volume of flow. In general, the majority of storage in the Clark Fork Basin is located above Kerr Dam. Storage in the Kootenai Basin is significant—Libby Dam has the ability to store nearly 70 percent of the runoff of the Kootenai River. There is little or no storage in the tributaries of the Kootenai in Montana.

Table VIII-2 Storage and annual runoff in the Clark Fork and Kootenai Basins

Major Sub-Basin	Major River(s) or Reach	Total Active Storage (Acre-Feet)	Estimated Natural Annual Runoff (Acre-Feet)		
			High Year 90th Percentile	Middle year 50th Percentile	Low Year 10th Percentile
Upper Clark Fork	Clark Fork, Flint Creek	71,692	1,559,846	817,299	466,264
Blackfoot	Blackfoot	11,000	1,916,408	1,033,257	561,769
Bitterroot	Bitterroot	64,362	2,967,785	1,517,766	810,767
Clark Fork Headwaters Total	Clark Fork, Blackfoot Bitterroot	147,054	3,457,219	1,906,355	1,082,048
Flathead Headwaters	North, South and Middle Forks of the Flathead River	3,608,400	12,035,194	6,213,859	3,277,208
Lower Flathead River *	Flathead Lake to Mouth	1,340,135	13,356,811	7,854,490	4,298,186
Flathead River Total	Entire Flathead Watershed	4,948,535	13,356,811	7,854,490	4,298,186
Lower Clark Fork River*	Missoula to Idaho boarder	408,300	22,884,730	13,925,171	7,103,113
Clark Fork River Total	Entire Clark Fork Watershed	5,525,157	22,884,730	13,925,171	7,103,113
Kootenai River	Kootenai, Fisher,Yaak and Tobacco	6,027,000	17,354,438	8,992,100	3,959,133

* indicates storage in that particular reach of the river. Lower Clark Fork storage does not include storage on the Flathead River.

Basins with Hydrology That Could Potentially Support New Storage

SUITABILITY OF THE CLARK FORK AND KOOTENAI BASINS HYDROLOGY FOR WATER STORAGE

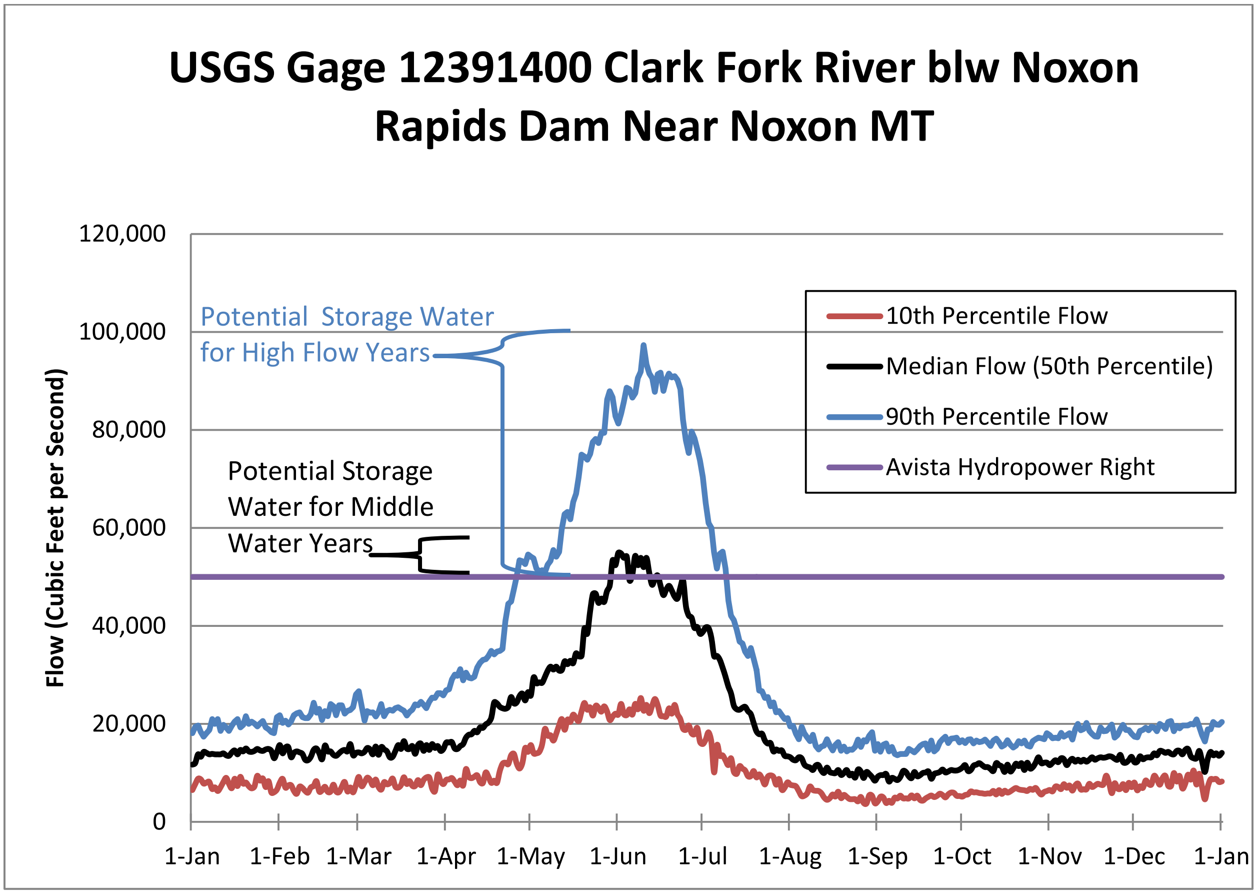
Development of storage is limited by basin closures, instream flow and hydropower water rights and economic feasibility. Development of storage water is limited to high spring flows in the closed Upper Clark Fork and Bitterroot basins. Outside of the closed portion of the Clark Fork basin non-consumptive water rights limit development of additional storage to primarily high spring flows on median or greater water years.

In addition to the non-consumptive uses, thousands of water rights exist for consumptive uses that further limit development of water for storage. DNRC records research indicates that no storage permits have been granted since the Upper Clark Fork and Bitterroot closures.

Two examples of area where additional storage water could potentially be developed are the Clark Fork River below its confluence of the Flathead River and the Tobacco River. A detailed technical study would be needed to determine the availability of additional storage water in the basin. The feasibility of a suitable storage location was not accounted for in the analysis.

Existing storage in the Clark Fork River below the Flathead confluence is limited to three percent of the annual flow. The largest and most prevalent hydropower water right in the Clark Fork Basin is the Avista water right (50,000 cfs) for Noxon Rapids Dam (Figure VIII-1). If the availability for potential storage water is based solely on the Avista water right, then water for storage is potentially available during runoff when water supply conditions are at or above median conditions.

Figure VIII-1 Potential for additional storage water in the Clark Fork basin

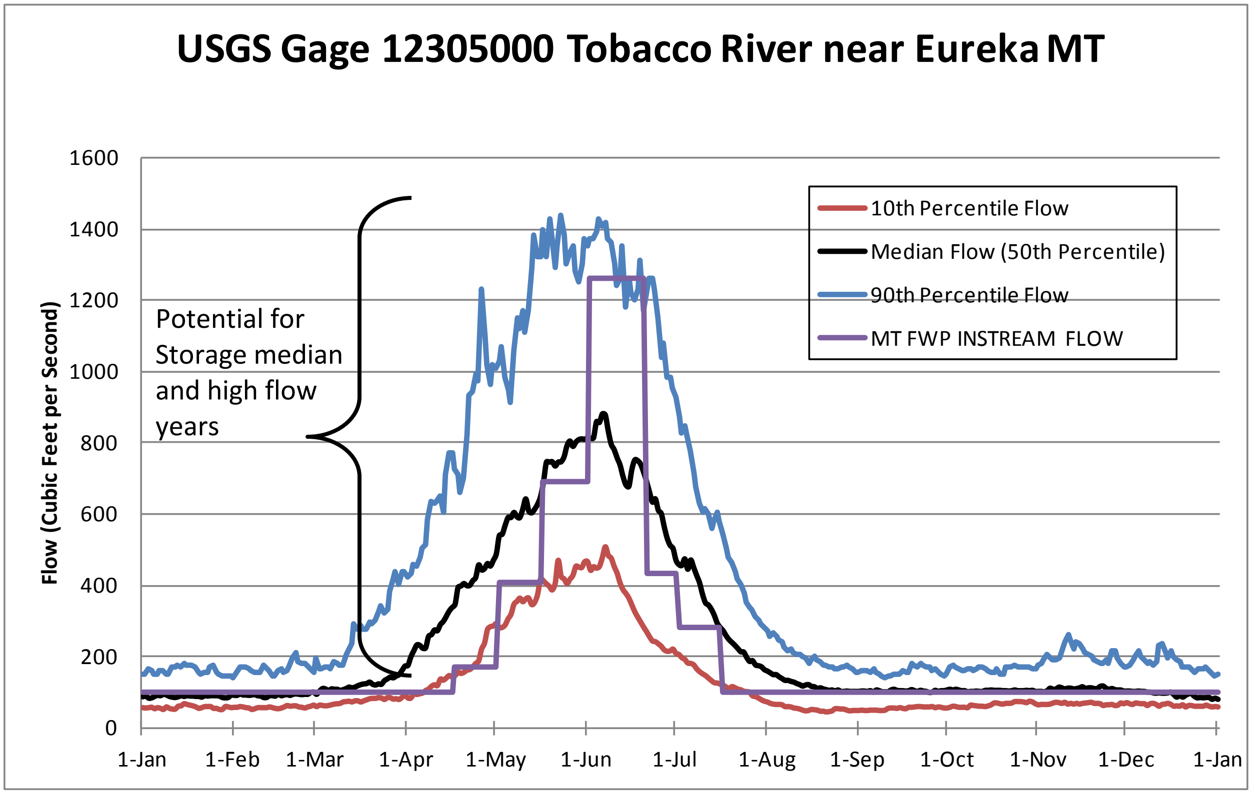


During high water years, water would be available for storage from approximately May 1 to early July. An estimated 3.4 million acre-feet could potentially be available during a 90th percentile year. During a median year, runoff water for storage would be available from approximately May 30 to June 15. An estimated 83,000 acre-feet could potentially be stored during a median runoff year. In general, water could be potentially available for storage in varying quantities every other year.

The Kootenai Basin has significant storage on the main stem of the Kootenai River, with Libby Dam storing more than 6 million acre-feet of water. However, in the Tobacco River valley little or no storage exist and water supplies are limited by demand for water use and instream flows rights. Water is potentially available for storage based on the FWP instream flow right during runoff in median and high flow years (every other year). The hydrograph in Figure VIII-2 shows average high, median, and low flows on the Tobacco River and the FWP instream flow right that varies to mimic the hydrograph.

During high runoff years water could be potentially available for storage year round except one week in June. An estimated 160,000 acre-feet could potentially be stored during a 90th percentile runoff year. During a median year, water for storage would be available from approximately March 1st to June 1st and July 1st to December 1st. An estimated 34,000 acre-feet could potentially be stored during a median runoff year. In general, water could potentially be stored most years on the Tobacco River.

Figure VIII-2 Potential for storage water in the Kootenai Basin on the Tobacco River.



EXAMPLE OF BASINS WHERE THE STORAGE POTENTIAL MIGHT BY MORE FULLY DEVELOPED

The strongest demand for new or additional storage in the Clark Fork Basin will likely be heard in the closed Upper Clark Fork, Bitterroot, and Blackfoot River watersheds, where demand for water is high and the water supply conditions are some of the lowest in the basin. Instream flow rights limit the potential for storage of high spring flows in these basins.

Water is potentially available in the Clark Fork River (below the Flathead River confluence) for storage (relative to the Avista water right) during runoff when water supply conditions are at median or greater conditions (every other year). The identified water, however, is located down-gradient of areas where new or additional stored water would be most beneficial. A detailed technical investigation would be needed to fully determine the legal availability of water for storage in the Clark Fork Basin.

Increased storage on the main stem of the Kootenai River would likely not benefit future development in Montana, since storage water would likely be available in Lake Koocanusa if needed. Development of storage in the Tobacco River valley would likely benefit local users if storage water was available. Water is potentially available for storage during runoff when water supply conditions are at median or greater conditions (every other year). A detailed technical investigation would be needed to fully determine the legal availability of water for storage in the Tobacco River.

NON-RESERVOIR STORAGE

Natural water storage features largely consist of floodplains and their associated wetlands and riparian areas, but also include anywhere that the natural process of infiltration is allowed to effectively convey surface water and precipitation to the underlying aquifer. When properly functioning, these natural features can absorb and retain large volumes of water and gradually release it to adjacent streams and other bodies of water during low-flow periods and at other times of the year. This slows runoff and promotes aquifer recharge by holding water on the land and allowing it to percolate into underlying soils, a process that simultaneously purifies water by absorbing excess nutrients such as nitrogen and phosphorus. Additionally, hearty hydrophytic (water loving) vegetation stabilizes and retains valuable soils and also stabilizes stream channels during runoff.

Disturbances to natural features can limit connectivity and access of flood waters to floodplains. Hydrologic alterations such as the introduction of impervious surfaces, the artificial draining, dredging or soil filling, artificial stream channel incising/channelization, or diverting water away from natural storage features can reduce the effectiveness of natural storage. Vegetation damage from overgrazing and trampling, the introduction of non-native species, and the removal of riparian vegetation and groundcover can also reduce natural infiltration.

Wetlands and riparian areas in Montana currently make up 3 to 5 percent of the land base. In some cases it is estimated that one acre of wetland can store 1 to 1.5 million gallons (3 to 4.6 acre-feet) of floodwater. These features help to buffer and improve late season water supplies, which equates to reducing conflicts over water use during the most critical times. Natural storage, however, needs to be protected and enhanced. Montana has lost almost 30 percent of its wetlands since settlement in the 1860s, and many of the remaining wetlands suffer from the disturbances listed above.

Artificial recharge of ground water aquifers via injection or infiltration of surface water is a potential alternative to structural storage in the basins. Irrigation canals and irrigated land in the basin currently recharge aquifers during the summer months. As land uses change in the basins the function of irrigation recharge to local ground and surface water resources should be evaluated by local planners and resource managers.

Non-structural warrants further research and investment as a potential way to enhance water resources in the Clark Fork and Kootenai basins.

VOLUNTARY WATER MANAGEMENT – A CASE STUDY

Ever since the early years of water use in Montana, demands for water focused primarily on agriculture and mining. In times of shortage, it was not uncommon for neighbors to ration water to get by. In the 1970s and 1980s river recreation came into its own in Montana. Interest in whitewater kayaking, rafting and fishing grew with increasing popularity in the headwaters of the river basins of Montana.

By June of 1994, the last vestigial population of riverine Arctic grayling in the lower 48 states was threatened by high water temperatures and dewatering in the upper reaches of the Big Hole River near the town of Wisdom. At the urging of instream flow advocates, then Governor Marc Racicot directed Montana Fish, Wildlife, and Parks to monitor the flow status of the river day to day and report back to his office through the drought advisory committee. Instantaneous discharge records of U.S. Geological Survey Records from July 6, 1994, indicate that not only was the Big Hole River fishery in jeopardy of a fish-kill, but in headwaters tributaries throughout Western and Central Montana.

With the prospect of the Arctic grayling being listed under the federal Endangered Species Act an accord between the Big Hole water users and the U.S. Fish and Wildlife Service and the state would soon be necessary. With temperatures rising and stream flows dropping, tension and acrimony erupted between the agricultural and instream flow advocates. Fisheries such as the Jefferson, Ruby, Beaverhead, and Gallatin east of the Continental Divide and the Blackfoot, Bitterroot, and Rock Creek west of the Divide were reaching critical high day time water temperatures and low flows as well, putting dwindling populations of bull trout and Westslope cutthroat trout as well as brook, rainbow and brown trout in jeopardy.

In the wake of 1994, conservation districts, water user groups, fishing guides and outfitters, and other instream advocacy groups called for collaboration among the interests. Irrigators wanted science and tools to better manage water instead of negative publicity or criticism for the legal use their water right. While the relationship between the interests could at times become adversarial they also had much in common: they both wanted the local businesses to thrive; they both wanted more information on the behavior of threatened and endangered species; they were both eager to learn more about the local hydrology of their river source; they wanted water rights to be respected, and they wanted the fisheries to be respected and lost habitat restored.

From the mid-1990s onward there was slow but steady progress on conservation. In 1993, the Governor's Drought Advisory Committee received over $1 million from the U.S. Bureau of Reclamation's Emergency Drought Relief Act of 1991. Reclamation also provided assistance through its Agri-Met (Agricultural – Meteorological) field stations for scientific irrigation scheduling; the purchase of water for threatened and endangered species; conjunctive use wells to take pressure off of dwindling surface water supplies; irrigation canal lining to reduce seepage; stock water provided from Reclamation storage projects; fish ladders; head-gates and other control structures , stream gages critical for managing chronically-dewatered stream reaches, and well-drilling for small town municipal water supplies. The Future Fisheries Program provided restoration for riparian habitat benefitting fisheries as well.

As the 2000s wore on and impacts of the drought carried over into the succeeding year, water users worked even harder to stretch water supplies. Further investigation of local water supplies revealed that if a group of irrigators formed an informal alliance they could satisfy their regular right because it was a matter of *timing* their diversions of water. Some groups hired a professional to calculate just how much water each irrigator in a tributary basin would need for a particular crop. When the flows got very low the users apportioned precious water supplies and shared the sacrifice by cutting back on diversions to take pressure off of the fishery. Outfitters stepped-up in return by agreeing to limit guiding hours per day, using barbless hooks, and not playing fish too long. Fish, Wildlife and Parks participated by placing restrictions on the hours in a day that fishing was allowed.

By 2008, there were over 40 watershed groups across the state formed by Conservation districts, irrigation districts, canal companies, and instream flow advocacy groups like Trout Unlimited. With assistance from state and federal scientists, and the local knowledge of water availability the groups began a shared knowledge period where the Montana Watershed Coordination Council hosted workshops for group coordinators and other interested parties.

The once ad hoc groups now have their own sophisticated water management and drought plans. And they celebrate their hard work and success with community events like golf matches on their hayfields, noxious weed pulling, barbecues, and fundraisers for worthy causes such as restoration of Trumpeter swans or Arctic grayling. With advances in climatological forecasting, improved water delivery systems, and tools such as automated mountain snow water stations and stream gauges the groups are better able to manage their shortages autonomously. And since those dreadful water years of the 2000s they remain vigilant never failing to meet year around to discuss and revise their flow plans on a regular basis no matter how good the mountain snowpack and water supply outlook may be.

IX. Major Findings and Key Recommendations

The major findings and recommendations detailed below are the work product of the Clark Fork Task Force with facilitation and staff support from the Center for Natural Resource Environmental Policy and DNRC. A complete presentation of the topics considered and changes made through the course of public meetings and final deliberations is available online in the *Clark Fork / Kootenai River Basins Task Force Final Recommendations Development Report* (http://www.dnrc.mt.gov/mwsi) and Appendix I-1 to this report.

Maintaining Water Availability

Occurrence of water in the Clark Fork and Kootenai Basins is limited by climatic conditions, precipitation, and snowpack. Water availability varies among years and dramatically between seasons of a given year. Recent data suggest changing trends in water availability, with earlier onset of spring snowmelt and runoff.

Montanans use water for many purposes. Whether used for commercial, conservation, domestic, flood control, industrial, irrigation, power generation, or recreation purposes, water availability can be increased or decreased by the associated method of diversion, amount of consumption, and timing. These influences will continue to affect water availability into the future. It is also important to be mindful that changing how the water is used in the future could result in associated changes in water availability.

Looking ahead, we must focus on finding innovative strategies to use water more wisely and educate water users about their role in conservation. Water regulations and management should be modified to recognize the limited nature of the resource. With proper regulatory and physical measures in place, we can maintain water availability for existing uses and help accommodate future growth.

GOAL: IMPLEMENT MEASURES THAT IMPROVE THE WAYS IN WHICH WE MANAGE AND CONSERVE WATER RESOURCES.

A. **Objective:** Encourage existing programs that implement and support conservation measures from all types of water users at the watershed, subbasin and basin levels.

1. **Recommendation:** Implement water conservation incentives within three years that are adaptable to the needs of individual watersheds. These incentives should focus on encouraging programs such as irrigation efficiency, water banking, drought management plans, etc.
2. **Recommendation:** Ensure that water regulations clarify that water users participating in water conservation measures will not be penalized.
    a. For example, DNRC could investigate the existing options to avoid abandonment by evaluating code section 85-2-404, “Abandonment of appropriation right” subsection 3 and develop provisions that insulate water right holders who participate in voluntary drought response efforts from the risks of water right abandonment.
3. **Recommendation:** The State should collaborate with other agencies, local entities and non-governmental organizations (NGOs) to establish additional, shared resources for coordinated education and outreach that encourages water conservation and efficiencies, along with a portal to disseminate those education resources.
4. **Recommendation:** Identify, protect, maintain, and restore constructed and natural storage features that can maintain and improve seasonal water availability.

5. **Recommendation:** Identify potential options for new constructed storage, evaluate the conditions, and, where appropriate, develop new storage.
   a. In the short-term, DNRC, as part of the 2015 State Water Plan, should develop a summary of actions taken and accomplishments made under the Water Storage Policy Act of 1999 (85-1-701 through 704), including:
      I. Accomplishments made using the state water storage development fund and well as other funding sources used to complete those projects;
      II. A summary list of priority water projects identified in bi-annual reports from 1999 to 2014 and delineate those project completed and those projects still pending and their ranking in priority (the bi-annual report and as required by 85-1-704 (1)(a));
      III. An evaluation of the potential of the Act to facilitate the protection or restoration of natural recharge functions; and,
      IV. Recommendations to improve the Act.
6. **Recommendation:** The State should maintain a strong voice or role in how flows are maintained from federal dams in Montana.

B. **Objective:** Montana should be fully represented and engaged in trans-boundary water management planning efforts that affect federal dam operations in the state.

1. **Recommendation:** Montana should ensure that federal dams are managed in a way that protects state water interests through continuous engagement in the Northwest Power Planning Council and other forums. In Western Montana, this includes operation of Libby and Hungry Horse Reservoirs.
2. **Recommendation:** Montana should ensure that re-negotiation of the Columbia Basin Treaty with Canada protects state interests.
3. **Recommendation:** DNRC should ensure that state residents and water interest are continuously informed on trans-boundary or regional water management efforts, and that stakeholder groups such as the Flathead Basin Commission and CFTF have opportunities to provide input on these processes.

GOAL: BETTER UNDERSTAND SURFACE AND GROUND WATER RESOURCES AND THE POTENTIAL FOR FUTURE NATURAL AND HUMAN CHANGES TO THOSE RESOURCES.

C. **Objective:** The State of Montana, in coordination with local and federal agencies, should continue to participate in, improve and expand efforts to gather the best scientific information available to better understand physical water availability.

1. **Recommendation:** State agencies, universities and others should identify and pursue research needed to develop new water management and conservation options, including but not limited to:
   a. Gray water use options;
   b. Return flows;
   c. Stream depletion zones / groundwater-surface water connections; and,
   d. Cost-benefit analysis of both natural and built storage options.

2. **Recommendation:** The DNRC should determine the accuracy of existing water rights claims to understand actual physical and legal availability. The water court should continue examining water rights to determine existing water rights.
3. **Recommendation:** State and federal agencies and private entities should collaborate to develop more information and data on consumptive water use.
4. **Recommendation:** Montana Bureau of Mines and Geology should characterize and assess groundwater resources in the greater Tobacco Valley.

5. **Recommendation:** Agencies and partners should evaluate proposed water conservation actions, such as converting to sprinkler irrigation or lining ditches, to define benefits and impacts to water supply and existing water uses.
6. **Recommendation:** DNRC should conduct, facilitate or fund additional subbasin hydrologic studies.
    a. Emphasis for studies should be placed on water bodies with dewatering conditions or those with high levels of diversionary water use
    b. Study examples include, but are not limited, to the “North Fork Blackfoot Hydrology Study” (March 2001) or “Flint Creek Return Flow Study” (December 1997).
    c. Future study reports should include options for water conservation and improved water management with some evaluation of potential benefits and impacts to the water supply system and flow conditions.
7. **Recommendation:** The state should encourage land management agencies to manage forest vegetation (e.g., prescribed fire, harvesting, etc.) to promote healthy forest conditions and increase physical water availability.
8. **Recommendation:** The DNRC should implement improved methods of water use measurement for management and enforcement.
    a. DNRC should continue its annual water commissioner training but should enhance that activity by:
        I. Providing more online materials and resources related to water measurement and control, and
        II. Expanding classes on water measurement and enforcement to a larger audience of water users with priority given to new administration of water rights under a Water Court Enforceable Decree or areas of known water use conflict.
        III. DNRC should continue or increase funding for installation of water measurement and water control devices at stream points of diversion.
        IV. DNRC and the Montana Water Court should host and fund a round table to evaluate, and if warranted, make recommendations for improving the effectiveness of the state’s water commissioner regulations. Invited participants should include water users, Water Commissioners and District Court judges involved in water right enforcement, and legislators from the Environmental Quality Council (EQC) and the Water Policy Interim Committee (WPIC).
9. **Recommendation:** Support partnerships among federal, state, tribal and local governments, agencies, and organizations to prioritize and fairly pay the costs of installing and maintaining existing and new stream flow gages.
    a. Governor’s Office and state agencies (DNRC, the Department of Environmental Quality [DEQ] and the Department of Fish, Wildlife and Parks [FWP]) should actively work with Montana’s Congressional Delegation to support and increase funding for both the U.S. Geological Survey (USGS) National Stream Gauging Network and the USGS cooperative program for stream gauging.
    b. Governor’s Office should actively promote state funding for Montana’s participation in the USGS cooperative stream gauge program.
    c. Governor’s Office and state agencies (DNRC, DEQ and FWP) should actively work with Montana’s Congressional Delegation to restore and enhance the USDA Natural Resources and Conservation water supply program including support for SNOTEL and manual snow courses, web based real time data sharing and monthly water supply forecasts and reports.
    d. Evaluate the development of a state sponsored and maintained stream gauging network on tributary streams.

10. **Recommendation:** Investigate the role of seasonal recharge on groundwater availability.
11. **Recommendation:** Repeat and update the Montana Water Resources Survey.
    a. The Montana Water Resources Survey was collected and published from 1943 through 1965 by the State Engineers Office and from 1966 through 1971 by the Water Conservation Board. Survey data was derived from courthouse records in conjunction with landowners, field investigations and aerial photography, and other data sources.
    b. Although the Survey is an excellent resource for various state and federal agencies, water users, and the public, the Survey's age (which many believe is outdated) represents a large data gap. Many water use changes have occurred since the Survey data was collected and published.

GOAL: FACILITATE COLLABORATIVE RESPONSES TO ISSUES OF WATER AVAILABILITY

D. Objective: In recognizing that water availability depends on conditions that vary locally at the watershed level, pursue opportunities to increase interaction among water users and develop collaborative stakeholder approaches to maintaining water availability.

1. **Recommendation:** Continue to fund the CFTF as a mechanism for water user networking, knowledge sharing, public engagement, and interaction on current water availability issues in the Clark Fork and Kootenai River Basins. Consider broadening the group's name to be more inclusive of both basins.
2. **Recommendation:** Provide public forums for water information sharing among scientists, technical experts, communities, landowners, NGOs, policy-makers, and others.
3. **Recommendation:** Offer funding, capacity-building, and technical assistance mechanisms to support the work of collaborative local watershed groups.
4. **Recommendation:** Develop better data on the local variability of watershed conditions and provide data at the watershed level to assist communities, agricultural producers, NGOs and others in collaborative planning.

Ensuring Natural Systems Health

Western Montana's natural water bodies and watersheds and associated biological resources support our recreational opportunities, quality of life and economy. The availability of water in the appropriate quantity, quality, timing and duration is necessary to ensure the health of water-dependent natural systems. Challenges and threats associated with water availability have resulted in natural systems impacts. Population growth, associated development, and increasingly uncertain weather patterns will increase risks to these systems in the future. Proactive policies and management practices which balance natural systems health with other important priorities must be pursued to support the health of these valuable systems.

GOAL: RESTORE AND/OR MAINTAIN SURFACE WATER FLOWS AND GROUNDWATER LEVELS NEEDED TO PROTECT NATURAL SYSTEMS HEALTH OVER SEASONAL AND LONG-TERM CLIMATE CYCLES.

E. **Objective:** Establish a more effective partnership between DNRC, DEQ and FWP to proactively identify and address current flow-related impairments of waterways, and to effectively address associated future threats to these systems.

1. **Recommendation:** Agencies that designate waterways with flow related impairments and/or chronic or period dewatering should make maps and data on impairments and dewatering accessible through the Montana State Library.
2. **Recommendation:** The CFTF is proposing that the Montana Legislature direct DNRC, DEQ, FWP and other entities to work together to determine the flows needed to address these impairments and dewatering so as to support beneficial uses and system health, including fisheries health.

3. **Recommendation:** The Montana Legislature should request that the Water Policy Interim Committee complete a study to proactively identify and report future threats and solutions to natural system health from increased water demands of population growth and development and other environmental changes within the Clark Fork and Kootenai River Basins.
4. **Recommendation:** The CFTF is proposing that the Montana Legislature direct DNRC, DEQ, FWP and other entities to work together to identify and report adaptive management and mitigation options to avoid/mitigate/adapt to future threats.
5. **Recommendation:** The CFTF or DNRC should propose legislation to enable the permanent change of an existing water right to instream use, similar to all other beneficial uses.

F. **Objective:** More effectively manage (i.e., restore and/or maintain) natural storage systems to promote retention and infiltration of surface runoff resulting in beneficial release during low flows.

1. **Recommendation:** Relevant state agencies should adopt best management practices to promote natural infiltration and preserve natural storage systems.
2. **Recommendation:** In managing storm runoff, consider natural storage options, or combined natural and artificial storage (e.g. detention and retention basins, wetlands, etc.) options that protect natural system health and store water for later use.
3. **Recommendation:** Allow use of water development funding for natural storage restoration projects.
4. **Recommendation:** Relevant state agencies should investigate feasibility and cost effectiveness of using and improving natural storage options like ground water recharge, wetland restoration, headwater ponds/reservoirs, beaver dams, etc.
5. **Recommendation:** Relevant state agencies should identify obstacles to restoration of natural storage.

G. **Objective:** Establish a more effective coordination mechanism between DNRC (and appropriate sister agencies) and citizen watershed restoration groups to implement flow restoration projects and programs throughout the basin.

1. **Recommendation:** The State Water Plan should prioritize coordination among DNRC and watershed groups or other relevant entities carrying out watershed restoration projects with a significant flow-restoration aspect.
2. **Recommendation:** The State Water Plan should prioritize coordination between the DNRC and the Department of Justice Natural Resource Damage Program in order to implement the flow restoration projects identified in the Final Upper Clark Fork River Basin Aquatic and Terrestrial Resources Restoration Plan (December 2012) within the 20 year timeline established by the Plan.

H. **Objective:** Establish a more effective partnership between DNRC, DEQ, FWP, the Montana Department of Transportation (DOT), and the U.S. Department of Agriculture (USDA) to pro-actively manage and reduce risk of introduction and spread of Aquatic Invasive Species (AIS).

1. **Recommendation:** In managing water resources, consider AIS that reduce water supply (e.g. salt cedar), species that become problems when flow is reduced (e.g. milfoil) or temperature increases due to lower flows.
2. **Recommendation:** Develop preapproved AIS responses for water management actions, such as herbicide applications, needed to prevent spread of harmful AIS.
3. **Recommendation:** Increase funding for watercraft inspection stations and public education in Montana in order to prevent introduction and spread of AIS.

Water Rights Administration, Protection and Enforcement

Montana water users of both surface and groundwater sources rely on a clear expectation of their rights to water. There is an opportunity to improve complex issues through modified procedures.

These complex issues include:

- Protection of water rights through enforcement of existing rights.
- Consistent, transparent, and streamlined administration of water rights and adjudication processes; measurement and monitoring; and planning.

GOAL: MAINTAIN A SYSTEM AND PROCESS FOR CHANGING EXISTING WATER RIGHTS AND ALLOWING NEW WATER RIGHTS THAT BOTH PROTECTS EXISTING WATER RIGHTS WHILE PROVIDING A TRANSPARENT, COHERENT, AND EXPEDITIOUS PROCESS FOR REVIEWING PROPOSED WATER RIGHTS CHANGES AND NEW USES.

A. **Objective:** Currently, DNRC requires change applicants to provide detailed explanations of how water rights were used prior to July, 1973. At times, this evidence is difficult to produce. DNRC should review its pre-1973 historic use criteria to ensure that it accurately assesses the effect of a change of use on other water rights. If the historic use criteria is modified, DNRC should assure that any modifications not sanction any post-1973 illegal expansions of use.
   1. **Recommendation:** DNRC should explore the issue of pre-1973 historic use criteria described in objective 3.2.1 and, if appropriate, propose administrative or legislative action that may implement a solution.

B. **Objective:** Review of change and new use applications from one region to another continues to vary as to the standards applied and as to the level of documentation expected of applicants. DNRC should work to assure consistency and clarity in DNRC's review process from one region to another and from one application to another.
   1. **Recommendation:** DNRC should establish a statewide point of contact for water rights review process questions. The CFTF envisions this as a clearinghouse where questions would be answered with consistency and authority, thereby solving the problem of current regional inconsistency.

GOAL: PROTECT WATER RIGHTS THROUGH ENFORCEMENT OF EXISTING RIGHTS.

A. **Objective:** Increase the DNRC's role in enforcement as it relates to illegal water use under the Montana Water Use Act.
   1. **Recommendation:** Increase DNRC's on-the-ground enforcement capability by providing it with more FTEs dedicated to water rights enforcement under the Montana Water Use Act.
   2. **Recommendation:** Provide DNRC with express statutory authority to issue cease and desist orders against and administratively levy civil penalties for illegal water use (i.e. water use not authorized under an existing water right or permit) and increase civil penalties from the current $1,000/day to an amount sufficiently large to act as a deterrent against illegal water use.
   3. **Recommendation:** The DNRC should determine the accuracy of existing water rights claims to understand actual physical and legal water availability.
      a. State of Montana must continue funding and support of the Montana Water Court as it continues the process of adjudicating pre-1973 water rights.
      b. State of Montana must continue funding DNRC's adjudication staff as the Water Court's technical assistant. (DNRC's technical expertise is provided to the Court upon request to evaluate technical issues that arise during the settlement and potentially litigation phases.)

c. DNRC's claims examination process should be funded, allowing the Water Court to review the interlocutory decrees know as Temporary Preliminary Decrees that were adjudicated prior to the establishment of the Supreme Court's "Claim Examination Rules".

B. **Objective**: Assure that the mechanisms for the enforcement of existing water rights (i.e., the appointment of water commissioners) are clear to existing water users and are adaptable to decrees that will be issued from the adjudication.

1. **Recommendation:** The water court, in concert with DNRC and district courts in the state, should clarify how decrees within subbasins will be administered when a water rights dispute arises within the subbasin.

C. **Objective**: Explore and adopt additional strategies in advance and in lieu of litigation for the resolution of water rights disputes.

1. **Recommendation:** DNRC and the Water Court should create and actively fund a water rights dispute mediation unit and promote it to water rights holders as an alternative to traditional litigation.
2. **Recommendation:** DNRC should offer mediation training to water commissioners.

Meeting Future Water Demand

Montana needs to address future demands for water while meeting existing water rights and uses. The economies of our communities are dependent upon water availability. This requires projecting where and when demand will occur and what type of supply will be required to meet that demand. Ascertaining future demand for water is a precursor to planning for and anticipating opportunities within the Clark Fork and Kootenai basins, and assessing those opportunities against potentially competing demands within the larger Columbia Basin.

GOAL: THE AVAILABILITY OF WATER IN MONTANA TO MEET FUTURE DEMANDS IS SUPPORTED BY A CONCISE, PREDICTABLE, AND DEFENSIBLE LEGAL FRAMEWORK.

A. **Objective:** Montana's existing laws regarding the availability of water should be complete, concise, and defensible.

1. **Recommendation:** The 2015 Montana Legislature should authorize and fund a comprehensive independent review of existing laws regarding water rights in Montana and forward recommendations to the 2017 Legislature, CFTF, WPIC, and the governor to ensure, to the best of our collective abilities, that Montana has a predictable and transparent legal framework that can guide future water use.

a. Identify regulations and legislation that impede the implementation of sound water use or water allocation practices because the regulations and legislation do not recognize site- and watershed-specific conditions. Forward recommendations for changes to the 2017 Legislature, CFTF, WPIC, and the governor.

B. **Objective:** Encourage the development of water use plans, including drought and conservation plans, while protecting water rights.

a. Based on a review of existing laws regarding water rights (as described above), DNRC should develop and fund programs to present to the CFTF and 2019 Legislature that encourage the implementation of watershed-based collaborative water use plans while protecting existing and future water rights.
b. DNRC will review the process and incentives for transferring water in support of a watershed-based collaborative water-use plan.

C. **Objective**: Determine if existing laws need to be modified to address concerns regarding water availability.

1. **Recommendation:** Modify state subdivision rules to recognize the need for an applicant to identify a path to a legally available water supply as a component of the subdivision review process.
2. **Recommendation:** Modify state subdivision rules to incentivize the implementation of community wells.
3. **Recommendation:** Water rights of the CSKT should be quantified.

GOAL: MONTANA ACTIVELY PURSUES THE DEVELOPMENT OF WATER RESOURCES TO MEET FUTURE WATER DEMANDS WITH SPECIFIC ATTENTION GIVEN TO THE SPATIAL AND TEMPORAL (SEASONALITY) OF THOSE RESOURCES AND THE ASSOCIATED DEMAND.

A. **Objective:** The quantification of water resources and water demand should be advanced to support the prioritization of opportunities that can improve the physical availability of water to meet anticipated demand.

1. **Recommendation:** DNRC, in cooperation with other state agencies, should complete a quantification of potential future water demand increases of water with a 20-year outlook with review and revision every 10 years.
2. **Recommendation:** Where demand warrants, the Montana Bureau of Mines should identify possible sites for aquifer storage and determine the feasibility of aquifer storage and recovery.
3. **Recommendation:** Building from the Montana Bureau of Mines work and warranted water demand, DNRC should determine if the deep aquifer in the Kalispell area can be developed without impacting other users or the resource itself.
4. **Recommendation:** DNRC should explore the use of Hungry Horse stored water, Flathead System Compact Water and Libby Dam storage water for use by the State of Montana.

GOAL: MONTANA MEETS FUTURE DEMAND THROUGH EDUCATION, OUTREACH, AND A SHARED UNDERSTANDING OF THE IMPORTANCE OF WATER TO THE ECONOMIC, SOCIAL, AND ENVIRONMENTAL WELL-BEING OF THE CITIZENS OF MONTANA.

A. **Objective:** Agencies and relevant NGOs should continue to invest in an outreach program to engage existing water users.

1. Agencies and relevant NGOs should educate water users regarding the existing processes to obtain water for new uses.
2. Agencies and relevant NGOs should initiate a systematic effort to develop and fund community driven, place-based drought and flood plans for each watershed within each basin**.** Provide grants to incentivize community-driven, placed-based watershed scale drought planning.
3. Agencies and relevant NGOs should develop a subbasin water plan/assessment program, perhaps patterned after the Bureau of Mines Groundwater Assessment Program (GWAP), to incorporate into future planning. Subbasin plans will assess vulnerabilities and opportunities for water supply and water quality relative to future water demands.

B. **Objective:** Invest in a program to educate individuals and communities on water use and availability in Montana.

1. **Recommendation:** DNRC should work with the Montana State Library's Water Information System, other state agencies, and stakeholder groups to continue to advance a one-stop clearinghouse for the citizens of Montana on resources for water availability, water quality, and water rights in Montana. Recommendation 2.2.2.1 could also be addressed by this recommendation.

2. **Recommendation:** DNRC should enhance the Montana Water Information System to allow the public to visualize the spatial and temporal nature of water right information in an intuitive and interactive manner.
3. **Recommendation:** DEQ should create a GIS overlay with comprehensive septic system information.
4. **Recommendation:** DNRC will work with stakeholder groups to develop a common approach, such as the Global Water Footprint Standard, as a method for quantifying and communicating water use, re-use, and availability.

Use of Basin Advisory Councils for Implementation of the State Water Plan and Management of the State's Water Resources

The CFTF was created in 2001 with passage of House Bill 397 (MCA 85-2-350). The CFTF's work in developing a water management plan for the Clark Fork Basin and in the implementation of that plan serves as a model for similar organizations in the other major Montana river basins. Given that water in the Clark Fork and Kootenai Basins is a limited resource, carefully structured allocation and management is necessary to sustain and improve the economic health of the basin communities while meeting the needs of various competing uses.

Moreover, the CFTF is charged with coordinating various entities in order to achieve long-term sustainable water management. Per MCA 85-2-350, the CFTF is mandated to coordinate local basin watershed groups, water user organizations, and individual water users and provide a forum for all interests to communicate about water issues. The CFTF must also advise government agencies about water management and permitting activities in the Clark Fork Basin and consult with local and tribal governments within the Clark Fork River basin. The CFTF's role, which has expanded in the last six months to include the Kootenai River basin, is of great importance.

1. **Recommendation:** The Water Use Councils defined in the Montana Water Supply Initiative (MWSI) should be permanently recognized as continuing organizations tasked to implement and modify the basin plans as needed, and to make recommendations regarding proposed changes in the state water management.
2. **Recommendation:** Council activities receive continuing support, including a professional facilitator to organize monthly meetings, keep records, and speak for the council as directed by the Council. Other needs include funding for organizing and conducting public meetings and symposia, publications, and coordination as needed between subbasin groups and the major basins themselves. These activities include:
   a. watershed meetings to evaluate/propose actions for solving problems;
   b. annual symposia regarding forecasts water availability and related issues;
   c. educational publications regarding plan changes, descriptions of program/legal requirements, experiences in managing water requirements, differing program approaches in other areas, etc.; and,
   d. collaboration with DNRC and other appropriate entities in the implementation of the Clark Fork and Kootenai Basins water management plan.
3. **Recommendation:** Legislative amendments should be considered to redefine the tasking of the current CFTF under any revised Water Use Council system (i.e., rename the CFTF the Clark Fork and Kootenai Basins Water User Council). Current CFTF reporting requirements should be retained for each council as well as routine coordination between councils and the state water management program.

C. **Objective:** The initial, and perhaps only, question is why an advisory council structure is needed in addition to permanent state water management program staff. Based on CFTF experience, the proposed structure presents the following advantages:

1. The councils would be a powerful tool for communication of management actions and problems between the state program and local users. Each council would bring together a group of volunteer, concerned individuals with significant expertise and knowledge regarding the local needs of the basin. *This may be extended to persons or groups representing local subbasin concerns.* Councils would regularly report to WPIC and other state bodies, serving as a critical link and continual interface between the Legislature, state agencies, and local water users, enabling a more proactive approach for state programs.
2. **Councils would provide a local contact point for concerned citizens.** This allows problems to be recognized and perhaps solved on the local level prior to required state action. A local judgment may also be made that local problems do represent something requiring state program attention. This is a special advantage if, as is expected, most problems have specific local circumstances.
3. Councils will develop a wide network of contacts with local basin citizens, groups, and government interests through representation by council members, council contacts with local groups, and public meetings and education. This can provide an ongoing review by the public of water management issues that should facilitate any needs for state program public hearings.
4. **Councils would encourage solutions such as local drought management plans.** Organization such as that described for the councils seems essential to encouraging and supporting any drought management plan.
5. **Councils may assist in drafting of workable and effective legislation from water users' points of view.** Frequently legislation prepared by local legislators fairs better in the legislative process, especially when the legislation requires additional funds. Councils may also independently propose budget changes from water users' perspectives.
6. Selection of Council members with applicable levels of expertise enables consideration of local technical problems and may result in proposed solutions that have not occurred to state program staff. Such coordinated state/local "brainstorming" offers an efficient approach to the best possible program. Obviously, such volunteer work may greatly reduce state costs as opposed to developing and overseeing similar contract work. These technical solutions may involve specific planning activities to increase water availability, consideration of various types of connections between surface and ground water, ongoing evaluation of priority for state hydrological research and measurement, and coordination meetings between major basin representatives. Watershed meetings could be held to evaluate and/or propose actions for more widespread concerns, as well as annual symposia regarding forecast water availability and related responses and problems, as well as publications addressing citizen concerns.
7. Council members will represent a number of different types of water users, including irrigators, public water system managers, hydrologists, tribal governments, ecologists, ranchers, real estate developers, hydropower generators, and other special interests (e.g., watershed groups, hunters, anglers, guides, tourism representatives, conservationists, forestry professionals, etc.). When a particular issue is reviewed by a council it will be considered from many different points of view resulting in a more thorough evaluation and possible prevention of unintended adverse impacts.

CLARK FORK TASK FORCE OPERATIONS

Task Force Administration

- Facilitator
- Meeting Expenses (lunch, reproduction costs, speaker stipends, video conferencing)
- Travel Expenses

Task Force Conferences

- Biannual water supply conferences
- Annual technical conference (focus on water availability and allocation)
- Annual Watershed Council coordination for Clark Fork & Kootenai Basins (may already being done by others).

Task Force Publications-Research & Education

- Public outreach – coordinate with existing entities (e.g. Montana Water Center)
- Publish topical documents (e.g. Prior Appropriation booklet) and conference proceedings.
- Define needed research, and oversee completion of such projects. Coordinate research among the various agencies and academic institutions to facilitate water management.

Task Force/Agency Coordination

- Coordinate water use and regulation among State and Local agencies (annual meeting?).
- Review and make recommendations for Columbia River Treaty negotiations to State and Federal entities.
- Review water right process and make recommendations to DNRC and Legislature. Potentially prepare necessary legislation.
- Develop water management structure for Basins - Based on experience in the Ogallala, management from the bottom up is working better than top down.

X. Glossary of Terms

Abandonment –The intentional, prolonged, non-use of a perfected water right. [1]

Acre-feet - A unit of volume, mostly used in the United States, to describe large-scale water volumes. It is the volume of one acre of surface area to the depth of one foot which is equal to 43,560 cubic feet.

Adjudication of Water Rights - In the context of Montana water law this refers to the statewide judicial proceeding to determine the type and extent of all water rights claimed to exist before July 1, 1973.[2]

Adverse Effect – Interference with a water right owner's ability to reasonably exercise their water right. In the context of new water use permits and change applications, the applicant must prove lack of adverse effect prior to appropriating water for a beneficial use pursuant to §85-2-311, MCA, or changing a water right pursuant to §85-2-402, MCA. [3]

Appropriate - To divert, impound, or withdraw, including by stock for stock water, a quantity of water for a beneficial use.[1]

Appropriation Right/Water Right - any right to the beneficial use of water which would be protected under the law as it existed prior to July 1, 1973, and any right to the beneficial use of water obtained in compliance with the provisions and requirements the Title 85, Chapter 2.[1]

Aquatic Ecology - The relationships among aquatic living organisms and between those organisms and their water environment.

Aquatic Invasive Species - Non-native plants, animals or pathogens that cause environmental or economic harm.

Beneficial Use - Use of water for the benefit of the appropriator, other persons, or the public, including but not limited to agricultural (including stock water), domestic, fish and wildlife, industrial, irrigation, mining, municipal, power, and recreational uses; use of water to maintain and enhance streamflows to benefit fisheries pursuant to conversion or lease of a consumptive use right. [1]

Call - The request by an appropriator for water which the person is entitled to under his/her water right; such a call will force those users with junior water rights to cease or diminish their diversions and pass the requested amount of water to the downstream senior water right holder making the call.

Claim/Statement of Claim - The assertion that a water right exists under the laws of Montana or that a reserved water right exists under the laws of the United States in Montana's general adjudication. [2]

Climate - The average weather over a period of time, typically taken as a 30-year period from a human perspective. Geologists and paleoclimatologists refer to the earth's climate over thousands to millions of years.

Climate Variability - The fluctuation of temperature, precipitation, wind, and other climate descriptors, over a period of time. This variation may be due to natural processes or human-induced factors.

Compact – a negotiated agreement for the equitable division and apportionment of waters between the State and its people and: 1) the several Indian Tribes claiming reserved water rights within the state (MCA 85-2-701); or, 2) between the State and its people and the federal government claiming non-Indian reserved waters within the state.

Conjunctive Management - Management of ground and surface water as a single resource.

Conjunctive Use - The deliberate combined use of groundwater and surface water.

Conservation District - A political subdivision of state government, possessing both public and private attributes, that primarily distributes irrigation water in a given region and that may also administer electric power generation, water supply, drainage, or flood control.

Consumptive Use - Use of water that reduces supply, such as irrigation or household use.[1]

Decree - Is a final product of adjudication and is a legal document issued by a district court or the Montana Water Court defining the priority, amount, use, and location of a water right or set of water rights. The Montana Water Court adjudicates and prepares decrees for entire basins as part of the adjudication process.[2]

Dewatering of Streams, Chronic and Periodic - Dewatering is a reduction in stream flow below the point where stream habitat is adequate to support healthy fish populations. Chronic dewatering is a significant problem in all years while periodic dewatering is a significant problem only in drought years.

Means of Diversion/Diversion - the type of structures, facilities, or methods used to appropriate, impound, or collect water including but not limited to a dike, dam, ditch, headgate, infiltration gallery, pipeline, pump, pit or well. [1]

Evapotranspiration (**ET**) - means the loss of water from the soil both by evaporation and by transpiration from living plants. Evaporation accounts for the movement of water to the air from sources such as the soil, canopy interception, and water bodies. Transpiration accounts for the movement of water within a plant and the subsequent loss of water as vapor through stomata in its leaves. [1]

Exempt Wells - Under Montana water law, wells that divert 35 gallons per minute or less, and do not exceed 10 acre-feet per year in the total volume of water diverted are considered exempt from the permitting process. Appropriators of water under these conditions are, however, required to file a notice of completion with DNRC.[4]

Existing Water Right - "Existing right" or "existing water right" means a right to the use of water that would be protected under the law as it existed prior to July 1, 1973. The term includes federal non-Indian and Indian reserved water rights created under federal law and water rights created under state law. [1]

Federal or Tribal Reserved Water Rights - Established by an act of Congress, a treaty, or an executive order. Gives a right to use water; the amount of water reserved depends on the purpose for which the land was reserved.

Flowing Well - An oil or water well from which the product flows without pumping due to natural or artificially supplied subterranean pressure.

Flow Rate - is a measurement of the rate at which water flows or is diverted, impounded, or withdrawn from the source of supply for beneficial use, and commonly measured in cubic feet per second (cfs) or gallons per minute (gpm). [1]

Geographic Information System (GIS) - a computer system designed to capture, store, manipulate, analyze, manage, and present geographical data.

Ground Water - Any water beneath the land surface.[1]

Ground Water Recharge or Aquifer Recharge - Can refer both to the natural process of ground water recharge (achieved by infiltration of precipitation or discharge from surface water), OR can refer to human efforts to enhance more groundwater storage. Artificial aquifer recharge (AR) is the enhancement of natural ground water supplies using man-made conveyances such as infiltration basins or injection wells. Aquifer storage and recovery

(ASR) is a specific type of AR practiced with the purpose of both augmenting ground water resources and recovering the water in the future for various uses.[1]

Hydrologic Regime - The relationship between precipitation inputs and streamflow outputs in a basin or watershed. The amount and timing of water moving through a watershed often characterized by the average annual hydrograph.

Hydrograph - A chart showing the relationship between flow rate and time at given point (gage) in a watershed flow network. Time is usually on the horizontal axis and flow rate is usually on the vertical access.

Instream Flow - Water left in a stream for non-consumptive uses such as aquatic habitat, recreation, navigation, or hydropower.

Interstate Compact - A legal agreement between two states that divides (or apportions) water crossing the states' boundaries.

Junior Appropriator/Junior Water Right - A general term referring to a water right or the owner of a water right with a priority date that is later in time than another water right.

Channel Migration - Natural movement of river channels through the processes of erosion and deposition.

Legal Water Availability - Typically determined based upon comparison of physical water availability to the legal demands on a source or reach of a source by subtracting the legal demands from physical water availability. [3]

METRIC (**M**apping **E**vapotranspiration at high **R**esolution and with **I**nternalized **C**alibration) is an image-processing tool for computing evapotranspiration (ET) using Landsat Thematic Mapper data.

Montana Code Annotated (MCA) - Laws of Montana classified by subject. Title 85 contains laws pertaining to water use.

Murphy Rights – Instream flow rights on 12 Blue Ribbon trout streams for the preservation of fish and wildlife. Named for the legislative author, Jim Murphy of Kalispell. Murphy Rights exist for specific reaches of the following rivers: Big Spring Creek, Blackfoot River, Flathead River, Middle Fork Flathead River, South Fork Flathead River, Gallatin River, West Gallatin River, Madison River, Missouri River, Rock Creek, Smith River, and Yellowstone River. The priority dates are 1970 and 1971 and only protect flows when senior water rights have been satisfied.

Natural Storage of Water - See storage of water, natural.

Non-Consumptive Use - Use of water that does not consume water.

Overstated Water Rights - Water rights in excess of what was perfected through beneficial use.

Permit - An authorization to use water, issued by DNRC, specifying conditions such as type, quantity, time, and location of use. [3]

Physical Water Availability - the amount of water physically available at a specific point on a source typically measured in flow rate and volume. [3]

Priority Date - The clock time, day, month, and year assigned to a water right application or notice upon DNRC acceptance of the application or notice. The priority date determines the ranking among water rights. [1]

Federal Reserved Water Right - A special water right accompanying federal lands or Indian reservations, holding a priority date originating with the creation of the land.

Resource Indemnity Trust - Article IX of the Montana Constitution provides for the protection and improvement of the Montana environment and requires the existence of a resource indemnity trust (RIT) fund for that purpose, to be funded by taxes on the extraction of natural resources.

Return flow - Part of a diverted flow that is applied to irrigated land or other beneficial use and is not consumed and returns underground to its original source or another source of water. Other water users may be entitled to this water as part of their water right. [1]

Riparian - Riparian means related to or situated on the banks of a river. A ***riparian*** zone or ***riparian*** area is the interface between land and a river or stream.

Riverine Processes - The processes of erosion, transport and deposition of sediment that shape a river's channel(s) and floodplain.

Senior Appropriator/Senior Water Right - A general term referring to a water right or the owner of a water right with a priority date that is earlier in time than another water right.[1]

Storage of Water, Artificial or Constructed - Storing water in reservoirs or other human made impoundments.

Storage of Water, **Natural** - Storage of water in natural landscape features such as groundwater aquifers, ponds (including beaver ponds, floodplain ponds), wetlands and swales.

Stream Depletion Zone - An area where hydrogeologic modeling concludes that as a result of a ground water withdrawal, the surface water would be depleted by a rate equal to a rate of at least 30% of the ground water withdrawn within 30 days after the first day a well or developed spring is pumped at a rate of 35 gallons a minute. [1]

Stream Gage - A stream gage measures the flow of water at a point along a stream. The U.S. Geological Survey defines a stream gage as, "an active, continuously functioning measuring device in the field for which a mean daily streamflow is computed or estimated and quality assured for at least 355 days of a water year or a complete set of unit values are computed or estimated and quality assured for at least 355 days of a water year".

Sub-basin - A structural topographic feature where a basin forms within a larger basin. For example, the Bitterroot River basin is sometimes referred to as a sub-basin of the Clark Fork River basin.

Surface water - All water of the state at the surface of the ground, including but not limited to any river, stream, creek, ravine, coulee, undeveloped spring, lake, and other natural surface source of water regardless of its character or manner of occurrence.[1]

Telemetered (real-time) Stream Gage - A telemetered gage has the capability to transmit water elevation and streamflow data to a central location where it may be viewed (for example, via the Internet) as the data is collected.

Waste - Unreasonable loss of water through the design or negligent operation of an appropriation or water distribution facility or the application of water to anything but a beneficial use. [1]

Water Bank - An institutional mechanism used to facilitate the legal transfer and market exchange of various types of surface water, groundwater, and storage entitlements. Water banks use the market to make water available for new uses.

Waterway and Water Body - Usually refers to surface water features like rivers, streams, lakes, or ponds.

Waterway Health - Waterways are considered to be healthy when surface & groundwater flows & levels are of a timing and duration that provides habitat capable of supporting self-sustaining populations of native fish species and water dependent wildlife. In addition, waterway health refers to flows that help meet water quality standards, support beneficial uses, and support stream renewal functions.

Water Commissioner - Local water users can petition for a water commissioner after the water rights in a basin have been verified by the Montana Water Court. The commissioner ensures that daily water allocations in the basin occur in accordance with the users' rights. The local district court appoints the commissioner, and oversees his or her work. [5]

Water Court - Located in Bozeman, the Montana Water Court's primary function is to carry out the state-wide adjudication. Disputes between water right holders are still handled in local district court, and the local district courts oversee water commissioners in their area.

Water Lease - An agreement with a water user to allow a person or organization, for a fee, to lease water from the user. Water leases are often used in Montana to maintain instream flow.[6]

Water Quality - Chemical, physical, and biological characteristics of water that determine its suitability for a particular use.

Water Right Change - A change in the place of diversion, the place of use, the purpose of use, or the place of storage of a water right. These changes need the approval of DNRC to assure that the change will cause no adverse effect to other water users. [3]

Watershed - All the land that drains to a river or lake, with boundaries defined by topography (and includes wetlands, floodplains, riparian areas and uplands). For the purpose of this planning document, the term "watershed" is referring to a subunit of a sub-basin (smaller area).

Watershed Health - A watershed is considered healthy if it can continue to perform without depletion or degradation of watershed services such as: water collection, storage & delivery, flood and drought moderation; water purification, wildlife habitat and support of waterway health (see Waterway Health).

Water Reservation: A water right created under state law after July 1, 1973, that reserves water for existing or future beneficial uses or that maintains a minimum flow, level, or quality of water throughout the year or at periods or for defined lengths of time. [7]

1 See §85-2-102, Mont. Code Ann., and Rule 36.12.101, Admin. Rules Mont.
2 See Title 85, Chapter 2, Part 2, Mont. Code Ann.
3 See §85-2-311, and 402, Mont. Code Ann., and Title 36, Chapter 12, Subchapters 17 through 19. Admin. Rules Mont.
4 See §85-2-306, Mont. Code Ann.
5 See Title 85, Chapter 5, Mont. Code Ann.
6 See Title 85, Chapter 2, Part 4, Mont. Code Ann.
7 See §85-2-316, Mont. Code Ann.

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