RECLAMATION
Managing Water in the West

Henrys Fork Basin Special Study

Interim Report

U.S. Department of the Interior
Bureau of Reclamation
Pacific Northwest Region
Boise, Idaho

July 2013

Mission of the Department of the Interior

Protecting American's Great Outdoors and Powering Our Future

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

Mission of the Bureau of Reclamation

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Front photograph: Fly fishing, irrigated agriculture, and wildlife habitat are important activities in the Henrys Fork River basin.

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EXECUTIVE SUMMARY

The Bureau of Reclamation and the State of Idaho (State), through the Idaho Water Resource Board (IWRB), in collaboration with a stakeholder working group, is conducting a Basin Study on water resources in the Henrys Fork River basin to develop alternatives to improve water supply conditions in the basin, in the Eastern Snake Plain aquifer (ESPA), and in the Upper Snake River basin in accordance with the ESPA Comprehensive Aquifer Management Plan (CAMP). This interim report describes the Basin Study processes used to develop alternatives, summarizes the results of reconnaissance-level studies, and documents the selection of alternatives which will be carried forward for appraisal level analysis. A final report is scheduled for October 2013.

The Basin Study will identify opportunities for developing water supplies (i.e., above-ground storage, aquifer storage) and improving water management (i.e., conservation measures, optimization of resources) while sustaining environmental quality. Alternatives developed to meet the objectives of the study will assist future planning efforts and provide specialized information that can be used for future decision-making processes at the Federal, State, and local levels.

A full range of potential water management alternatives has been identified in the Basin Study, including 28 alternatives for potential surface storage sites; 5 alternatives related to managed groundwater recharge; 3 alternatives related to water marketing; 10 alternatives related to conservation, water management, and demand reductions; and 5 combined alternatives. Through a rigorous screening process, the alternatives carried forward to the reconnaissance-level study include 7 surface water storage alternatives, 5 managed groundwater recharge alternatives, 1 water market alternative, and 5 conservation, water management, and demand reduction alternatives. From these 18 reconnaissance-level alternatives, 10 were chosen to move forward to the appraisal study level.

The appendices to this report include the water needs assessment and the Technical Series reports that describe each reconnaissance-level alternative in detail, along with the analyses that were conducted during the reconnaissance-level studies:

- Appendix A – Water Needs Assessment
    - Basin Study Water Needs Assessment, Technical Series No. PN-HFS-001
- Appendix B – Surface Storage Alternatives
    - New Surface Storage Alternatives, Technical Series No. PN-HFS-002

- Dam Raise Alternatives, Technical Series No. PN-HFS-003
- Teton Dam Storage Alternative, Technical Series No. PN-HFS-005

- Appendix C – Managed Groundwater Recharge Alternatives
  - Managed Recharge Alternatives, Technical Series No. PN-HFS-004
- Appendix D – Water Markets
  - Preliminary Water Market Analysis – Technical Series No. PN-HFS-008
- Appendix E – Conservation, Water Management, and Demand Reduction Alternatives
  - Conservation Alternatives, Technical Series No. PN-HFS-006
  - Municipal Water Conservation Measures and New Non-Potable Water Supply Options, Technical Series No. PN-HFS-007

1.0 INTRODUCTION

The Henrys Fork of the Snake River (Henrys Fork River) basin in eastern Idaho is experiencing population growth, urban development, irrigation needs, changes in climate, and drought conditions which are depleting water resources. The Henrys Fork watershed provides irrigation for over 280,000 acres and sustains a world class-trout fishery. Located in the upper reaches of the Snake River, the Henrys Fork River basin also contributes approximately one-third of the Snake River's flow in eastern Idaho and supplies groundwater recharge to regional aquifers and the Eastern Snake Plain Aquifer (ESPA), all of which are tapped for municipal, industrial, and irrigation water. The upper Snake River region, which includes the Henrys Fork River basin, produces approximately 21 percent of all goods and services in the State of Idaho, resulting in an estimated value of $10 billion annually (IDWR 2009). Water is the critical element for this productivity.

The State of Idaho (State), through the Idaho Water Resource Board (IWRB), requested assistance from the Bureau of Reclamation (Reclamation) under the WaterSMART Basin Program to study the water supply in the Henrys Fork River of the Snake River and analyze alternatives to help resolve in-basin and out-of-basin water supply issues to meet the needs of the State and region. This study included a comprehensive assessment of the water resources and hydrology of the Henrys Fork and their impacts to the ESPA. Reclamation, in cooperation with the IWRB, developed this Interim Report for the Henrys Fork Basin Study (Basin Study) which is jointly funded by Reclamation's WaterSMART Program and the IWRB. This Interim Report summarizes the activities of the Basin Study and the reconnaissance-level analyses of the alternatives developed in collaboration with a stakeholders working group to address the water issues in the Henrys Fork River basin. This Interim Report also documents the alternatives to be carried forward to the appraisal study level and outlines the next step in the Basin Study.

The members of the stakeholders working group (Workgroup) are from the Henrys Fork Watershed Council (Watershed Council), an organization made up of State and Federal agencies, irrigation districts, conservation organizations, universities, and the farming community which is co-facilitated by the Fremont Irrigation District (FMID) and the Henrys Fork Foundation. The Workgroup collaborated with Reclamation and the IWRB to develop a set of alternatives that would potentially improve the water supply reliability for instream flows, irrigation water, municipal/industrial water supplies, power generation, groundwater recharge, and fish habitat in the Henrys Fork basin and the Eastern Snake River Plain.

1.1 Purpose

The Basin Study Program is part of the Department of the Interior's WaterSMART Program which addresses 21st century water supply challenges such as population growth, increased competition for finite water supplies, and climate change. Under the WaterSMART Program, Reclamation partners with basin stakeholders to conduct comprehensive studies to define options for meeting future water demands in river basins where imbalances in supply and demand exist or are projected.

The purpose of this Basin Study was to conduct analyses of the water supplies and needs of the Henrys Fork watershed and identify alternatives to assist future planning efforts and provide specialized information that can used in decision-making processes at the Federal, State, and local levels. Reclamation and IDWR collaborated with the Workgroup in formulating possible strategies that address supply and management challenges in the future and improve water supply reliability; analyze the alternatives; and present them back to the State with feedback from the Workgroup.

1.2 Objectives

The water management issues addressed by this Study are complex and involve multiple water uses. As set forth in the Henrys Fork Basin Study Framework, the objectives of the Study are to identify alternatives for developing the water supply, improving water management, and sustaining environmental quality. All of the alternatives should manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. As a result of this study, the alternatives put forward by the Workgroup identified additional water supplies and improvements of water management through surface storage, managed recharge, water marketing, conservation, and demand reductions (see Sections 2.0 and 3.0).

1.3 Authorities

1.3.1 Federal Authorities

Reclamation is authorized to conduct this Study under the Reclamation Act of 1902 (P.L. 57-161, 32 Stat. 388, June 17, 1902). The Act, as amended and supplemented, authorizes Reclamation to manage and develop innovative water management tools and partnerships to meet the growing demand for water in the American West. Reclamation's water resource planning process involves three levels of planning, starting with a preliminary reconnaissance-level assessment. The assessment helps determine the Federal role(s) and the desirability of potential partners to proceed to the subsequent appraisal and feasibility analyses. In its role of conducting water management and related activities, Reclamation is assessing risks to the water resources of the western United States and developing strategies to mitigate risks to help ensure that the long-term water resources management of the United States is sustainable.

Under the Omnibus Public Land Management Act of 2009, Subtitle F – SECURE Water (Public Law 111-11, March 30, 2009), Reclamation is authorized to continually evaluate and report on the risks and impacts on water supplies under changing climate conditions. In conjunction with stakeholders, Reclamation is to identify appropriate mitigation strategies utilizing the best available science to ensure that long-term water resources management is sustainable.

1.3.2 State Authorities

State Senate Bill 1511

In 2008, the State House Joint Memorial No. 8 directed the IWRB to investigate potential new surface water projects across the state. State Senate Bill 1511, passed by the 2008 Idaho State Legislature, appropriated $1.4 million to the Water Resource Board to determine the feasibility of enlarging Minidoka Dam and $400,000 to study replacing Teton Dam. The State Legislature recognized the need for additional water supplies and found that it was in the best interests of the State's citizens to invest in short- and long-term water projects that provide a balance between water use and water supply of Idaho's aquifers.

1.4 Legislation Affecting Projects

1.4.1 Federal Legislation

Clean Water Act (33 U.S.C. §1251 et seq.)

The Clean Water Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. It is the cornerstone of surface water quality protection in the United States. Although the Act does not deal directly with groundwater or with water quantity issues, it provides the regulatory and nonregulatory tools to achieve the broader goal of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters and to protect fish, shellfish, wildlife, and recreation in and on the water.

Endangered Species Act (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq.)

The Endangered Species Act (ESA) provides a program for the conservation of threatened and endangered plants and animals and their habitats. The law requires Federal agencies, in consultation with the U.S. Fish and Wildlife Service (USFWS) and/or the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries Service) to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any ESA-listed species or result in the destruction or adverse modification of its designated critical habitat. The law also prohibits any action that causes a "taking" of any listed species of endangered fish or wildlife.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) of 1969 established a policy and framework for encouraging environmental protection in the United States. The NEPA process is a set of activities to collect information, analyze, and document the potential environmental effects of the proposed project. NEPA is required when a proposed Federal action may have impacts on the human or natural environment. Federal actions include those that occur on Federal lands or require the use of Federal funding, permits, facilities, equipment, or employees.

Secure Water Act (Public Law 111-11)

Under the Omnibus Public Land Management Act of 2009 (also known as the Secure Water Act) that was passed into law in March 2009, Congress found that adequate and safe supplies of water are fundamental to the health, economy, security, and ecology of the United States. Congress also found that data, research, and development will help ensure future water supplies, but global climate change poses a significant challenge to the protection of these resources. Although the States bear the primary responsibility and authority for managing the water resources of the United States, the Federal Government should support State, regional, local, and Tribal governments in this endeavor. This study of water use is vital to the understanding of human impacts on water and ecological resources, and in assessing whether surface and groundwater supplies will be available to meet future needs.

1.4.2 State Legislation

Idaho Constitution Article XV

Article XV, section 3 of the Idaho Constitution provides for the appropriation and allocation of water. Section 3 provides that:

> The right to divert and appropriate the unappropriated waters of any natural stream to beneficial uses shall never be denied, except that the state may regulate and limit the use thereof for power purposes. Priority of appropriation shall give the better right as between those using the water; but when the waters of any natural stream are not sufficient for the service of all those desiring the use of the same, those using the water for domestic purposes shall (subject to such limitations as may be prescribed by law) have the preference over those claiming for any other purpose; and those using the water for agricultural purposes shall have preference over those using the same for manufacturing purposes. And in any organized mining district those using the water for mining purposes or milling purposes connected with mining have preference over those using the same for manufacturing or agriculture purposes. But the usage by such subsequent appropriators shall be subject to such provisions of law regulating the taking of private property for public and private use, as referred to in section 14 of article I of this Constitution.

Idaho Statutes (Title 42, Idaho Code)

Title 42, Idaho Code Irrigation and Drainage – Water Rights and Reclamation: The Idaho Department of Water Resources (IDWR) regulates the appropriation and regulation of water, including most of the water quantity related issues in the State of Idaho. IDWR's authority to regulate the water resource is established in Title 42, Idaho Code which includes statutes addressing the administration of ground and surface water, stream channel alternation, injection wells, safety of dams, geothermal resources, ground water recharge as well as other statutes regulating the state's water.

In addition to IDWR, a number of other state agencies regulate different activities related to Idaho's water resources including but not limited to Title 22, Idaho Code Agriculture and Horticulture, Title 36, Idaho Code Fish and Game, Title 39, Idaho Code Health and Safety, Title 43, Idaho Code Irrigation Districts, and Title 47, Idaho Code Mines and Mining.

Idaho Comprehensive State Water Plan

The Comprehensive State Water Plan (Plan) is authorized under Idaho Code Section 42-1734A and represents the state's position on water development, management, conservation, and optimum use of all unappropriated water resources and waterways. It is developed and adopted by the IWRB and approved by the Idaho Legislature. The wise use and management of the state's water is critical to the state's economy and to the welfare of its citizens. The Plan seeks to ensure that through cooperation, conservation, and good management, future conflicts will be minimized and the optimum use of the state's water resources will benefit the citizens of Idaho. The authority of the Plan is recognized by all state agencies.

1.5 Stakeholder Involvement and Outreach

The State and Reclamation collaborated with the Watershed Council to form a Workgroup that would develop and provide input and feedback on a set of alternatives for developing new water supplies and improving water supply reliability for instream flows, irrigation water, municipal/industrial water supplies, power generation, groundwater recharge, and fish habitat. In June 2010, the Watershed Council hosted the first session for the Henrys Fork Special Study and members of the Watershed Council and other interested stakeholders were recognized as the Workgroup for the Basin Study. For more than two years, Reclamation and representatives from the IWRB met with the Watershed Council, Workgroup members, and stakeholder groups collectively and individually to develop alternatives and discuss the analyses and selection processes.

In addition to the meetings, Reclamation established a website that included documents or links to documents relevant to the Basin Study. All meeting notes, handouts, and status reports were posted for public viewing. The draft versions of the Needs Assessment and the Technical Series reports were posted for public comment and notifications were sent out to the partners, Workgroup, and other stakeholders.

1.5.1 Other Outreach Efforts

Humboldt University

Dr. Rob Van Kirk from Humboldt State University, Department of Mathematics, developed a model to estimate a water budget for the watershed’s surface irrigation system. Funded by a grant from the U.S. Department of Agriculture, Cooperative State Research, Education and Extension Service, field research was conducted by graduate students supervised by Dr. Van Kirk and additional data were compiled from existing water resources and land use databases. Groundwater and surface water flows were modeled under historic, current, and future land and water use scenarios. Socioeconomic factors were identified that determine water use on formerly irrigated land that has been developed for housing and on irrigated land in proximity to development. The study resulted in a water budget and analysis of water supplies and use in the watershed. The modeling and study results on hydrology and water use were shared with decision makers and stakeholders so that they could develop strategies to increase water availability while enhancing ecological benefits in key stream reaches. The modeling and study results were also used by Reclamation in the Basin Study to evaluate potential water management alternatives.

1.6 Study Area

The Henrys Fork River basin includes most of Fremont, Madison, and Teton counties in eastern Idaho (Figure 1). The Basin Study area encompasses the Henrys Fork watershed, covering approximately 3,300 square miles bound by high desert areas of the Eastern Snake Plain on the west and on the north by the Continental Divide along the Centennial and Henry's Lake mountains. The Yellowstone Plateau and Teton Mountains form the eastern boundary and the southern boundary is marked by the Snake River. Elevations in the Basin Study area range from over 10,000 feet along the Continental Divide to approximately 4800 feet near Henrys Fork River's confluence with the Snake River.

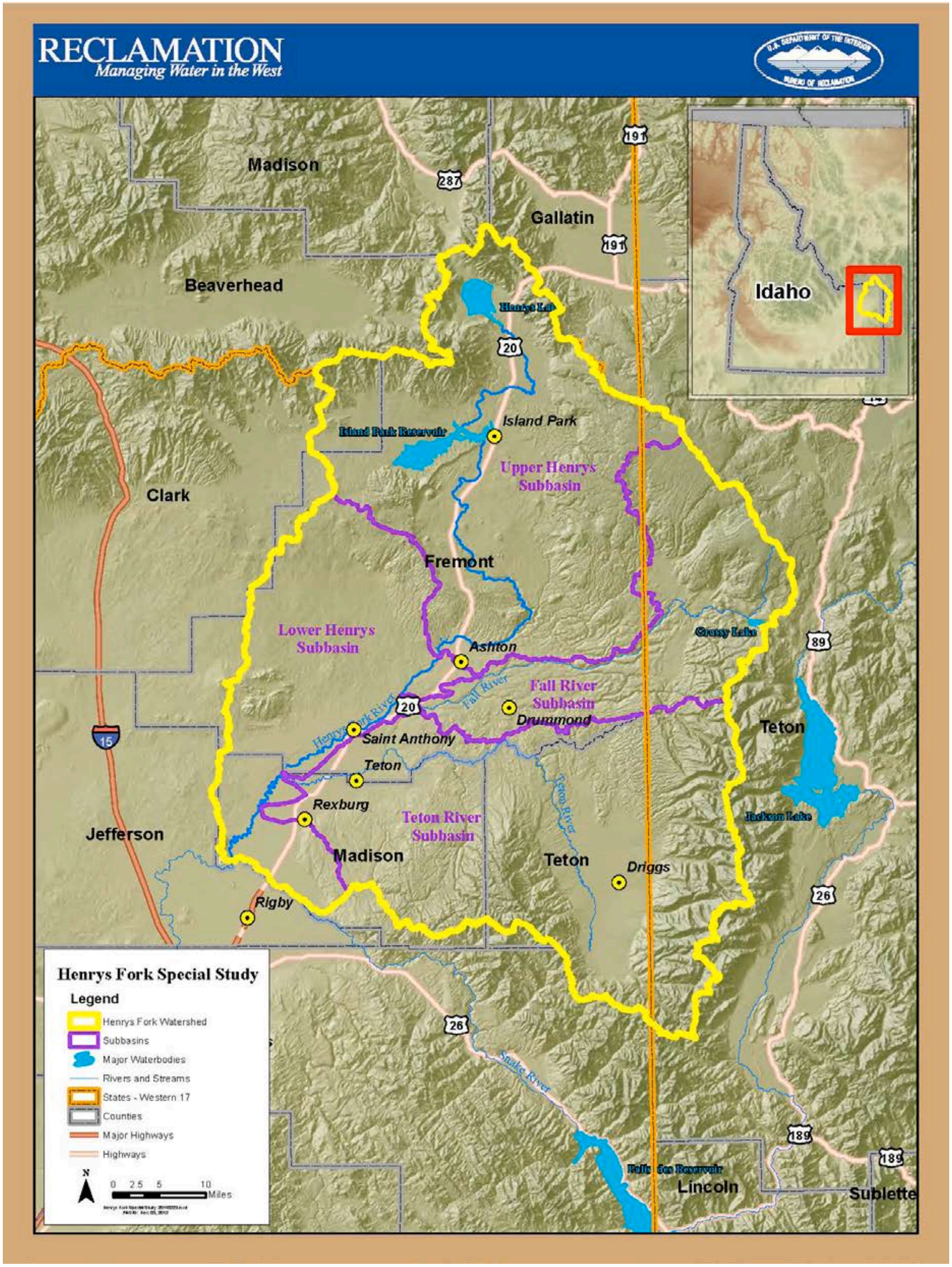

Figure 1. Map of Henrys Fork River basin and its subbasins, major tributaries, and reservoirs.

1.6.1 Geology

Geology in the Basin Study area was formed by volcanic cycles and flows that left the Island Park basin layered with primarily rhyolitic magma which fractured and allowed basaltic magma to erupt and flood the floor of the basin. The rhyolite formations are highly permeable, particularly in the upper 100 feet of the highly fractured zones. Rainfall and snowmelt appear to rapidly infiltrate the formation so that little runoff or evapotranspiration occurs. The alluvium fill that covers most of the basin is derived from the volcanic and sedimentary rocks from the adjacent highlands. In general, the alluvium fill is thickest in the area of Henrys Lake and thins as it goes south (IDWR 1978).

1.6.2 Climate

The climate in the Basin Study area varies with elevation and proximity to the mountain ranges on the north and east. The headwaters of the Henrys Fork River are located in one of the coldest areas of Idaho, with minimum annual average temperatures of 22°F in the winters to a maximum annual average of 52°F in the summers. Freezing spring temperatures usually last through the first of June and start again in late August to early September, giving an average of about 60 to 70 frost-free days. Further downstream away from the mountain ranges, the average temperatures around Rexburg range from an average annual maximum temperature of 57°F to an average annual minimum temperature of 30°F. Freezing spring temperatures usually end in May and start again in mid September to late October, giving an average of about 100 frost-free days (WRCC 2012).

Weather systems generally move across the Basin Study area traveling eastward from the Pacific Ocean. The orographic lifting of these systems as they pass over the Continental Divide causes an average of over 43 inches of precipitation in the headwaters of the Henrys Fork River above Island Park Dam. Average annual precipitation amounts decrease with distance from the mountains, with only about 14 inches falling at St. Anthony and Rexburg (WRCC 2012). Over 70 percent of the precipitation falls between November and May, mainly in the form of snow (Reclamation 1980).

1.7 Regional Setting

1.7.1 Population

The 2010 Census recorded 13,242 people in Fremont County, 37,536 people in Madison County, and 10,170 people in Teton County (Census 2012). The average county population of the Basin Study area has increased by about 34 percent since 2000, with Fremont County population increasing 7.4 percent, Madison County increasing 39.9 percent, and Teton County increasing 55.7 percent (Census 2011). The population is expected to continue to grow approximately 2 percent a year.

1.7.2 Land Use and Socioeconomic Conditions

Land use in the Henrys Fork River basin is comprised of forestland, rangeland, irrigated cropland, dryland agriculture, and other uses such as urban and housing development areas (IDWR 1992). The forest land and much of the rangeland are located mostly in the mountainous northern and eastern parts. Most of the forested lands are owned by the U.S. Forest Service or the National Park Service. The majority of the agricultural land is concentrated in the western, central, and southern areas of the basin, especially on both sides of the lower Henrys Fork River and the lower Teton River.

The primary crops grown in the Basin Study area are barley, wheat, potatoes, vegetables harvested for sale, and forage (Ag 2007). Irrigated agriculture and its related food processing are the main economic activities in the Henrys Fork River basin (IWRB 1992), with the FMID lands generating over $100 million annually in crop sales (Reclamation 2004).

Tourists come to the upper Henrys Fork River basin area to visit the nearby Yellowstone and Grand Teton National Parks and to participate in a variety of outdoor recreational activities on National Forest lands. The Henrys Fork River's reputation for world class fly fishing and the National Forest lands provide summer and winter outdoor recreational opportunities, drawing tourists from all over the world, and sustain the tourism/recreation businesses in the area. On the Henrys Fork River alone (Fremont and Madison Counties), angling contributed $29 million and 851 jobs to eastern Idaho's economy. Improved stream conditions could lead to higher catch rates and larger fish would result in larger benefits to the rural communities, up to $49 million annually (Loomis 2005).

1.7.3 Fish and Wildlife

The Henrys Fork River basin has three primary subbasins (Fall, Teton, and Henrys Fork) that support wild populations of native Yellowstone cutthroat trout and nonnative rainbow trout and brown trout. In the Teton River basin, the native Yellowstone cutthroat trout population decreased over the past 15 years while the nonnative rainbow trout population has increased (Van Kirk and Jenkins 2005); however, recent IDFG surveys suggest an increase in Yellowstone cutthroat trout populations (IDFG 2012). Rainbow trout have displaced cutthroat trout throughout most of the northern portion of the Henrys Fork watershed and the Fall River drainage.

The natural hydrology of the mainstem Henrys Fork River and Fall River is dominated by groundwater from the headwater springs on the Yellowstone Plateau. In the absence of large snowmelt freshets to scour their eggs and fry during late spring, there is essentially nothing in the physical or biotic environment to act negatively on rainbow trout. They have competitive advantages over cutthroat trout and will hybridize with them, eventually displacing native cutthroat trout population. In the Teton River watershed, the natural hydrology is driven by snowmelt, and the resulting spring freshet is large enough to limit rainbow trout spawning success. Hydrologic alteration of the rivers by the diversion of flows has also contributed to reduced numbers of Yellowstone cutthroat trout (Van Kirk and Jenkins 2005).

As part of the Greater Yellowstone Ecosystem, the Basin Study area provides habitat for a variety of large and small mammals and birds. Over 50 IDFG Species of Greatest Conservation Need are found throughout the watershed. Columbian sharp-tailed grouse are found throughout the watershed in suitable grassland steppe and agricultural habitats and are considered a species of concern by the U.S. Fish and Wildlife Service and a sensitive species by the U.S. Forest Service and Bureau of Land Management. Sage-grouse are found in isolated areas of the watershed and are a candidate species for Endangered Species Act listing by the U.S Fish and Wildlife Service. The northern goshawk has been seen in the Basin Study area and is considered a sensitive species by the U.S. Forest Service (Reclamation 2006). The canyons along the Teton River, Bitch Creek, Badger Creek, and Canyon Creek provide winter range and linkage corridors for big game animals, especially mule deer and elk.

1.8 Water Supply

1.8.1 Surface Water Supply

The Henrys Fork River is the largest tributary of the Snake River, which in turn, is the largest tributary to the Columbia River. For many years, surface flows in the basin have been extensively measured at numerous gaging stations along the Henrys Fork River and many of its tributaries. Water in the Henrys Fork River basin is stored in reservoirs at Henry’s Lake, Grassy Lake, and Island Park Reservoir for delivery to irrigated lands across the basin. Water storage and irrigation deliveries have altered river and stream hydrology in the Henrys Fork subbasin. This alteration is highest during low water years and greatest in the upper portion of the basin (Reclamation 2004).

Under natural, unregulated conditions, the total watershed discharge would be around 2.5 million acre-feet per year. The Fall River contributes about 700,000 acre-feet per year of that total, and the Teton River contributes a natural discharge of over 600,000 acre-feet per year. Currently, the regulated system of the Henrys Fork River basin discharges around 1.6 million acre-feet per year after diversion for in-basin water uses and the increased evapotranspiration of irrigation, storage, and canal conveyances. Much of the water lost to reservoir, stream, and conveyance system seepage and irrigation is recaptured as discharge to the aquifers (Reclamation 2012c in Appendix A).

1.8.2 Groundwater Supply

The Henrys Fork River basin contributes to the recharge of regional aquifers from precipitation, percolation from streambeds, and groundwater underflow from the neighboring highlands (Reclamation 1991). There are three main aquifers in the Basin Study area which influence the flows in the Henrys Fork watershed. The Yellowstone Plateau Aquifer, formed of rhyolite, covers hundreds of square miles and is recharged by snowmelt. It discharges hundreds of thousands of acre-feet annually to the headwaters of the Henrys Fork River. The Teton Valley Aquifer, which is comprised of alluvial fan and basin-fill deposits, covers 90 square miles, is recharged by stream channel, irrigation canal, and irrigation activity seepages (Bayrd 2006). The ESPA lies beneath the southwestern portion of the basin and is recharged in part by flows in the basin.

1.8.3 Existing Water System Regulation and Operation

In 1935, FMID was formed to unite the many irrigation and canal companies spread across Fremont, Madison, and Teton Counties in eastern Idaho. FMID provides a supplemental water supply to about 1,500 water users irrigating over 285,000 acres associated with the original Upper Snake River Storage Division of the Minidoka Project and the Lower Teton Division of the Teton Project (Reclamation 2004). Irrigated acreage and irrigation methods have changed through the years, increasing the efficiency of water use. FMID estimates that over 70 percent of the acreage is sprinkler irrigated; the remaining lands are flood or subirrigated.

1.9 Water Needs Assessment

The Basin Study Program requires an assessment of the projected water supply and demand, including the risks to water supplies related to climate changes. To meet this program objective, a water needs assessment was conducted by Reclamation as part of the Study and is attached to this document as Appendix A. The findings of the assessment are summarized in Sections 1.9.1 through 1.9.4.

1.9.1 Surface Water Irrigation Needs

The Henrys Fork River basin is divided into four major irrigated regions that have varying degrees of needs (Figure 2):

- Egin Bench – has a surplus in average water years; a balance in a drought year following a drought year.
- Lower Watershed – adequate supply in average water year; deficit in a drought year following a drought year.
- North Fremont – always significant deficit. The region currently uses several strategies in dealing with the deficit.
- Teton Valley – always significant deficit. The region currently uses several strategies in dealing with the deficit.

The greatest shortage is evident in a drought year that follows a drought year when all of the irrigated regions have a deficit of water except for the Egin Bench which may have a balance in their water needs. Additional surface water could also be used to support conversion projects (conversion from ground water to surface water) and recharge in the ESPA.

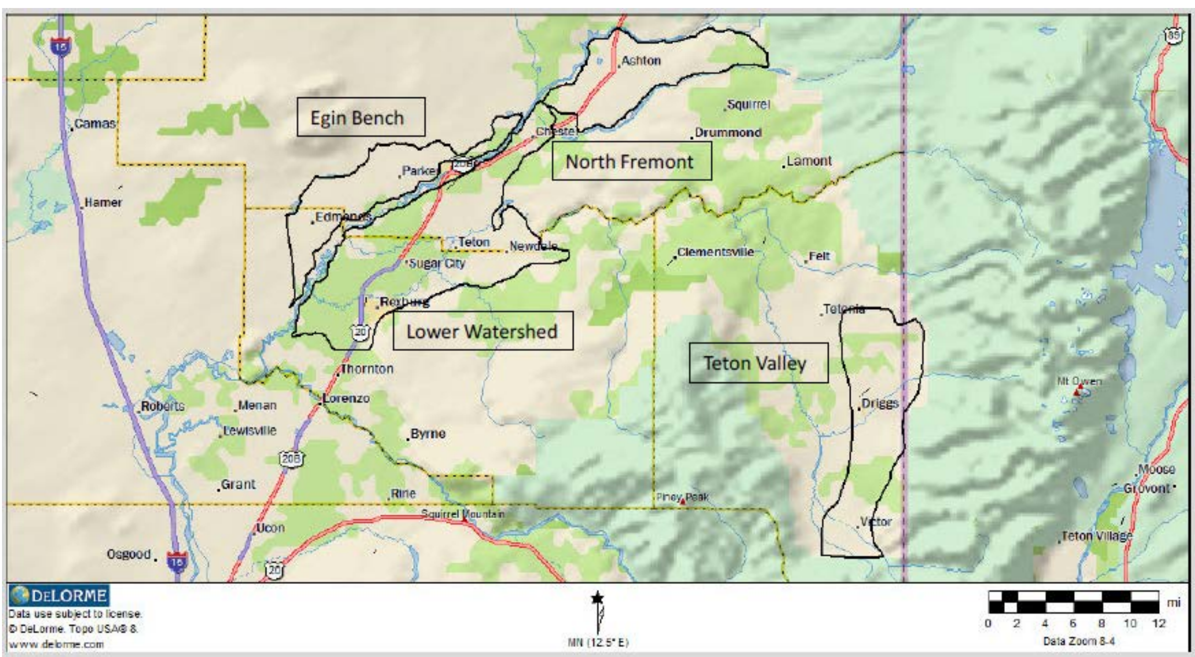

Figure 2. Major irrigated regions in the Henrys Fork watershed.

1.9.2 Groundwater Needs

Groundwater pumping may impact the Henrys Fork River depending on the rate of pumping, proximity to the river, water storage in Island Park Reservoir, and amount of seepage recharge (Reclamation 2004). With the installation of more efficient irrigation systems across the Basin Study area, recharge to the aquifer from irrigation has decreased which in turn has decreased groundwater inflows to the rivers which, over time, could impact wildlife and fisheries and their habitats (Van Kirk 2011). Changes in groundwater recharge could also potentially affect agricultural, municipal, and industrial water needs and limit future economic growth in the Basin Study area.

The changes in groundwater recharge could also impact out-of-basin needs, especially the ESPA. The State's ESPA Comprehensive Aquifer Management Plan (CAMP) outlined a long-term objective of incrementally achieving a net ESPA water budget change of 600,000 acre-feet annually. The budget change recommended by the ESPA CAMP could be achieved through implementation of a mix of management actions including, but not limited to, aquifer recharge, ground-to-surface water conversions, and demand reduction strategies (IWRB 2009).

1.9.3 Municipal/Industrial Water Needs

According to USGS (2011), each person uses 80 to 100 gallons of water per day for normal household activities. Assuming about a 2 percent annual population growth, the population and subsequent municipal and household demands would double over the next 40 years. While municipal and industrial needs are very important to the Henrys Fork Basin economy, they represent less than 4 percent of the overall Henrys Fork Basin water budget.

According to IDWR, the primary source for drinking water statewide is groundwater (IDWR 2013). Development of new groundwater rights to accommodate additional demand is difficult at this time. The Henrys Fork River basin is tributary to the Snake River above Milner which is within the "non-Trust Water Area" as designated by the IDWR. Because all of the reaches of the Snake River upstream from Milner Dam have water rights that are not fully satisfied at certain times, a new appropriation of groundwater within the non-Trust Water Area would almost certainly injure senior right holders at some point each year. New water right applications must demonstrate to the State that the proposed new diversion and consumptive use of water will not injure other rights or that mitigation can be done during times that injury would occur. These criteria may limit new water supplies in the future for municipalities and industries.

1.9.4 Wildlife

The minimum streamflow is defined as the amount of flow necessary to preserve desired stream values such as fish and wildlife habitat, aquatic life, recreation, water quality, and aesthetic beauty. Various recommended minimum flow amounts to preserve stream values have been planned by the Idaho Department of Fish and Game (IDFG 1999 and IDFG 1978), the Snake River Resources Review panel (SR3 2001), and other entities.

Fisheries in the Henrys Fork River basin may suffer from drawdowns of Island Park Reservoir which eliminates habitat and benthic invertebrate production in the reservoir. Winter flow releases from Island Park Dam are the primary factor controlling trout abundance in the Henrys Fork River. Under the Henrys Fork River Drought Management Plan, Reclamation cooperates with the Idaho Department of Fish and Game and FMID to minimize these impacts and meet trout fishery needs while still considering irrigation needs.

1.10 Potential Climate Change Impacts

The impacts of future climate change in the Henrys Fork subbasin are uncertain. Ongoing research indicates that the Henrys Fork River basin may experience warmer air temperatures and varied precipitation amounts. There may be a shift in the timing of peak flows to earlier in the year and a decrease of summer flows during the warmer months. The predicted warmer air temperatures could extend the irrigation season to later in the year than is currently experienced.

Climate change inflows were generated by Reclamation and used in existing reservoir models in the Upper Snake River above Brownlee Reservoir. A number of metrics were reported including storage changes at reservoirs throughout the upper Snake River. The timing of peak inflows generally shifted to earlier in the year (this was a monthly model so shorter timing shifts were not reportable) and flow volumes increased above historical flows in the cool season (October or November through April) and decreased below historical flows in the summer and fall seasons (May through September or October). This shift in peak flow timing and increased cool season inflow occurs when reservoirs are full or near full and may increase the chance of passing of floodwaters downstream. The lower flows that are projected in the future summer months may result in less water in channel to fulfill natural flow water rights, subsequent increased use of stored water to those that hold contracted storage space, and potentially impact reservoir carryover during particularly long-term drier periods. Warmer temperatures during the growing season, along with an extended growing season, would also increase demand for all uses (Reclamation 2011).

2.0 FORMULATION OF RECONNAISSANCE ALTERNATIVES

In October 2010, Reclamation and IDWR met with the Henry's Fork Watershed Council to communicate the issues, opportunities, and constraints that should be considered in formulating alternatives. The process involved three steps:

1. Identifying the full range of potential alternatives for augmenting water storage and for optimizing and conserving water supply in the Henrys Fork River basin. In the case of storage, alternatives to meet both in-basin and regional/state needs were identified. For water supply optimization and conservation, the focus was on in-basin needs.
2. Conducting initial opportunities and constraints assessment of all storage, supply optimization, and conservation alternatives to identify potential "fatal flaws" that may make some alternatives infeasible.
3. Selecting a short list of the most promising alternatives for reconnaissance-level studies.

Reclamation, IDWR, and the Workgroup collaborated throughout this process. All of the suggested alternatives were placed in a matrix to facilitate ranking the issues, opportunities, and constraints involved with each one.

2.1 Identification of Potential Alternatives

The full range of potential options to provide additional water storage and to optimize and conserve water resources in the Henrys Fork Basin was identified through a review of existing sources[1] and through discussions with the Workgroup. Primary emphasis was placed on providing and managing water supplies to meet the local and regional/state needs. The full list of potential water storage, optimization, and conservation options identified through this process is provided in Sections 2.1.1 through 2.1.5.

2.1.1 Surface Storage Sites

Twenty-eight potential surface storage reservoir sites with capacities ranging from 10,000 to 210,000 acre-feet were identified by reviewing existing sources or through consultation with the Workgroup. These alternatives are listed and described in Table 1 with the estimated capacities, location, impounded drainages, and water sources for off-stream locations.

[1] Many of these published sources may be found at http://www.usbr.gov/pn/programs/studies/idaho/henrysfork/reference/index.html.

Table 1. Potential surface storage sites in Henrys Fork River basin.

Alt #	Name	Estimated Storage Potential (AF)[a]	On-stream	Off-stream[b]	Existing	Impounded Drainage(s)	Off-stream Water Source(s)[c]
1	Ashton Dam Enlargement	29,000-40,000	✓		✓	Henrys Fork River	
2	Bitch Creek	142,000-210,000		✓		Bitch Creek	Teton River, Falls River, Conant Creek
3	Blackfoot Dam				✓		
4	Boone Creek	80,000-83,000		✓		Boone Creek	Falls River
5	Conant Creek	20,000-40,100		✓		Conant Creek	Bitch, Squirrel & Boone Creeks and Falls River
6	Driggs	50,000	✓			Teton River	
7	Felt Dam	14,500-35,000			✓	Teton River	
8	Generic Reservoir in Flat Land	NA		✓			
9	Grassy Lake	NA			✓		
10	Harrops Bridge/Tetonia	590,000	✓			Teton River	
11	Horseshoe Creek	60,000		✓[d]		Horseshoe Creek[d]	Teton River[d]
12	Howell Ranch	30,000-32,000		✓		Rock Creek, Porcupine Creek	Falls River, Robinson Creek
13	Island Park Enlargement	8000	✓		✓		
14	JY Ranch	49,000-80,000		✓		Rock Creek, Shaefer Creek	Falls River, Porcupine Creek, Robinson Creek

Alt #	Name	Estimated Storage Potential (AF)[a]	On-stream	Off-stream[b]	Existing	Impounded Drainage(s)	Off-stream Water Source(s)[c]
15	Lane Lake	69,000-70,000		✓		dry basin north of Teton River	Bitch Creek, Conant Creek, Fall River, Teton Creek
16	Lower Badger Creek	70,000-73,000		✓		Badger Creek	Teton River, Bitch Creek
17	Marysville Headworks	38,000-56,000	✓			Falls River	
18	Moody Creek (Webster Dam)	46,000-50,000		✓		Moody Creek	Teton River, Canyon Creek
19	Moose Creek	60,000		✓		Moose Creek	Henrys Fork Snake River
20	Park Lake	37,000-40,000		✓		Upper Rock Creek	Falls River, Belcher River
21	Robinson Creek	70,000		✓		Robinson Creek, Bear Creek	Falls River, Fish Creek
22	Spring Creek (Canyon Creek)	30,000-32,000		✓		Spring Creek (tributary to Canyon Creek)	Bitch Creek, Canyon Creek, Teton River
23	Squirrel Creek	126,000-130,000		✓		Squirrel Creek	Conant Creek, Boone Creek, Falls River
24	Squirrel Meadows (Wyoming)	10,000		✓		tributary to Squirrel Creek	Boone Creek
25	Teton (rebuild or new site)	200,000 (active)	✓			Teton River	
26	Teton Creek (Alta Project)	3,424		✓		Teton Creek	
27	Upper Badger Creek	49,000-50,000		✓		Badger Creek	Teton River
28	Warm River	75,000 (active)	✓			Henrys Fork Snake River, Warm River, Robinson Creek	

[a] Literature Sources:

[1] A Preliminary Appraisal of Offstream Reservoir Sites for Meeting Water Storage Requirements (IWRRI 1981)

[2] Comprehensive State Water Plan - Henrys Fork Basin (IWRB 1992)

[3] Snake River Basin Storage Appraisal Study (Reclamation 1994)

[4] Upper Snake River Basin, Wyoming-Idaho-Utah-Nevada-Oregon, Volume I Summary Report (Reclamation 1961)

[5] Hydropower Resource Assessment at Existing Reclamation Facilities (Reclamation 2011)

[b] Primary water source is off-stream

[c] Off-stream water sources, and associated pumping/conveyance facilities, were identified in existing literature sources. Offstream water sources may be refined during subsequent analysis.

[d] No published information available, however, estimates/assumptions have been made based on best professional judgment and/or Workgroup member estimates.

2.1.2 Groundwater Storage (Managed Recharge)

Managed recharge is defined as the artificial placement of water into the groundwater from a source other than precipitation infiltration. Incidental recharge of an aquifer may result from normal water deliveries for irrigation (i.e., canal losses), river flows, or other water uses. Recharge from canal seepage is discussed in Section 2.1.4.

Table 2 lists the five alternatives for expanding groundwater/aquifer recharge programs which were identified by the Workgroup. These alternatives focused on Egin Lakes (existing and potential expansion), Egin Bench (FMID Recharge Program), other FMID recharge initiatives, and the Teton Valley Recharge Program.

Table 2. Managed groundwater recharge sites in the Henrys Fork River basin.

Alt #	Name	Description
29	Egin Lake enlargement	5,000 acre-feet (fall); Egin Lakes is a dedicated, constructed recharge site and is part of FMID and participates in the IWRB's Managed Aquifer Recharge Program.
30	FMID Recharge Program (Egin Bench)	18,000-30,000 acre-feet (spring); Egin Bench would include five different canal companies who currently participate in recharge efforts under FMID's contract in the IWRB's Managed Aquifer Recharge Program.
31	FMID Recharge Program (all other FMID)	13,000-19,000 acre-feet (spring); multiple canal companies within FMID would participate in the IWRB's Managed Aquifer Recharge Program under a contract between FMID and the IWRB.
32	Teton Valley Recharge Program	Capacity not identified; individual recharge sites would be encouraged to participate in the IWRB's Managed Aquifer Recharge Program.
33	Evaluation of the benefits of expanding Egin Lake groundwater recharge	Analysis included assessing (1) whether or not managed recharge at this location contributes to meeting in-basin and/or out-of-basin water supply needs, and (2) potential benefits of expanding recharge at this site.

2.1.3 Water Markets

Program alternatives related to water markets included using and/or expanding the existing State banking program and developing a credit system (Table 3). Further study of the relationship between the economic value of water and the viable incentive thresholds to drive water markets was also suggested.

Table 3. Candidate water market programs in the Henrys Fork River basin.

Alt #	Name	Description
34	Credit system	The approach and system details would be defined
35	Utilize and/or expand existing banking program	The State Water Supply Bank (IWRB's Bank and Water District 1 Rental Pool) are active programs administered by the State.
36	Economic valuation of water	While not strictly a water supply alternative, this perspective assesses the economic value of water to determine thresholds for incentives to drive water markets and other water management strategies.

2.1.4 Conservation, Water Management, and Demand Reduction

Suggested alternatives for conservation, water management, and demand reduction included improving the efficiency of the Henrys Fork River basin water budget through changes in water diversions for the four irrigated regions (Table 4). Six other strategies were suggested for study to assess using existing resources more efficiently in both location-specific and program/system-wide areas.

Table 4. Conservation, water management and demand reduction options in the Henrys Fork River basin.

Alt #	Name	Description
37	Teton Valley water conservation, water management, and demand reduction	Evaluate impacts to the basin water budget through simulated changes in water diversions (i.e., delivery system conservation measures, groundwater recharge, and demand reductions)
38	North Fremont water conservation, water management, and demand reduction	Evaluate impacts to the basin water budget through simulated changes in water diversions (i.e., delivery system conservation measures, groundwater recharge, and demand reductions)
39	Lower Bench water conservation, water management, and demand reduction	Evaluate impacts to the basin water budget through simulated changes in water diversions (i.e., delivery system conservation measures, groundwater recharge, and demand reductions)
40	Egin Bench water conservation, water management, and demand reduction	Evaluate impacts to the basin water budget through simulated changes in water diversions (i.e., delivery system conservation measures, groundwater recharge, and demand reductions)
41	Increase capacity of Cross Cut Canal	Increase capacity of the canal by 200 cfs to meet the current needs in the Lower Teton

Alt #	Name	Description
42	General demand reduction alternatives	Utilize programs offered by IWRB through Natural Resource Conservation Service's Agriculture Water Enhancement Program (AWEP) and encouraged through the ESPA CAMP process
43	Weather modification	A pilot program in the Upper Snake River currently in operation through the ESPA CAMP process
44	Consolidation	As an example, the Lemhi Irrigation District
45	Domestic, commercial, municipal, and industrial (DCM&I) supply and conservation	Evaluate the limiting factors for adequate DCM&I supply to help municipalities characterize potential conservation practices and use of programs such as Reclamation's Rural Water Program
46	FMID system optimization	Conduct a system optimization assessment that would provide a broad, system-wide look at potential measures to improve efficiency of the water delivery system

2.1.5 Combination Alternatives

Storage alternatives in the Henrys Fork River or Fall River drainages were considered in combination with expanding the Cross Cut Canal. Expanding the Cross Cut Canal, which currently is at full capacity, would allow additional water stored in the Henrys Fork River or Fall River drainages to be transferred to the Teton River, helping to meet needs in the Lower Teton irrigated region. Table 5 lists these combination alternatives.

Table 5. Combination alternatives.

Alt #	Description
47	Island Park Enlargement (existing surface storage), enlarge Cross Cut Canal
48	Ashton Dam Enlargement (existing surface storage), enlarge Cross Cut Canal
49	Moose Creek (on-stream surface storage in upper Henrys Fork basin), enlarge Cross Cut Canal
50	JY Ranch (on-stream surface storage in upper Henrys Fork River basin), enlarge Cross Cut Canal
51	Robinson Creek (on-stream surface storage in upper Henrys Fork River basin), enlarge Cross Cut Canal

2.2 Preliminary Screening – Opportunities and Constraints Assessment

The preliminary screening of all alternatives was based on the evaluation categories and factors listed in Table 6 and each alternative was assigned a score for each evaluation factor according to the following hierarchy:

Table 6. Evaluation categories, factors, and scoring (rating) system.

	Score of 1	Score of 2	Score of 3
Water Supply			
Hydrology potential (average annual in acre-feet)	High potential: greater than 100,000 acre-feet	Moderate potential: 30,000-100,000 acre-feet	Low to no potential: less than 30,000 acre-feet
Restrictions on hydropower development (i.e., IWRB or NPCC designation)	No restrictions	Moderate: NPCC restrictions	IWRB or both IWRB & NPCC restrictions
Flood control potential	High potential	Moderate potential	Low to no potential
Natural Environment			
Wildlife habitat (i.e., large game winter range and large game migration corridors)	Low to no constraints	Moderate constraints: e.g., adverse but not significant or significant but mitigable adverse impact	High constraints: e.g., significant impact not subject to mitigation
Federally listed species, including At-Risk (U.S. Forest Service and Bureau of Land Management sensitive species and Idaho Species of Greatest Conservation Need), and threatened, endangered, candidate and experimental nonessential species			
Wetland/habitat values, including National Wetlands Invenstory (NWI) wetlands			
State aquatic species of special concern (i.e., Yellowstone cutthroat trout, presence and conservation/management tier)			
Special designation (i.e., Bureau of Land Management/U.S. Forest Service eligible stream, State natural river, State recreational river, and designated wilderness)			

	Score of 1	Score of 2	Score of 3
Socioeconomic Environment			
Land management (i.e., private, Federal or State landownership and presence of conservation easements)	Low to no constraints	Moderate constraints: e.g., adverse but not significant or significant but mitigable adverse impact	High constraints; e.g., significant impact not subject to mitigation
Recreation/economic value (i.e., boating, fishing, hunting, Yellowstone National Park, guiding/outfitting, scenic/natural features, cultural/historic resources, and developed recreation facilities such as campgrounds and trails)			
Infrastructure (i.e., roads, utility lines, structures, habitation)			

The results of this screening are shown on Table 7, which summarizes ratings for all evaluation factors and applies the numeric scoring system from Table 6. Sections 2.2.1 through 2.2.4 following Table 7 describe how these results were used to determine which alternatives were carried forward into the reconnaissance-level studies.

Table 7. Preliminary screening of water storage and resource management options: opportunities and constraints.

	Water Supply			Natural Environment					Socioeconomic Environment			Preliminary Screening			
	Benefit Potential			Constraint/Impact Potential					Constraint/Impact Potential						
	Hydrology (average annual acre-feet)	Hydropower Development	Flood Control	Wildlife Habitat	Federally Listed Species	Wetland and Habitat Values	State Species of Special Concern	Special Designation	Land Management	Recreation/ Economic Value	Infrastructure	Score	Rank	Carried Forward to Final Screening	Eliminated
Surface Storage Sites															
Lane Lake	High	High	Moderate	High	Moderate	Low to none	High	Moderate	Low to none	Low to none	Low to none	18	1	✓	
Moody Creek (Webster Dam)	Moderate	Moderate	Low to none	Low to none	Low to none	Moderate	Moderate	Moderate	Low to none	Low to none	Low to none	18	1	✓	
Teton Creek (Alta Project)	Moderate	Moderate	Low to none	High	Moderate	Low to none	Moderate	Low to none	Low to none	Low to none	Low to none	19	2	✓	
Ashton Dam enlargement	Moderate	High	High	Moderate	Moderate	Low to none	Low to none	Low to none	High	High	High	20	3	✓	
Horseshoe Creek	High	Moderate	Low to none	High	Low to none	Low to none	Moderate	Low to none	High	Moderate	Low to none	20	3	✓	
Island Park Enlargement	Low to none	High	Low to none	Low to none	Moderate	Low to none	Low to none	Low to none	High	Low to none	High	20	3	✓	
Grassy Lake	Low to none	High	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	TBD	TBD	Low to none	21	4	✓	
Squirrel Meadows (Wyoming)	Low to none	High	Low to none	Low to none	High	Moderate	Moderate	Low to none	High	Low to none	Low to none	21	4	✓	
Conant Creek	Moderate	Moderate	Low to none	Moderate	Moderate	Moderate	Moderate	Low to none	Low to none	High	Moderate	22	5	✓	
Moose Creek	Low to none	Low to none	Low to none	Low to none	Moderate	Low to none	Low to none	Moderate	High	Moderate	Low to none	22	5	✓	
Squirrel Creek	Moderate	Moderate	Low to none	Low to none	High	Moderate	Moderate	Low to none	High	Moderate	Low to none	22	5	✓	
Driggs	High	Low to none	High	Low to none	Moderate	High	Moderate	Moderate	Moderate	High	High	23	6	✓	
Spring Creek (Canyon Creek)	Low to none	Moderate	Low to none	High	Moderate	Low to none	High	Moderate	Moderate	Low to none	Low to none	23	6	✓	
Teton (rebuild or new site)	High	Moderate	High	High	Moderate	High	Moderate	Moderate	High	High	Low to none	23	6	✓	
Upper Badger Creek	High	Moderate	Moderate	High	Moderate	Moderate	High	Moderate	High	High	Low to none	23	6	✓	
JY Ranch	Moderate	Low to none	Low to none	Moderate	Moderate	Low to none	High	Moderate	High	Moderate	Low to none	24	7		✓

	Water Supply			Natural Environment					Socioeconomic Environment			Preliminary Screening			
	Benefit Potential			Constraint/Impact Potential					Constraint/Impact Potential						
	Hydrology (average annual acre-feet)	Hydropower Development	Flood Control	Wildlife Habitat	Federally Listed Species	Wetland and Habitat Values	State Species of Special Concern	Special Designation	Land Management	Recreation/ Economic Value	Infrastructure	Score	Rank	Carried Forward to Final Screening	Eliminated
Lower Badger Creek	High	Low to none	Moderate	High	Moderate	Low to none	High	Moderate	High	High	Low to none	24	7		✓
Marysville Headworks	Moderate	Low to none	Low to none	Moderate	Low to none	Low to none	Moderate	Moderate	High	High	Moderate	24	7		✓
Warm River	High	Low to none	High	Moderate	Moderate	Low to none	High	Moderate	High	High	High	24	7		✓
Park Lake	Moderate	Low to none	Low to none	Moderate	High	Moderate	Moderate	Moderate	High	Moderate	Low to none	25	8		✓
Howell Ranch	Moderate	Low to none	Low to none	Moderate	High	Low to none	High	Moderate	High	Moderate	Low to none	25	8		✓
Felt Dam	Low to none	Low to none	Low to none	High	Moderate	Moderate	Moderate	Moderate	Moderate	High	Low to none	26	9		✓
Harrips Bridge/ Tetonia	High	Low to none	High	High	Moderate	High	Moderate	Moderate	High	High	High	26	9		✓
Boone Creek	Moderate	Low to none	Low to none	Low to none	High	High	Moderate	High	High	High	Low to none	27	10		✓
Robinson Creek	Low to none	Low to none	Low to none	Moderate	High	Low to none	High	Moderate	High	High	Low to none	27	10		✓
Bitch Creek	High	High	High	Low to none	Low to none	Low to none	Low to none	Moderate	Low to none	Low to none	Low to none	28	11		✓
Blackfoot Dam	Outside Study Area											NA	NA		✓
Generic reservoir in flat land	Undefined											NA	NA		✓

	Water Supply			Natural Environment					Socioeconomic Environment			Preliminary Screening			
	Benefit Potential			Constraint/Impact Potential					Constraint/Impact Potential						
	Hydrology (average annual acre-feet)	**Hydropower Development**	**Flood Control**	**Wildlife Habitat**	**Federally Listed Species**	**Wetland and Habitat Values**	**State Species of Special Concern**	**Special Designation**	**Land Management**	**Recreation/ Economic Value**	**Infrastructure**	**Score**	**Rank**	**Carried Forward to Final Screening**	**Eliminated**
Managed Groundwater Recharge Sites															
Egin Lake enlargement	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	17	Carried forward – define the most promising recharge/recovery options through further discussion/study		
FMID Recharge Program (Egin Bench)	Moderate	High	High	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	12			
FMID Recharge Program (other)	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	17			
Teton Valley Recharge Program	Moderate	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Moderate	Low to none	Low to none	16			
Evaluation of the benefits of expanding Egin Lake groundwater recharge	TBD	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	Low to none	14*			
Water Market															
Credit system	TBD	Low to none	Low to none	NA					NA			Carried forward – evaluate market-based mechanisms as a whole			
Utilize and/or expand existing banking program	TBD	Low to none	Low to none												
Economic valuation of water	TBD	Low to none	Low to none												

*Benefit from hydrology was not scored so total score is not complete.

<table>
<tr><th></th><th colspan="3">Water Supply</th><th colspan="5">Natural Environment</th><th colspan="3">Socioeconomic Environment</th><th colspan="4">Preliminary Screening</th></tr>
<tr><th></th><th colspan="3">Benefit Potential</th><th colspan="5">Constraint/Impact Potential</th><th colspan="3">Constraint/Impact Potential</th><th></th><th></th><th></th><th></th></tr>
<tr><th></th><th>Hydrology (average annual acre-feet)</th><th>Hydropower Development</th><th>Flood Control</th><th>Wildlife Habitat</th><th>Federally Listed Species</th><th>Wetland and Habitat Values</th><th>State Species of Special Concern</th><th>Special Designation</th><th>Land Management</th><th>Recreation/ Economic Value</th><th>Infrastructure</th><th>Score</th><th>Rank</th><th>Carried Forward to Final Screening</th><th>Eliminated</th></tr>
<tr><td colspan="16">Conservation, Water Management, and Demand Reduction</td></tr>
<tr><td>Teton Valley water conservation</td><td rowspan="10">TBD</td><td rowspan="10">NA</td><td rowspan="10">NA</td><td rowspan="10" colspan="5">NA</td><td rowspan="10" colspan="3">NA</td><td rowspan="10" colspan="4">Carried forward – define the most promising conservation, water management and demand reduction options through further discussion/study</td></tr>
<tr><td>North Fremont water conservation</td></tr>
<tr><td>Lower Bench water conservation</td></tr>
<tr><td>Egin Bench water conservation</td></tr>
<tr><td>Increase capacity of Cross Cut Canal</td></tr>
<tr><td>General demand reduction alternatives</td></tr>
<tr><td>Weather modification</td></tr>
<tr><td>Consolidation (e.g., Lemhi)</td></tr>
<tr><td>DCM&I supply and conservation</td></tr>
<tr><td>FMID system optimization</td></tr>
</table>

	Water Supply			Natural Environment					Socioeconomic Environment			Preliminary Screening			
	Benefit Potential			Constraint/Impact Potential					Constraint/Impact Potential						
	Hydrology (average annual acre-feet)	Hydropower Development	Flood Control	Wildlife Habitat	Federally Listed Species	Wetland and Habitat Values	State Species of Special Concern	Special Designation	Land Management	Recreation/ Economic Value	Infrastructure	Score	Rank	Carried Forward to Final Screening	Eliminated
Combination Alternatives															
Island Park enlargement (existing surface storage), enlarge Cross Cut Canal	Low to none	High	Low to none	Low to none	Moderate	Low to none	Low to none	Low to none	High	Low to none	High	20	Pursue combination alternatives as part of the reconnaissance-level study (e.g., combining additional storage at Island Park, Ashton, or Moose Creek with enlarging the Cross Cut Canal may hold the most promise).		
Ashton Dam enlargement (existing surface storage, enlarge Cross Cut Canal	Moderate	High	High	Moderate	Moderate	Low to none	Low to none	Low to none	High	High	High	20			
Moose Creek (on-stream surface storage in upper Henrys Fork basin), enlarge Cross Cut Canal	Low to none	Low to none	Low to none	Low to none	Moderate	Low to none	Low to none	Moderate	High	Moderate	Low to none	22			
JY Ranch (on-stream surface storage in upper Henrys Fork basin), enlarge Cross Cut Canal	Moderate	Low to none	Low to none	Low to none	Moderate	Low to none	Low to none	Moderate	High	Moderate	Low to none	21			
Robinson Creek (on-stream surface storage in upper Henrys Fork basin), enlarge Cross Cut Canal	Low to none	Low to none	Low to none	Moderate	High	Low to none	High	Moderate	High	High	Low to none	27			

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2.2.1 Surface Storage Site Alternatives

The surface storage alternatives that ranked from 1 to 6 were carried forward into the final screening assessment. Rankings above this range were generally considered too constrained to warrant further study.

2.2.2 Managed Groundwater Recharge Site Alternatives

These alternatives generally represented low to moderate capacity for water storage and recovery/use and no potential for hydropower and flood control benefits. Since the managed aquifer recharge alternatives did not have the same potential for adverse environmental impacts that may accompany the surface storage alternatives, all of the alternatives identified in this first phase of assessment were carried forward for further discussion.

2.2.3 Water Market(s), Conservation, Water Management, and Demand Reduction Alternatives

At this preliminary stage of analysis, no estimates could be derived from these alternatives related to the volumes or locations of water; however, these options may have the potential to meet at least part of the local needs and generally have no potential for adverse environmental impacts. Consequently, all identified options in this category were carried forward for further discussion and analysis.

2.2.4 Combination Alternatives

Reclamation, IDWR, and the Workgroup recognized that the potential to combine alternatives aimed at increasing storage and improving management of water resources holds significant promise for meeting local and regional/state needs. At this early stage of planning, too little is known about the characteristics of the individual elements, how feasible they are, and how they may synchronize with each other. Consequently, the study of potential combination options or water supply and management programs was deferred until the appraisal-level study when the individual elements are more fully analyzed.

2.3 Final Screening of Alternatives

The results of preliminary screening were reviewed by Reclamation, IDWR, and the Workgroup. Large-group and small-group meetings were held for discussions on which alternatives were most feasible for reconnaissance-level studies (see Section 3.0 for detail discussion). For candidate surface storage sites, the review focused on the relative severity of potential environmental impacts and the potential to mitigate those impacts. For the remaining alternatives (managed aquifer recharge; water markets; and conservation, water management, and demand reduction), the review centered on determining whether the most feasible and productive options had been identified. The results of this review/final screening are summarized in the Sections 2.3.1 through 2.3.4.

2.3.1 Surface Storage Site Alternatives

Fifteen candidate surface storage sites received a ranking of 1 through 6 in the preliminary screening process. A more in-depth review found that eight of these had constraints that were both significant and not subject to mitigation. As shown in Table 8, these seven sites were eliminated from further consideration and the remaining eight sites were carried forward into the reconnaissance-level study.

Table 8. Final screening results for the surface storage alternatives

	Carried Forward into Reconnaissance-Level Study	Removed from Consideration	Rationale for Screening
Ashton Dam Enlargement	✓		
Conant Creek		✓	Impact on Yellowstone cutthroat trout
Driggs		✓	Impact on community (infrastructure inundation)
Grassy Lake		✓	Limited additional capacity; within National Park boundary
Horseshoe Creek		✓	No local knowledge; Horseshoe Creek is on the west side of a bifurcation of Teton River near Bates Road. This would be a partial alternative of Driggs above.
Island Park Enlargement	✓		
Lane Lake	✓		
Moody Creek (Webster Dam)	✓		
Moose Creek	✓		
Spring Creek (Canyon Creek)	✓		
Squirrel Creek		✓	Significant Endangered Species Act concerns; grizzly bear habitat; contiguous with National Forest and National Park boundaries.

	Carried Forward into Reconnaissance-Level Study	Removed from Consideration	Rationale for Screening
Squirrel Meadows (Wyoming)		✓	Significant Endangered Species Act concerns; grizzly bear habitat; contiguous with National Forest and National Park boundaries.
Teton (rebuild or new site)	✓		A reconnaissance evaluation already exists for Teton Dam. This information will be used to allow Teton Dam to be compared to the other alternatives.
Teton Creek (Alta Project)		✓	Geologic fatal flaw
Upper Badger Creek	✓		

2.3.2 Managed Groundwater Recharge Site Alternatives

A more in-depth review by Reclamation, IDWR, and the Workgroup resulted in fine-tuning and restating the options for managed aquifer recharge (Table 9). The restatement of the alternatives was intended to provide better focus on the most promising actions or sets of actions related to groundwater recharge and recovery.

Table 9. Final screening results for the managed groundwater recharge alternatives. Note: recharge using existing irrigation canals was moved to the agricultural water conservation category.

Preliminary Alternatives	Final/Revised Alternatives Carried Forward into Reconnaissance-level study
Egin Lakes enlargement	Expansion of managed recharge in Egin Basin
FMID Recharge Program (Egin Bench)	Expansion of managed recharge in Egin Basin
FMID Recharge Program (all other FMID)	Evaluate recharge in the Lower Teton through development of new facilities
Teton Valley Recharge Program	Evaluate recharge in the Lower Teton through development of new facilities
Evaluation of the benefits of expanding Egin Lake groundwater recharge	Expansion of managed recharge in Egin Basin

2.3.3 Water Market Alternatives

The three alternatives related to water markets identified in the preliminary screening process represent different aspects of or approaches to a water marketing program. During the final screening, Reclamation, IDWR, and the Workgroup decided to consolidate these aspects and carry forward the broad concept of water markets into the reconnaissance-level study (Table 10).

Table 10. Final screening results for the water market alternatives.

Preliminary Alternatives	Final/Revised Alternatives Carried Forward into Reconnaissance-level study
Credit system	Evaluate existing and potential market-based mechanisms
Utilize and/or expand existing banking program	Evaluate existing and potential market-based mechanisms
Economic valuation of water	Evaluate existing and potential market-based mechanisms

2.3.4 Conservation, Water Management, and Demand Reduction Alternatives

As with the managed groundwater recharge and water market alternatives, the Reclamation, IDWR, and Workgroup discussions during the final screening process resulted in a substantial restatement of alternatives related to conservation, water management, and demand reduction. As shown on Table 11, management or demand reduction options are lost or eliminated in this restatement process. The restatement was intended to more clearly describe options as the reconnaissance-level study effort is initiated.

Table 11. Final screening results for the conservation, water management, and demand reduction alternatives.

Preliminary Alternatives	Final/Revised Alternatives Carried Forward into Reconnaissance-level study
Teton Valley water conservation	Piping and lining, canal automation, demand reduction, on-farm conservation practices, recharge using existing canals alternatives
North Fremont water conservation	Piping and lining, canal automation, demand reduction, on-farm conservation practices, recharge using existing canals alternatives
Lower Bench water conservation	Piping and lining, canal automation, demand reduction, on-farm conservation practices, recharge using existing canals alternatives
Egin Bench water conservation	Piping and lining, canal automation, demand reduction, on-farm conservation practices, recharge using existing canals alternatives
Increase capacity of Cross Cut Canal (CCC)	Considered in conjunction with Moose Creek, raising Island Park Reservoir, and raising Ashton Dam alternatives.
General demand reduction alternatives	
Weather modification	Practice currently being carried out by Idaho Power Company
Consolidation (e.g., Lemhi Irrigation District)	FMID to consider implementation
DCM&I supply & conservation	Municipal and industrial conservation alternatives
FMID system optimization	Beyond the scope of a Basin Study; however, site specific opportunities for automation could be identified and evaluated.

3.0 RECONNAISSANCE-LEVEL ANALYSIS OF ALTERNATIVES

Four general categories of alternatives emerged from the alternatives put forward by the Workgroup and from the processes described in Section 2.0: 1) surface storage; 2) groundwater recharge; 3) water markets; and 4) conservation water management and demand reduction in agricultural and municipal uses. The individual alternatives under each category were evaluated at the reconnaissance level and the results were presented to the Workgroup for subsequent consideration. The reconnaissance-level study included defining the alternative, defining the benefits or impacts of the alternative; general designs of structures or processes involved; relative costs of implementation; and issues, constraints, and opportunities that may influence further consideration or development.

Sections 3.2 through 3.6 list the alternatives from the reconnaissance-level study that will and will not be carried forward to the appraisal-level study, provide the basis for these decisions, and describe the future study actions for the alternatives to be carried forward. This section also includes a general list of public and stakeholder comments received about each alternative. Though the lists may not provide a complete summary of the project issues, they document discussion, information and opinions held by participating stakeholders. Each of the alternatives is covered in detail in the Technical Series Reports in Appendix B through Appendix E. The Technical Series report in which the alternative is discussed and the appendix in which it is found are given in parenthesis in the subsection headings.

3.1 Selection Process for Appraisal Study

Reclamation met with individual (small) groups to discuss the results of each draft Technical Series report including the corresponding reconnaissance evaluations, in order to assess levels of acceptability, determine the requirements for future study, and address the concerns and comments from the individual participants. Between June 2012 and October 2012, Reclamation met with the IWRB, the study partner, as well as the following groups:

- Henrys Fork Watershed Council
- Fremont Madison Irrigation District
- Friends of the Teton River
- Trout Unlimited
- Idaho Department of Water Resources

- Idaho Water District 1
- The Henrys Fork Foundation
- Idaho Fish and Game
- U.S. Forest Service
- Bureau of Land Management
- Interim Committee, Natural Resources and Environment, Idaho State Legislature
- American Rivers

While not universally agreed upon, the alternatives carried forward as a result of the small-group meetings provide a cross-section of structural and management alternatives and a reasonable approach forward. A selection of generalized comments from the small-group discussions is given for each alternative and may reflect individual opinions or unverified information. The comments do not necessarily provide a complete technical or objective summary of the project issues, but document feedback provided during this Basin Study process. The appendices provide a complete analysis of each alternative.

3.2 Assessment of Surface Storage Sites

Six new surface storage sites were suggested by the Workgroup that would provide additional surface water supplies to the Henrys Fork River basin: Lane Lake Dam, Spring Creek Dam, Moody Creek Dam, Upper Badger Creek Dam, Moose Creek Dam, and a new Teton Dam. Each site was evaluated with respect to hydrology, potential dam configurations, hydropower potential, and the conveyance system required to move the water to where it is needed, as well as environmental, land management, and recreational benefits and impacts (CH2MHILL 2012a; Reclamation 2012a).

3.2.1 Lane Lake Dam (No. PN-HFS-002 in Appendix B)

The Lane Lake Alternative features a new 170-foot-tall off-channel dam and a 68,000-acre-foot reservoir (Table 12). The proposed dam site is located in the Teton River basin on a generally dry drainage that is situated about 1 mile north of the Teton River and 5 miles downstream of the Bitch Creek confluence. Water for the reservoir could be supplied from several sources, including the Teton River, Conant Creek, Falls River, and Bitch Creek. An optional water supply from the Teton River would require pumping. When full, Lane Lake could provide a roughly 500-foot drop to a new hydropower facility on the Teton River.

Table 12. Summary of the Lane Lake Dam Alternative.

Dam	Water Source	Storage Capacity (acre-feet)	Relative Costs
Lane Lake	Off-channel location, pumping from Teton River, Fall River, Conant Creek, and Bitch Creek	68,000	$333,290,000

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- Lane Lake has the advantage of being off-stream.
- Bitch Creek is very important to Yellowstone cutthroat trout and should not be considered as a water source.
- Some of the canals needed for water delivery are very long and may have a lot of water loss due to seepage.
- Multiple water sources, with the exception of Bitch Creek, should be considered, along with looking at a larger reservoir size.
- The estimated costs are high, but the cost estimates in the Technical Series Reports were high-level estimates.
- A pump-back system with the Teton River as a water source may be very costly.
- A pump-back system with the Teton River as a water source would pump when power is abundant in the early spring and generate power when the power supply is constrained in the late summer or early fall.
- The hydrologic and environmental impacts on the supply sources should be evaluated, as well as in the overall Henrys Fork River basin and ESPA system.
- Lane Lake water storage may help meet ESPA and the lower watershed irrigation needs.
- Analysis is needed to demonstrate how water storage in Lane Lake will meet the defined needs.

Decision

This alternative will continue on to the appraisal study, but further study will include reconfiguring the alternative from multiple water sources. Bitch Creek will be eliminated as a potential source due to public comment and environmental concerns. Reconfiguration will also include investigation of a larger size reservoir. Seepage issues, hydrologic and environmental impacts, and how water storage would meet needs will be addressed. The appraisal-level study will briefly discuss the pump-back system, but not produce a design or detailed cost estimates for the pump-back system.

3.2.2 Spring Creek Dam (No. PN-HFS-002 in Appendix B)

The Spring Creek Alternative features a new 180-foot-tall dam and a 20,000-acre-foot reservoir (Table 13). The proposed dam site is located in the Teton River basin on the Spring Creek headwater tributary where it joins Canyon Creek. Water for the reservoir could be supplied from several sources including Spring Creek, Canyon Creek, Teton River, and Bitch Creek. Pumping from the Teton River or Bitch Creek would be required to satisfy storage objectives. When full, Spring Creek Reservoir could provide a roughly 160-foot drop to a new hydropower facility on Spring Creek at the base of the dam (CH2M HILL 2012).

Table 13. Summary of the Spring Creek Dam Alternative.

Dam	Water Source	Storage Capacity (acre-feet)	Relative Costs
Spring Creek	Spring Creek and Canyon Creek, with pumping from Bitch Creek and Teton River	20,000	$41,290,000

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- The reservoir may provide some improvement to late season flows in Spring Creek.
- Options with pumping from the Teton River are very costly and not practical.
- Only water sources from the drainage area above reservoir site should be considered.
- The estimated costs are high, but the cost estimates in the Technical Series Reports were high-level estimates.

- The hydrologic and environmental impacts on the supply sources and downstream Spring Creek need to be evaluated as well as in the overall Henrys Fork River basin and ESPA system.
- Analysis is needed to demonstrate how water storage in Spring Creek will meet the defined needs.
- Spring Creek Dam water storage may help meet ESPA and the lower watershed irrigation needs.

Decision

This alternative will continue on to the appraisal study. Only water sources from the drainage area above reservoir site will be considered. Hydrologic and environmental impacts and how storage would meet needs will be evaluated in the appraisal study.

3.2.3 Moody Creek Dam (No. PN-HFS-002 in Appendix B)

The Moody Creek alternative features a new 220-foot-tall dam and a 37,000-acre-foot reservoir (Table 14). The proposed dam site is located in the Teton Basin on Moody Creek, just downstream of the Dry Canyon Creek confluence. Water for the reservoir could be supplied from several sources, including Moody Creek, Canyon Creek, and the Teton River. Pumping or gravity flow from the Teton River would be required to satisfy the storage objectives. When full, Moody Creek Reservoir could provide a roughly 200-foot drop to a proposed new hydropower facility on Moody Creek at the base of the dam (CH2M HILL 2012).

Table 14. Summary of the Moody Creek Dam Alternative.

Dam	Water Source	Storage Capacity (acre-feet)	Relative Costs
Moody Creek	Moody Creek and Canyon Creek, with pumping from Teton River	37,000	$54,490,000

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- The reservoir may provide some improvement to late season flows in Moody Creek.
- Options with pumping from the Teton River are very costly and not practical.
- Only water sources from drainage area above reservoir site should be considered.
- The estimated costs are high, but the cost estimates in the Technical Series Reports were high-level estimates.
- The hydrologic and environmental impacts on the supply sources and downstream Moody Creek should be evaluated, as well as in the overall Henrys Fork River basin and ESPA system.
- Analysis is needed to demonstrate how water storage in Moody Creek will meet the defined needs.
- Moody Creek Dam water storage may help meet ESPA and the lower watershed irrigation needs.

Decision

This alternative will continue on to the appraisal study. Only water sources from the drainage area above reservoir site will be considered. Hydrologic and environmental impacts and how storage would meet needs will be evaluated in the appraisal study.

3.2.4 Upper Badger Creek Dam (No. PN-HFS-002 in Appendix B)

The Upper Badger Creek Alternative features a new 290-foot-tall dam and a 47,000-acre-foot reservoir (Table 15). The proposed dam site is located in the Teton River basin on Badger Creek approximately 5 miles upstream of the Teton River. Water for the reservoir could be supplied from Badger Creek and pumped from the Teton River. When full, Upper Badger Creek Reservoir could provide a roughly 590-foot drop to a new hydropower facility on the Teton River (CH2M HILL 2012).

Table 15. Summary of the Upper Badger Creek Dam Alternative.

Dam	Water Source	Storage Capacity (acre-feet)	Relative Costs
Upper Badger Creek	Badger Creek, with pumping from Teton River	47,000	$77,130,000

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- The proposed reservoir area currently goes dry in late summer.
- A resident population of Yellowstone cutthroat trout resides near the proposed reservoir site when water is available and then moves upstream when the proposed reservoir site is dry.
- A population of Yellowstone cutthroat trout exists intermixed with nonnative trout in lower Badger Creek.
- A reservoir would provide an opportunity to introduce nonnative species into upper Badger Creek where they do not currently exist.
- The surrounding area is scenic.
- The estimated costs are high, but the cost estimates in the Technical Series Reports were high-level estimates.
- A pump-back system using the Teton River as a water source may be very costly.
- A pump-back system using the Teton River as a water source would pump when power is abundant in the early spring and generate power when the power supply is constrained in the late summer or early fall.
- The hydrologic and environmental impacts on Badger Creek will be evaluated, as well as on the overall Henrys Fork River basin and ESPA system.
- Analysis is needed to demonstrate how water storage in Upper Badger will meet the defined needs.
- Upper Badger Creek Dam water storage may help meet ESPA and the lower watershed irrigation needs.

Decision

This alternative will continue on to the appraisal study. Hydrologic and environmental impacts and how storage would meet needs will be evaluated in the appraisal study. The appraisal study will briefly discuss the pump-back system, but not produce a design or detailed cost estimates for the system. The impacts to Yellowstone cutthroat trout will also be discussed.

3.2.5 Teton Dam (No. PN-HFS-005 in Appendix B)

This Alternative includes building Teton Dam and its facilities to the same scale as proposed in the 1991 Reappraisal Report which included these features:

- Dam, spillway, and reservoir.
- Power generation, switchyard, power substations, and transmission line facilities.
- Fish and wildlife mitigation facilities, lands, and improvements.
- Recreation lands and facilities.
- General property and Government-reserved works.

An average annual supplemental water supply of 55,000 acre-feet would be provided by the project, with 44,000 acre-feet available for irrigation to 111,210 acres and 11,000 acre-feet available for release for wildlife mitigation needs (Table 16). During the driest years, there would be a supplemental need for 514,000 acre-feet of water, an amount in excess of the project's capacity. The supplemental supply would reduce the critical year shortages to an average of about 10 percent (Reclamation 2012).

Table 16. Summary of the Teton Dam Alternative.

Dam	Water Source	Storage Capacity (acre-feet)	Relative Costs
Teton	Teton River	50,000 - 288,000[1]	$92,912,000 - $322,171,000[1]

[1]Four dam configurations were evaluated. The ranges of capacity and costs of those configurations are given.

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- The reconnaissance evaluation was based on existing reports completed in 1991 and 1995. The same level of detail is not available for the other storage alternatives; therefore, this alternative cannot be reasonably compared to the other storage alternatives at this point in the study.
- A large reservoir on the mainstem of the Teton River would be strongly opposed by a number of groups.

- Teton Dam is listed in the State of Idaho State Water Plan as a potential reservoir site.
- The Teton River is the largest remaining water source for storage in Idaho.
- The history of Teton Dam has created strong public perceptions.
- Teton Dam included storage volume for flood control which was not considered for other storage alternatives.
- There is a large difference in the estimated cost per acre-foot documented in the 1991 and 1995 study.
- There is a large difference in the estimated cost of a rock fill alternative compared to a roller-compacted alternative (1991 study).
- While construction of a Teton Dam replacement may not happen in the near future, irrigation interests do not want to see this potential site eliminated from future consideration.
- Environmental interests do not want to see Teton Dam replaced and would like to see it eliminated from future consideration.
- The hydrologic and environmental impacts on the Teton River need to be evaluated, as well as the overall Henrys Fork River basin and ESPA system.
- Analysis is needed to demonstrate how water storage in Teton Dam will meet the defined needs.
- Teton Dam water storage may help meet ESPA and the lower watershed irrigation needs.

Decision

This alternative will continue on to the appraisal study. Details from previous studies with regard to the design, cost estimating, and environmental impacts need to be resolved so that Teton Dam can be compared on an equal basis with the other storage alternatives. Issues that need to be addressed include the hydrologic and environmental impacts and how storage would meet the needs.

3.2.6 Island Park Dam Raise (No. PN-HFS-003 in Appendix B)

The Island Park Dam Raise Alternative consists of raising the Island Park Reservoir normal pool elevation by 1 to 8 feet to increase reservoir storage by 8,000 to 74,000 acre-feet (Table 17). The 1-foot raise would be accomplished by replacing the rubber bladder on the spillway, whereas the 8-foot raise would be accomplished by building up the entire dam embankment and raising the spillway.

Island Park Reservoir is located on the Henrys Fork River by the town of Island Park and would require no secondary water sources. When full, the proposed 1-foot reservoir raise could provide a roughly 44-foot drop to the existing hydropower facility on the Henrys Fork River at the base of the dam, and the 8-foot dam raise would provide a roughly 51-foot drop to a new hydropower facility. A variation of this alternative includes expansion of the Crosscut Canal, which would allow water released from the reservoir to be transferred to the Lower Teton Basin (CH2M HILL 2012).

Table 17. Summary of the Island Park Dam Raise Alternative.

Dam	Water Source	Storage Capacity (acre-feet)	Relative Costs
Island Park	Henrys Fork River	8,000 – 74,000	\$850,000 - \$51,470,000

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- Expanding the existing reservoir may have less impact than constructing new dams.
- The costs per acre-foot are low for both the 1-foot and 8-foot reservoir raises.
- The 8-foot reservoir raise would impact many structures.
- What is the optimum reservoir raise level between 1 and 8 feet, considering impact to structures?
- How will additional storage in Island Park Reservoir be managed with consideration to the existing Drought Management Plan?

- It may be possible to increase the spillway capacity and reduce the volume set aside for flood flows, thus allowing this volume to be used for irrigation and/or conservation purposes.

- The hydrologic and environmental impacts on the supply sources and the downstream Henrys Fork River should be evaluated, as well as in the overall Henrys Fork River basin and ESPA system.

- Analysis is needed to demonstrate how additional water storage in Island Park Reservoir will meet the defined needs.

- An Island Park Dam raise may help meet ESPA and the lower watershed irrigation needs via the Crosscut Canal.

Decision

This alternative will continue on to the appraisal study. The optimum height of dam raise should be determined and an evaluation of increasing the spillway capacity should be completed. Issues that need to be addressed include the hydrologic and environmental impacts and how storage would meet needs.

3.2.7 Ashton Dam Raise (No. PN-HFS-003 in Appendix B)

The Ashton Dam Raise Alternative consists of raising Ashton Dam by approximately 43 feet to a total height of 100 feet which would increase reservoir storage by 20,400 acre-feet to a total of 30,200 acre-feet (Table 18). Ashton Reservoir is located on the Henrys Fork River by the Town of Ashton, and would require no secondary water sources. When full, Ashton Reservoir could provide a roughly 80-foot drop to a new hydropower facility at the base of the dam. A variation of this alternative includes expansion of the Crosscut Canal, which would allow water released from the reservoir to be transferred to the Lower Teton Basin (CH2M HILL).

Table 18. Summary of the Ashton Dam Raise Alternative.

Dam	Water Source	Storage Capacity (acre-feet)	Relative Costs
Ashton	Henrys Fork River	20,400	$28,210,000

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- Expanding the existing reservoir may have less impact than constructing new dams.
- The costs per acre-foot of storage are low.
- Ashton Dam is currently being modified for structural reasons.
- The dam raise project would consist of a new dam being constructed immediately below the existing dam.
- Power generating costs were not included in the cost estimate.
- Increasing the reservoir size will reduce the free-flowing river and increase slack water which is a concern of fishery interests.
- The increase in reservoir size is not very large.
- The 43-foot reservoir raise would impact many structures.
- Given the amount of the potential increase in storage, increasing the capacity of Crosscut Canal is not practical.
- The hydrologic and environmental impacts on the supply sources and the downstream Henrys Fork River should be evaluated as well as on the overall Henrys Fork River basin and ESPA system.
- Analysis is needed to demonstrate how additional water storage in Ashton Dam Reservoir will meet the defined needs.
- An Ashton Dam raise may help meet ESPA and the lower watershed irrigation needs, via the Crosscut Canal.

Decision

This alternative will continue on to the appraisal study. The appraisal study will briefly discuss power generation, but not produce a design or detailed cost estimates for power generation. Issues that need to be addressed include the hydrologic and environmental impacts and how storage would meet needs.

3.2.8 Moose Creek Dam (No. PN-HFS-002 in Appendix B)

The Moose Creek Alternative features a new 160-foot-tall dam and a 60,000-acre-foot reservoir (Table 19). The proposed dam site is located in the Henrys Fork River basin at the headwaters of Moose Creek between Island Park Reservoir and upstream natural springs. Water for the reservoir must be pumped from the Henrys Fork River or potentially from the springs' channel, depending on volumes and restrictions. When full, Moose Creek Reservoir could provide a roughly 140 to 260-foot drop to a new hydropower facility on Moose Creek at the base of the dam or on the Henrys Fork River. Expansion of the Crosscut Canal would also allow water released from the reservoir to be transferred to the Lower Teton Basin (CH2M HILL 2012).

Table 19. Summary of the Moose Creek Dam Alternative.

Dam	Water Source	Storage Capacity (acre-feet)	Relative Costs
Moose Creek	Natural springs, with pumping from Henrys Fork River	60,000	$238,490,000

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- The location of the proposed reservoir is grizzly bear habitat as documented in U.S. Forest Service's grizzly bear management plan.
- Available water may be captured at Island Park Reservoir.
- Local home owners oppose Moose Creek Dam.
- The Big Springs water source is designated as a National Natural Landmark.

Decision

This alternative would have severe impacts to wildlife habitat and protected landmark features. Moose Creek Dam is not considered a viable option to meet the needs of the Henrys Fork River basin and will not be carried forward.

3.3 Managed Groundwater Recharge

The managed aquifer recharge category had two alternatives: expansion of recharge in the Egin Bench area and new facilities in the lower Teton River basin.

3.3.1 Expansion of Managed Recharge in the Egin Basin (No. PN-HFS-004 in Appendix C)

The alternative to expand managed aquifer recharge in Egin Basin increases annual water deliveries to Egin Lakes from the current approximately 5,000 acre-feet to either 7,500 acre-feet or 10,000 acre-feet, an increase of 50 or 100 percent (Table 20). The Egin Lakes recharge site currently receives approximately 5,000 acre-feet of recharge water over 60 days each fall, with slight variations in quantity and duration year to year. The Egin Recharge Canal capacity would have to be expanded to carry the increased flows. Egin Lakes is located approximately 10 miles west of St. Anthony at the terminus of the Egin Recharge Canal (CH2M HILL 2012).

Table 20. Summary of Egin Basin Recharge Alternative.

Alternative	Impact on Water Budget	Relative Costs
Egin Lakes	7,500-10,000 acre-feet to be recharged annually (incremental increase of 2,500 to 5,000 acre-feet beyond existing baseline), some of which would go to aquifer storage and some of which would enhance ecological flows.	$13,618,000

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- Approximately 22 percent of water diverted to Egin Basin is retained in the ESPA, assuming continual years of recharge.
- The cost of recharge for the ESPA from Egin Basin is very high.
- The Workgroup is interested in understanding the local (in-basin) benefits of recharge.
- The IWRB currently operates a managed aquifer recharge program to meet the goals of the ESPA CAMP which includes contracts with certain canal companies in the Henrys Fork River basin to deliver the IWRB’s recharge water. Significant efforts are

underway at the IWRB and legislative levels to refine policy and guidance for recharge across the ESPA. Issues under consideration include the following:

- Timing and location of recharge to meet the State's needs.
- Timing and location of recharge to avoid impacting optimal capture of surface water in existing storage reservoirs.
- Timing and location of recharge to avoid impacting senior water right holders; opportunities for a credit-based system.
- Whether private entities other than the IWRB may hold a water right for recharge purposes.
- Prioritize finance and construction of recharge infrastructure.
- Finance overall recharge program across the ESPA.
- Updating and integration of the Eastern Snake Plain Aquifer Model 2.1 (ESPAM2.1) groundwater modeling results coupled with a recharge site capacity analysis.

- IDWR is initiating use of the ESPAM2.1 model. The modeling done thus far was with the ESPAM1.1 model.

Decision

Managed recharge may have the ability to meet both in-basin and out-of-basin water needs. A reanalysis of recharge using the ESPAM2.1 model and a recharge site capacity analysis is currently being performed by IDWR in conjunction with an analysis of recharge sites across the ESPA (this includes analysis of the Egin Basin). The studies of recharge are being carried forward by IDWR and IWRB with participation from key leadership, stakeholders, water users, and the public throughout the ESPA. The studies conducted by IDWR and IWRB will be used in lieu of an appraisal-level analysis.

3.3.2 Development of New Recharge Facilities in the Lower Teton River Basin (No. PN-HFS-004 in Appendix C)

This alternative entails the identification of one or more promising new recharge locations in the Lower Teton River basin, selection of a preferred site for development of new recharge facilities, selection of an alignment for a new canal to convey recharge water diverted from the Teton River, and the design and construction of both recharge facilities and the canal. A tentative site for recharge facilities has been identified near Sugar City between the Teton and South Fork Teton Rivers. This site (Teton Island Recharge Site) was identified because of its potential to enhance ecological flows in adjacent river reaches. For any new recharge facility in the Lower Teton Basin, a new canal would have to be constructed to convey recharge water diverted from the Teton River. For comparison purposes, the Teton Island Recharge Site and a representative water-delivery canal alignment were selected to represent the range of possible choices for a new recharge facility in the lower Teton River basin (Table 21). Three subalternatives consisting of different annual recharge quantities of 5,000 acre-feet, 7,500 acre-feet, and 10,000 acre-feet were evaluated (CH2M HILL 2012).

Table 21. Summary of the Lower Teton River Basin Recharge Alternative.

Alternative	Impact on Water Budget	Relative Costs
Teton Island	5,000-10,000 acre-feet to be recharged annually, some of which would go to aquifer storage and some of which would enhance ecological flows	No costs were formulated

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- Less than 5 percent of water recharged returns to the ESPA.
- While modeling shows a slight increase in lower Henrys Fork River in late summer, it is likely that taking water from either the North Fork or South Fork of the Teton River will reduce flows in the lower Henrys Fork River, offsetting any benefit.

Decision

Managed recharge may have the ability to meet both in-basin and out-of-basin water needs. A reanalysis of recharge using the ESPAM2.1 model and a recharge site capacity analysis is currently being performed by IDWR in conjunction with an analysis of recharge sites across the ESPA (this includes analysis of the Egin Basin). The studies of recharge are being carried forward by IDWR and IWRB with participation from key leadership, stakeholders, water users, and the public throughout the ESPA. The studies conducted by IDWR and IWRB will be used in lieu of an appraisal-level analysis.

3.4 Water Market Alternatives

3.4.1 Market Based Alternatives (No. PN-HFS-008 in Appendix D)

In the Snake River basin, water markets have developed as a means to temporarily or permanently reallocate available water supplies to uses with higher economic values. The Idaho Water Supply Bank (WSB), including the Upper Snake (Water District 01) Rental Pool, provides a centralized mechanism to lease (deposit water to the bank) and rent (withdraw water from the bank) surface and groundwater rights throughout the state (WestWater andCH2MHILL 2012a).

This analysis explored the regulatory and economic factors that are necessary for water markets to effectively operate and briefly compared those factors to conditions in the Henrys Fork River basin. Examples of currently active water markets were used to illustrate some key market considerations. The analysis of operating market regions included (WestWater Research, CH2M HILL 2012):

- Regulatory Environment - Markets for water can be regulated in a variety of ways to satisfy water supply objectives including regulatory constraints on certain types of market transfers or the development of market demand through regulatory drivers that create incentives for trades. The existing regulatory environment for market-based mechanisms in the selected regions was compared in order to provide information on the variety of forms available for market development.

- Water Supply and Demand - Water supply availability and alternative water uses within the region have important implications for market-based opportunities to support reallocation of existing water supplies and to provide economic incentives for water supply development projects. Market-based approaches are generally the most effective in areas where the marginal value of water in alternative uses exceeds the value in existing uses or the costs associated with freeing up or developing a new unit of water supply. Where opportunities for "gains from trade" are limited, competitive water markets will not emerge.

- Market Participation - The level and type of market participation within the selected regions were compared and contrasted and the market activity by water use type was identified. In many regions, water supplied to the market is associated with surplus water supplies or obtained through fallowing irrigated land planted to pasture and hay crops. The mechanisms through which water is supplied to the market in the selected regions was considered.

- Water Pricing and Trading - The level of water prices and associated trading were compared among the selected regions to evaluate the price levels that can be supported by end user categories and to provide a comparison to the value and costs of alternative water supply opportunities.

In recent years, the State has been pursuing managed aquifer recharge opportunities to improve water supply conditions in the ESPA. Recharge activities were conducted when flow conditions allowed for diversions for recharge purposes, typically during short windows in the spring and fall. These recharge activities were completed without the need for fallowing or temporary idling of irrigated farmland to make water available. The IWRB is pursuing additional opportunities to maximize the use of surplus water during wet conditions through development of additional recharge capacity. This may limit the need for market-based mechanisms that require a reduction in irrigation in one location to support water use in another. However, it is unclear at this time if aquifer recharge and other activities can be used to support issuance of new permanent water rights to support expanding water demand in the region.

Due to the relatively low prices for water and limitations on agricultural payment capacity in the Henrys Fork River basin and the ESPA, development of low cost water supply projects that can be funded solely by payments from direct beneficiaries may be challenging. A credit accounting system that would facilitate water trading among private parties and improve aquifer conditions by requiring a “cut to the aquifer” for recharge and demand reduction activity could be developed; however, such a program will only benefit aquifer conditions if there is a sufficient level of private trading activity which would be difficult to accomplish in the absence of increased water prices and public funding (WestWater andCH2MHILL 2012a).

Despite the pricing challenges, there may be some opportunity to promote wet year recharge activities that would benefit the aquifer and provide mitigation credits for out-of-priority water uses during dry years. It is unclear if the differential in the costs to recharge water during wet years and the market price during dry years will be adequate to support private trading given the temporal nature of recharge activities and associated credits and the necessary coupling of recharge location and mitigation. The requirement of a “cut to the aquifer” for each transaction may result in a need for an even wider cost-value differential. Even if the cost-value differential is adequate to support competitive market activity, it is unclear if the current regulatory environment will require a large number of water users to seek mitigation. It should also be noted that there is currently no policy or structure in place to support this type of market.

In order to expand the use of water markets in the region to improve aquifer conditions and meet projected future demands, some level of public funding or a broader funding base will likely be required.

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- The Water District 1 rental pool, serving the Basin Study area, is the most active in the State. Idaho is a leading state in leasing water between users.
- The Idaho Water Supply Bank, which allows leasing of natural flow and groundwater, is relatively active in the Henrys Fork River basin, but to a much smaller degree than the rental pool.
- The reconnaissance-level evaluation did not provide recommendations about any new proposed market structure or recommendations to mitigate constraints to using existing water markets.
- What is necessary to implement a "conserved water use law" in Idaho similar to the one in Oregon where conserved water, obtained through implementing conservation practices, is in part left for instream use and in part allowed to be applied to new acreage?
- In general, water prices are low in the Henrys Fork River basin as compared to other markets.
- Market prices are limited by the payment capacity of agricultural produces.
- There might be more market activity if constraints to market participation were addressed (for example, the current $14 per acre-foot Water Supply Bank suggested rental rate).
- In the upper Teton Valley, while some landowners have expressed interest in leasing water, the water is owned by their associated canal company and cannot be leased without the canal company’s permission.
- The efficient use of markets may eliminate the need for storage.
- Market mechanisms do not address or improve the Henrys Fork River basin’s water budget.

Decision

Water markets may have the potential to help meet the needs in the Henrys Fork River basin; however, they must be used in conjunction with storage or conservation alternatives. Water markets and how they could meet needs will be incorporated in the appraisal-level study.

3.5 Agricultural Water Conservation

Four water conservation alternatives were evaluated to help meet the water needs of the Henrys Fork River basin: 1) recharge using existing canals; 2) canal automation; 3) installing pipelines or canal linings in irrigation canals; and 4) demand reduction. A fifth alternative, on-farm conservation practices, would have evaluated the conversion of surface irrigation systems to sprinkler irrigation systems and was originally planned for analysis. Due to the lack of extensive surface irrigation systems and the complexity of estimating the reduction of irrigated seepage along with increased crop consumptive use or reduced canal discharge, this alternative was not evaluated. Based on the analysis of the other conservation alternatives, it is probable that this alternative would yield similar results to the piping and lining of irrigation canals except on a much smaller scale.

The primary analysis tool for evaluating the conservation alternatives was a computational model (Model) developed by Dr. Van Kirk which allowed for the analysis of conservation alternatives to be made by changing diversions and by adjusting canal loss rates. The 43 diversion points analyzed with the Model corresponded to the water budget modeling Dr. Van Kirk developed for the Henrys Fork River basin (Reclamation 2012). Output results from the Model were associated with USGS stream gage locations and compared the modeled alternative's streamflow to the current streamflow conditions.

Monthly time-step water budgets of irrigated regions and major river reaches in the Henrys Fork River basin were developed (Figure 2). Water budget components, including stream flow, consumptive use, stream seepage, and groundwater return flows, were developed and documented for the modeling.

3.5.1 Recharge Using Existing Irrigation Canals (No. PN-HFS-006 in Appendix E)

Incidental recharge has a major impact on the rivers and streams of the Henrys Fork River basin. Increased recharge was modeled by diverting more water during the irrigation season using the existing canals. This was modeled for 20 percent and 40 percent increases in diversions for each of the four major irrigated regions, using the historical diversions for the basis of evaluating recharge (Table 22). Diversions were limited by the amount of available water in the stream or river (Teton Valley region) or the canal’s capacity (all regions).

Table 22. Summary of Recharge using Existing Irrigation Canals Alternative.

Irrigated Region	Impact on Water Budget	Relative Costs
North Fremont	Reduced annual, peak, and non-peak flows; no positive impact to flows	$0
Egin Bench	Reduced annual, peak, and non-peak flows; no positive impact to flows	$0
Teton Valley	Reduced annual and peak flows, but increased non-peak flows; improved non-peak flows make positive impact	$0
Lower Watershed	Reduced annual and peak flows, but increased non-peak flows; improved non-peak flows make positive impact	$0

Model output from this alternative indicated that total annual flows would be reduced in all irrigated regions which would have a negative impact on water supply; however, the Model output indicated that low season flows increased in the Teton Valley and Lower Watershed irrigated region which would have a positive impact on environmental needs. This alternative, modeled only for the irrigation season, is a no-cost alternative.

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- In the North Fremont and Egin Bench regions, recharge using existing irrigation canals reduces annual flows, peak flows, and non-peak flows. There is no positive impact to stream flows for this alternative in these regions.
- In the Teton Valley and Lower Watershed regions, recharge using existing irrigation canals reduces annual flows and peak flows, but increases non-peak flows. While a reduction of annual flows is a negative impact from the perspective of the overall water budget, the increase of non-peak flows is a positive impact during periods of normally low flows.
- The assumption of zero cost to implement this alternative may be optimistic.
- This alternative requires additional water rights for recharge to be obtained, which poses significant challenges.

Decision

Due to the significant challenges related to obtaining additional water rights and the limited and/or conflicting benefits/impacts, recharge using existing irrigation canals is not considered a viable option to meet the needs of the Henrys Fork River basin and the ESPA. This alternative will not be carried forward.

3.5.2 Canal Automation Alternative (No. PN-HFS-006 in Appendix E)

Automated canals more accurately adjust and divert water than manual systems and are a useful tool that allows irrigators to match diversion with irrigation requirements (Table 23). For this alternative evaluation, historical diversions were adjusted to match the crop consumptive use derived from historical evapotranspiration (ET) values for the geographic area. The Model internally calculated the theoretical crop consumption use based on the irrigated regions composite ET. Model runs were performed for each of the four major irrigated regions.

Model output from this alternative indicated an increase in the total annual flows in all of the irrigated regions, resulting in a positive impact on water supplies. Canal automation reduces flows during the low flow season in the Teton Valley and Lower Watershed irrigated regions which would have a negative impact on environmental needs.

Table 23. Summary Canal Automation Alternative.

Irrigated Region	Impact on Water Budget	Relative Costs*
North Fremont	Increases annual, peak, and non-peak flows; overall, positive impact to flows	$0.2 million
Egin Bench	Increases annual and peak flows; overall, positive impact to flows Reduced non-peak flows; negative impact to flows	$0.9 million
Teton Valley	Increases annual and peak flows increased; overall, positive impact to flows Reduced non-peak flows; negative impact to flows	$0.8 million
Lower Watershed	Increases annual and peak flows; overall, positive impact to flows Reduced non-peak flows; negative impact to flows	$2.3 million

*Canal automation costs were estimated for the primary diversion point of each canal in an irrigated region.

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- Automated canals provide flow measurement and data transmittal.
- Irrigators may reduce operation and maintenance costs using automated canals.
- Installation of fish screens, in conjunction with construction of automated canal systems, would have a positive environmental impact.
- For all four irrigated regions (Teton Valley, North Fremont, Lower Watershed, and Egin Bench), canal automation increases both total annual and peak flow volumes. This is a positive impact to the overall water budget of the Henrys Fork River basin.
- For the North Fremont region, canal automation increases non-peak flows. The increase of non-peak flows is a positive during periods of normally low flows. While the benefit to low flows is relatively small (less than a 2 percent non-peak flows increase), the absolute quantity of improved non-peak flows may have a positive impact.
- For the Teton Valley, Lower Watershed, and Egin Bench regions, canal automation may decrease non-peak flows. This would have a negative environmental impact.
- The analysis of automated canals in the Henrys Fork Basin only documented instream flows at existing USGS gaging stations. While model results show increased flows in the Henrys Fork River and Teton River, these increases likely come at the expense (reduction) of recharge to the Snake River or the ESPA below Rexburg.

Decision

This alternative will continue on to the appraisal study. Automated canals are considered a viable option to help meet the needs of the Henrys Fork River basin. A more detailed assessment of priority locations, costs, and how automated canals would meet needs will be provided in the appraisal study.

3.5.3 Piping and Lining of Irrigation Canals (No. PN-HFS-006 in Appendix E)

The installation of pipelines and the lining of irrigation canals to limit water loss due to canal seepage are routine conservation practices. These alternatives were modeled by setting irrigation diversions to ET demand while canal seepage losses were adjusted to simulate the piping and lining of canals and the water previously lost to seepage was used for crop irrigation (Table 24). Canal seepage losses were reduced 100 percent to model pipelines and reduced 75 to model canal linings (Reclamation 2012).

Table 24. Summary of Piping and Lining of Irrigation Canals Alternative.

Irrigated Region	Impact on Water Budget	Relative Costs
North Fremont	Increases annual, peak, and non-peak flows; overall, positive impact on flows	Piping: $167.1 million Lining: $ 97.6 million
Egin Bench	Reduces annual, peak, and non-peak flows; overall, negative impact on flows	Piping: $626.4 million Lining: $434.7 million
Teton Valley	Reduces annual, peak, and non-peak flows; overall, negative impact on flows	Piping: $418.8 million Lining: $154.0 million
Lower Watershed	Reduces annual, peak, and non-peak flows; overall, negative impact on flows	Piping: $963.8 million Lining: $633.7 million

Model output from this alternative indicated that the installation of pipelines and the lining of existing irrigation canals reduced the total annual flows in the Teton Valley, Lower Watershed, and Egin Bench irrigated regions which would have a negative impact on water supplies in those regions. However, total annual flows would be increased in the North Fremont region, resulting in a positive impact on water supplies in that region. Piping and lining of irrigation canals would decrease seasonal low flows in the Teton Valley, Lower Watershed, and Egin Bench irrigated regions which would have a negative impact on environmental needs in those regions; however, seasonal low flows would increase in the North Fremont region, resulting in a positive impact on environmental needs in that region.

The installation of pipelines and the lining of existing irrigation canals are expensive, with cost estimations ranging from $97.6 million for lining canals in the North Fremont irrigated region to $633.7 million for installing pipelines in the Lower Watershed region.

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- Piping and lining of irrigation canals is expensive.

- Pipeline may provide pressurized water, reducing pump needs, and conserving electricity.

- For the Teton Valley, Lower Watershed, and Egin Bench regions, piping and lining irrigation canals would reduce both total annual and non-peak flows and would have a relatively small impact, from a reduction of less than 1 percent to an increase of less than 1 percent on peak flows. The reduction in total annual flows and of non-peak flows would have a negative impact on the Henrys Fork River basin's water budget and environmental needs.

- In the North Fremont region, piping and lining irrigation canals would increase total annual flows, peak flows, and non-peak flows. This would have positive benefits to both the Henrys Fork River basin's water budget and environmental needs.

- A system of canal piping has been planned in the North Fremont system with the help of NRCS as a 5-phase project. Phases 1 and 2 have been constructed with financial assistance from IWRB and NRCS. A third phase has been designed and is under consideration for financing by IWRB. NRCS has committed its cost share. Construction of the remaining phases is planned for the near future.

Decision

Piping and lining are considered a viable option in the North Fremont irrigation region, but not considered a viable option in the Egin Bench, Lower Watershed, and Teton Valley irrigated regions to meet the needs of the Henrys Fork River basin. Given the advanced stage of implementation of pipeline projects in the North Fremont irrigation region, this alternative will not be carried forward to the appraisal study.

3.5.4 Demand Reduction (No. PN-HFS-006 in Appendix E)

The Demand Reduction Alternative evaluated the potential of reducing the number of irrigated acres. Other alternative demand reduction scenarios included changing from one crop type to another with lower irrigation requirements and partial or rotational fallowing systems. Reducing the number of irrigated acres in the demand reduction scenario allowed for both the most direct modeling and cost estimation.

The demand for water was reduced by setting diversions to ET demand and scaling back the irrigated area served by each of the canals by a 25 percent and a 50 percent acreage reduction (Table 25). Diversions were decreased by the model since ET demand is calculated by multiplying ET data by the irrigated area being served.

Table 25. Summary of Demand Reduction Alternative.

Irrigated Region	Impact on Water Budget	Relative Costs for 25% Demand and 50% Demand, respectively
North Fremont	Increases annual, peak, and non-peak flows; overall, positive impact on flows	$14.8 million and $29.5 million
Egin Bench	Increases annual, peak, and non-peak flows; overall, positive impact on flows	$13.9 million and $27.70 million
Teton Valley	Increases annual and peak flows; overall, positive impact on flows Reduced non-peak flows; overall, negative impacts during low flows	$24.0 million and $48.0 million
Lower Watershed	Increases annual and peak flows; overall, positive impact on flows Reduced non-peak flows; overall, negative impacts during low flows	$33.1 million and $66.3 million

Model output from this alternative indicated that reducing the number of acres irrigated would increase total annual flows in all of the irrigated regions, resulting in a positive impact on water supplies across the watershed; however, demand reduction would reduce seasonal low flows in the Teton Valley and Lower Watershed irrigated regions which would have a negative impact on environmental needs. Seasonal low flows would increase in the North Fremont and Egin Bench regions which would have a positive impact on environmental needs.

The demand reduction costs ranged from $14.8 million with a 25-percent demand reduction in the North Fremont irrigated region to $66.3 million with a 50-percent demand reduction in the Lower Watershed region.

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- Estimating the cost to achieve an acre of demand reduction is complex and variable.
- With the recent high commodity prices, there may not be interest in reducing agricultural production.
- Demand reduction would have other economic impacts due to the economic importance of agriculture in the Henrys Fork River basin.

- For all four of the irrigated regions, demand reduction would increase total annual flows and peak period flows. This would have a positive impact on the Henrys Fork River basin's water budget.
- For the North Fremont and Egin Bench regions, demand reduction would increase non-peak period flows. This would have positive effects on the Henrys Fork River basin's water budget and environmental needs.
- For the Teton Valley and Lower Watershed regions, demand reduction would decrease non-peak period flows.

Decision

This alternative will continue on to the appraisal study. Demand reduction is considered a viable option to meet the needs of the Henrys Fork River basin, but it will be difficult to implement on a large scale due to costs. Further demand reduction studies will augment understanding of the costs associated with reducing demand using deficit irrigation options or crop mix modification, rather than fully setting aside acreage. In addition, review of existing programs currently being implemented by the State and Federal partners, including the Conservation Reserve Enhancement Program (CREP) and Agricultural Water Enhancement Program (AWEP), could be performed to identify opportunities to increase program effectiveness. Specifically, identify options to increase the number of acres enrolled in CREP and evaluate costs necessary to encourage participation in the new endgun removal program through AWEP. The costs associated with these efforts could be clarified in addition to how demand reduction efforts meet needs.

3.6 Municipal and Industrial Water Conservation

Growth in domestic, commercial, municipal, and industrial water use is limited by inadequate water supplies or an inability to balance use of surface water and groundwater supplies. Water conservation measures, including new non-potable water supply options, were evaluated at the reconnaissance level.

Municipalities in the upper Snake River attempting to secure new sources of water to meet current and future needs have struggled to find the a source of water to mitigate the effects of new groundwater pumping on Snake River flows. The mitigation options would need to be effective in quantity, timing, and location. In recent years, the costs and regulatory constraints associated with some of the options have been prohibitive for a number of municipalities filing for new groundwater rights in the upper Snake River basin (IDWR 2013).

3.6.1 Municipal and Industrial Conservation (No. PN-HFS-007 in Appendix E)

This alternative is intended to assess and explore options for conserving water and developing potential new water supply sources for the municipal and industrial sectors of cities in and near the Henrys Fork River basin. Growth in domestic, commercial, municipal, and industrial water use is currently considered to be limited by inadequate water supplies or an inability to balance use of surface water and groundwater supplies (high costs for additional surface water treatment or non-potable conveyance systems and inability to acquire new groundwater permits).

Current water demands in Idaho Falls, Rexburg, Driggs, and Victor (all located near or within the Basin Study area) were assessed for potential conservation measures and new non-potable water supplies. These cities, which represent a range of small to large municipalities in or near the Henrys Fork River basin, were also compared to other Idaho cities that have implemented additional water conservation measures and use non-potable water supply for outdoor water use. The case study cities that were used for comparison purposes were Meridian, Caldwell, and Nampa, Idaho.

The following conservation measures and new non-potable water supply options were outlined in this study (CH2M HILL 2012):

- Municipal water conservation measures (Table 26)
    - Metering
    - Public education
    - Replace water lines buried above frost depth
- New non-potable water supply (Table 26)
    - Reuse treated domestic wastewater effluent (reclaimed water)
    - Raw water non-potable systems
    - Industrial conservation

Table 26. Municipal and industrial water conservation alternatives evaluated at the reconnaissance level (WestWater and CH2MHILLb).

Alternative	Impact on Water Budget	Relative Costs
Water conservation measures	19,230 acre-feet to be conserved annually by the municipalities, but likely with reductions in water available to downstream users.	$5,769,000 - $21,153,000
New non-potable water supply options	4.450 acre-feet to be conserved annually by the municipalities, but likely with reductions in water available to downstream users.	Not calculated

Discussions

The following key points were provided as feedback in the meetings between Reclamation and the interested groups. The comments provided may reflect opinions or unverified information and are not intended to provide a complete description of project issues:

- The basin cities use more than twice the water per capita as compared to the case study cities.
- The basin cities are constrained from growth due to their inability to obtain new groundwater rights.
- The basin cities often have substantial surface water rights due to annexation of nearby farmland.
- In Idaho, it is possible to convert surface water rights to groundwater rights. The basin cities believe they do not receive sufficient credit for this conversion and consequently, are not converting surface water rights to groundwater rights to any substantial degree.
- Some of the case study cities have separate pipelines for landscape irrigation with water obtained under their surface water rights. Thus the per capita use rate in the case study cities is higher than reported only for municipal water delivery.
- There is concern by the cities that dual pipe systems, with surface water for landscape irrigation, will be difficult and expensive due to the long and cold winters in the basin.
- If the basin cities use conservation to reduce per capita water use and then use the conserved water for additional population growth, there would be a negative impact on the basin's water budget.
- While municipal population growth and municipal water demand grew rapidly prior to 2008, recent economic conditions have slowed municipal population growth.

- Municipal and industrial water use represents less than 4 percent of the Henrys Fork River basin water budget.

Decision

Municipal and industrial conservation is considered a viable option to help basin cities meet their population growth needs, but this would not be a benefit to the Henrys Fork River basin water budget or the ESPA. The municipalities which participated in this Study will be able to implement conservation on their own to meet their needs. No further study of municipal and industrial conservation will be carried forward to the appraisal level.

4.0 NEXT STEP: APPRAISAL-LEVEL STUDIES

All of the alternatives carried forward to the appraisal level will be analyzed based on their impacts to the water budget and will be evaluated with respect to the Needs Assessment (Appendix A). The water management issues addressed by this Study are complex and involve multiple water uses. The objectives of the Study are to identify alternatives for developing the water supply, improving water management, and sustaining environmental quality. All of the alternatives should manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Reclamation defines an appraisal study as an initial planning investigation performed to determine the response of water supplies to an action, related resource problems, and needs in a particular area; to formulate and assess preliminary alternatives; to determine Reclamation's interests; and to recommend subsequent actions. Appraisal studies are based primarily on available existing data (Reclamation Manual, Directives and Standards, CMP 09-02). At the conclusion of the appraisal-level studies, the Basin Study work product will be a joint Reclamation/IWRB Basin Study report containing the appraisal-level analyses of the storage, water management, and conservation alternatives carried forward.

The analyses will include the implementation stages and the complexity of activities involved with each alternative. To fully evaluate impacts of all the alternatives, some of the processes that will be used to complete the appraisal study are:

- Documenting hydrologic and environmental impacts of alternatives – use RiverWare modeling procedures, water availability analysis, and individual and/or combinations of alternatives to show predicted temporal and spatial changes to river systems.

- Documenting environmental impacts of alternatives – review output of hydrologic analysis to assess environmental impacts.

- Documenting potential climate change impacts – use regional data set, incorporating climate change predictions, when evaluating impacts.

4.1 Summary

Based on the assessment of reconnaissance alternatives as shown in Section 2.0 and the group discussions presented in 3.0, the development of the appraisal-level alternatives will focus on the following items:

- Storage Alternatives:

  - Lane Lake – reconfigure the design for a larger reservoir and multiple water sources, eliminate Bitch Creek as water source, and evaluate impacts.
  - Spring Creek– consider alternatives with natural flows and evaluate impacts.
  - Moody Creek – consider alternatives with natural flows and evaluate impacts.
  - Upper Badger Creek – evaluate impacts.
  - Teton Dam - compare to other storage structures, evaluate impacts, and narrow down options.
  - Island Park Dam Raise – determine optimum height for Island Park Raise, consider increasing Island Park Spillway capacity, and evaluate impacts.
  - Ashton Dam Raise – evaluate impacts.

- Recharge Alternatives
  - Managed recharge – coordinate with IDWR using the ESPA2 recharge model in the Henrys Fork River basin.
- Water Market Alternatives
  - Water markets - investigate use of water markets in conjunction with all of the conservation and storage alternatives.
- Agricultural Conservation Alternatives:
  - Automated canals – prioritize canals, improve cost estimate, and evaluate impacts.
  - Demand reduction – augment technical report to include the costs associated with deficit irrigation and crop mix modification. Evaluate the potential to increase enrollment in CREP and encourage participate in the AWEP endgun program.

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Appendices