RECLAMATION

Managing Water in the West

Draft Environmental Assessment
Draft Finding of No Significant Impact

Colorado Water Users' Commitment to Provide 10,825 acre-feet to the 15-Mile Reach of the Upper Colorado River
Great Plains Region, Eastern Colorado Area Office

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

September 2011

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

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.

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FONSI NO. _____

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Great Plains Region, Eastern Colorado Area Office

Approved: _____ _____

Mike Collins, Area Manager — Date

U.S. Department of the Interior
Bureau of Reclamation
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Introduction

This Finding of No Significant Impact has been prepared to document the environmental review and evaluation of the proposed action in compliance with the National Environmental Policy Act of 1969, as amended. Based on the following finding, the Bureau of Reclamation (Reclamation) has determined that completing up to four contracting actions that would allow releases of 10,825 acre-feet per year (AF/yr) of water to benefit endangered fish species habitat as part of the east and west slope water users' commitment in the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) will not result in a significant impact to the human environment.

Preferred Alternative

Reclamation evaluated the effects of two alternatives: the No Action Alternative and the Proposed Action Alternative, and has selected the Proposed Action as the Preferred Alternative. Under this alternative, Reclamation will complete up to four contracting actions that are:

- A contract for release of 5,412.5 AF of water from Ruedi Reservoir. The term of this contract would be for up to 40 years.
- An "if and when" contract for use of facilities to store and exchange non-project water in the excess capacity of Green Mountain Reservoir. The term of this contract would be for up to 40 years.
- A contract or similar agreement between Northern Colorado Water Conservancy District (Northern Water) and an entity in the Grand Valley to release 5,412.5 AF of water from Granby Reservoir, which would allow the state to protect the water during conveyance to and through the 15-Mile Reach of the upper Colorado River. Reclamation would consent to the contract in writing but would not be a party to the contract. The term of this contract or agreement would be for up to 40 years.
- Supplement (modify) Contract No. 9-07-70-W0020 with Northern Water, which would recognize that 5,412.5 AF of the Redtop Valley Ditch water that would accrue to the Colorado-Big Thompson Project would be delivered to Mesa County, Colorado.

The purpose of the proposed 10825 Project is to allow water users who divert from the Colorado River or its tributaries upstream of the Gunnison River to fulfill a commitment described in the *1999 Final Programmatic Biological Opinion* [PBO] *for Bureau of Reclamation's Operations and Depletions, Other Depletions, and Funding and Implementation of the Recovery Program Actions in the Upper Colorado River Above the Confluence with the Gunnison River* (Service 1999). Pursuant to the PBO, the water users will permanently release 10,825 AF of water to augment baseflow in the 15-Mile Reach of the upper Colorado River in late summer and early fall in support of the recovery of endangered fish species.

The Proposed Action Alternative is comprised of the following elements:

- The permanent dry-up of a portion of the land irrigated by the Redtop Valley Ditch near Granby Reservoir through shares in the ditch that Northern Water owns or would acquire.
- The annual release of 5,412.5 AF of water from Granby Reservoir. Water not used for irrigation as a result of the dry-up would accrue to the C-BT Project consistent with the Colorado water rights system and be released from Granby Reservoir in accordance with

the supplement to Contract No. 9-07-70-W0020, which will allow Northern Water to contract with a Grand Valley entity with Reclamation concurrence.

- The annual release of 5,412.5 AF of water from Ruedi Reservoir.
- A periodic exchange of the water released from Granby Reservoir into Green Mountain Reservoir and the subsequent release of this water from Green Mountain Reservoir.
- Contracting actions between Reclamation and the appropriate parties to implement the above actions.

Finding of No Significant Impact

In the attached Environmental Assessment, Reclamation evaluated the environmental consequences associated with implementing the Proposed Action. Table 1 (see page 4) provides a brief summary of the environmental effects of the Proposed Action. The Proposed Action would not affect air quality, flooding/floodplains, transportation, visual resources, noise and vibration, cultural resources, Indian trust assets, and hazardous materials.

Environmental Commitments

Use of the Redtop Valley Ditch to supply the 5,412.5 AF from Granby Reservoir would result in a portion of the water that was historically diverted to the Redtop Valley Ditch being instead diverted and stored in Granby Reservoir under a C-BT 1935 priority. When Redtop Valley Ditch water is stored at times when C-BT is out of priority, additional releases from a 52,000-AF C-BT replacement pool in Green Mountain Reservoir would be necessary. Because the replacement pool fills first, the out of priority diversions could impact or short required releases from Green Mountain Reservoir's contract and HUP allocations in subsequent years when Green Mountain Reservoir does not fill. In a worst-case scenario, the shortage caused by the additional C-BT replacement release would be up to an estimated 1,786 AF. Additionally, storage of Redtop Valley Ditch water in Granby Reservoir and the additional C-BT replacement releases from Green Mountain Reservoir would also increase the substitution requirements of Denver Water and Colorado Springs Utilities.

To mitigate these impacts, this FONSI includes a commitment to create an "insurance pool" that would keep the Green Mountain Reservoir contract and HUP pools whole and augment the substitution requirements of Denver Water and Colorado Springs Utilities . How this insurance pool will be created has yet to be determined but it will be created through the cooperative efforts of Reclamation, Northern Water, Denver Water, Colorado River Water Conservation District, and possibly others. Reclamation will complete any necessary and appropriate NEPA documentation.

One of three options, or any combination of the three options described below, will form an insurance pool:

1. An "if and when" storage pool in Wolford Mountain Reservoir that could be filled by exchange from Grand County environmental water supplies if and when they were not needed for environmental purposes on the Colorado River below the confluence with the Blue River, as determined by Grand County. This pool would be the first to spill in the event that Wolford Mountain Reservoir filled and thus may not be available in all years.

Under terms of the Colorado River Cooperative Agreement, a negotiated but not formally approved agreement between Denver Water and a group of West Slope interests, Grand County will receive 1,000 AF of water supply from Denver's Moffat Collection system and up to 1,000 AF from Denver's Williams Fork Reservoir, which will be used to improve stream flows in the Upper Colorado River. Additionally, negotiations are currently underway with the Municipal Subdistrict of the Northern Colorado Water Conservancy District related to the Windy Gap Firming Project. Additional environmental water supplies may be made available to Grand County as the result of these negotiations. Collectively, these releases are called "Grand County environmental water."

2. Similar to 1) above, Grand County environmental water could be exchanged to Green Mountain Reservoir and held in an "if and when" storage pool or simply used to offset the releases from the 52,000-AF C-BT replacement pool caused by the 10825 water being stored in Granby Reservoir.

3. The CRWCD could obtain 2,000 AF water supply contract in Ruedi Reservoir that would back-up the Wolford Mountain Reservoir and Green Mountain Reservoir pools in years when they were not available or sufficient. A new contract for Ruedi Reservoir water would be consistent with the Ruedi Reservoir Round II Water Marketing EIS (Reclamation 1989), which required appropriate site-specific NEPA compliance by Reclamation on a case-by-case basis before any Ruedi water sales contracts can be executed. Any water sales contract with a prospective water user will contain environmental compliance requirements in relation to mitigating site-specific impacts of water sales that must be met as a part of the water sales contracting process.

Table 1. Summary of Direct and Indirect Environmental Effects of Proposed Action.

Surface Water Hydrology	Moderate long-term increase in North Fork Colorado River flow between the Redtop Valley Ditch and Shadow Mountain Reservoir and in Stillwater Creek between the Redtop Valley Ditch and Granby Reservoir during May, June, and July. Minor long-term decrease in Willow Creek flow during May, June, and July. Moderate long-term increase in Colorado River flow between Granby Reservoir and 15-Mile Reach during August and September. Minor, long-term infrequent changes in Blue River flow if an exchange of water was made from Granby Reservoir to Green Mountain Reservoir.
Groundwater Hydrology	Minor to negligible long-term reduction in groundwater levels near the Redtop Valley Ditch and agricultural dry-up area due to flow reductions in the Redtop Valley Ditch.
Water Quality	Minor long-term reduction in temperatures in Colorado River below Windy Gap when reservoir releases were made. Negligible effect on stream water quality. No effect on reservoir water quality.
Reservoir Operations and Hydroelectric Generation	No effect on Shadow Mountain Reservoir and Grand Lake storage levels and minor effect on Granby Reservoir storage levels. Minor, long-term infrequent increase in Green Mountain Reservoir storage levels if an exchange of water was made from Granby Reservoir to Green Mountain Reservoir. Minor decreased summer reservoir levels in Green Mountain Reservoir in dry years only. Potential reduction in the contract and HUP allocations in Green Mountain Reservoir and potential increase in the amount of water Denver Water and Colorado Springs Utilities "owes" Green Mountain Reservoir to complete a first fill (see environmental commitments). No effect on hydroelectric generation.
Aquatic Resources	Minor to negligible long-term beneficial effect in North Fork Colorado River and Stillwater Creek. Minor to moderate long-term adverse effect in Willow Creek. Minor long-term reduction in August and September stream temperatures and improvement in fish habitat in Colorado River below Windy Gap. Negligible effect on other rivers, streams, and reservoirs.
Wetland and Riparian Resources	Increased riparian and wetland vegetation along Stillwater Creek long-term. Negligible effect on wetlands along Willow Creek, Colorado River, and Blue River. About 62 acres of wetlands occur within the agricultural dry-up area. Wetlands that are supported solely by irrigation would be permanently lost; wetlands supported by a naturally occurring high water table or streamflows that existed before development of irrigated agriculture would remain. No effect on wetlands associated with Granby or Green Mountain reservoirs.
Vegetation and Wildlife Resources	No effect on federally threatened and endangered wildlife or plant species or Colorado plant species of concern. Minor long-term habitat reduction for sandhill crane, greater sage grouse, boreal toad, and wood frog. Negligible effect on raptor foraging habitat and no effect on known raptor nests or on large game. Minor change in species composition in agricultural dry-up area.
Soils and Farmland	Permanent loss of 479 acres of farmland of statewide importance in agricultural dry-up area.
Recreation	Negligible to minor long-term effects on reservoir recreation in Granby and Green Mountain. Negligible effects on boating and fishing in the Blue River and Colorado River.
Socioeconomics and Land Use	Negligible to minor long-term effects on water-based recreation economies. Negligible adverse effect on the agricultural portion of the Grand County economy. No disproportionately high and adverse human health or environmental effects on minority and low-income populations.

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Acronyms

15-Mile Reach	Colorado River from the confluence of the Gunnison River upstream approximately 15 miles to the Grand Valley Irrigation Company Diversion Dam near Palisade, CO
10825 water	10,825 acre-feet of water permanently released by the water users
2012 Agreement	Ruedi Reservoir 2012 Agreement
AF	acre-feet
AF/yr	acre-feet per year
ACS	American Community Survey
C-BT	Colorado-Big Thompson Project
CEQ	Council on Environmental Quality
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
cfs	cubic feet per second
CROA	Colorado River Outfitters Association
CRWCD	Colorado River Water Conservation District
CWCB	Colorado Water Conservation Board
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, and Trichoptera (common aquatic insects)
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
Fry-Ark	Fryingpan-Arkansas Project
GVIC	Grand Valley Irrigation Company
HUP	Historic Users Pool
MW	Megawatt
NEPA	National Environmental Policy Act
Northern Water	Northern Colorado Water Conservancy District
OMID	Orchard Mesa Irrigation District
PBO	15-Mile Reach Programmatic Biological Opinion
Plan	Grand County Rural Land Use Plan
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Recovery Program	Upper Colorado River Endangered Fish Recovery Program
SDO	Colorado State Demography Office
Service	U.S. Fish and Wildlife Service
Subdistrict	Municipal Subdistrict of the Northern Colorado Water Conservancy District
USGS	U.S. Geological Survey
Water users	Subset of east and west slope water providers in Colorado that divert water from the Colorado River Basin participating in the 10825 process
WQS	Water Quality Standards

1.0 Purpose and Need

1.1 Introduction

The Bureau of Reclamation (Reclamation) is proposing to complete up to four contracting actions that would allow releases of 10,825 acre-feet per year (AF/yr) of water to benefit endangered fish species habitat as part of the east and west slope water users' commitment in the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) (10825 Project). The completion of these contracting actions is the proposed federal action. The Recovery Program was formed in 1988 to recover the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail, which are endangered fish species inhabiting the upper Colorado River Basin. The target reach, which is referred to as the 15-Mile Reach, is a reach on the Colorado River that extends from the confluence of the Gunnison River upstream about 15 miles to the Grand Valley Irrigation Company Diversion Dam near Palisade, Colorado. Reclamation's Proposed Action is in response to a request from Northern Colorado Water Conservancy District (Northern Water) on behalf of a group of east and west slope water users that divert from the upper Colorado River Basin. The water users are: City of Aurora, Colorado River Water Conservation District, Denver Water, Eagle River Water and Sanitation District, Municipal Subdistrict-Northern Colorado Water Conservancy District, Northern Colorado Water Conservancy District, Southeastern Colorado Water Conservancy District, Upper Eagle Regional Water Authority, and Ute Water Conservancy District. The four proposed contracting actions are:

- A contract for release of 5,412.5 AF of water from Ruedi Reservoir, a Reclamation facility on the Fryingpan River. The term of this contract would be for up to 40 years.
- An "if and when" contract for use of facilities to store and exchange non-project water in the excess capacity of Green Mountain Reservoir, a Reclamation facility on the Blue River. The term of this contract would be for up to 40 years.
- A contract or similar agreement between Northern Water and an entity in the Grand Valley to release 5,412.5 AF of water from Granby Reservoir, a Reclamation facility on the Colorado River, which would allow the state to protect the water during conveyance to and through the 15-Mile Reach of the upper Colorado River. Reclamation would consent to the contract in writing but would not be a party to the contract. The term of this contract or agreement would be for up to 40 years.
- Supplement (modify) Contract No. 9-07-70-W0020 with Northern Water, which would recognize that 5,412.5 AF of the Redtop Valley Ditch water that would accrue to the Colorado-Big Thompson Project would be delivered to Mesa County, Colorado.

As the lead federal agency, Reclamation prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended; the Council on Environmental Quality (CEQ) regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] 1500-1508); the U.S. Department of the Interior's regulations for Implementation of the National Environmental Policy Act of 1969 (43 CFR 46); and Reclamation's Draft NEPA Handbook (Reclamation 2000). This EA is not a decision document, but rather it is a disclosure of the potential environmental consequences of Reclamation's Proposed Action.

The U.S. Fish and Wildlife Service (Service), an agency of the U.S. Department of the Interior, was invited to participate in the NEPA process as a cooperating agency. The Service accepted formal cooperating agency status and retains review and comment responsibility on the 10825 Project.

1.2 Purpose and Need

The purpose of the proposed 10825 Project is to allow water users who divert from the Colorado River or its tributaries to fulfill a commitment described in the *1999 Final Programmatic Biological Opinion* [PBO] *for Bureau of Reclamation's Operations and Depletions, Other Depletions, and Funding and Implementation of the Recovery Program Actions in the Upper Colorado River Above the Confluence with the Gunnison River* (Service 1999). Pursuant to the PBO, the water users will permanently release 10,825 AF of water ("10825 water") to augment baseflow in the 15-Mile Reach of the upper Colorado River in late summer and early fall in support of the recovery of endangered fish species. Under the PBO, the water users are to determine the existing or new facilities from which the water will be released and execute any necessary agreements to supply the 10825 water on a permanent basis. Reclamation cannot issue contracts with a duration of more than 40 years; to reflect the permanence of the 10825 water supply, Reclamation would include a renewal clause in the proposed contracts.

The water users and the Service implemented two interim agreements to supply the 10825 water until a permanent supply could be developed. Each of the interim agreements provided up to 5,412.5 acre-feet of water for the 15 Mile Reach. These agreements are explained in Section 1.4.3.2.

The Service recommended numeric mean monthly streamflow targets for the 15-Mile Reach as part of the Recovery Program (Osmundson et al. 1995). The Recovery Program is described in more detail in Section 1.4.3. The actual recommended flow targets vary by type of year (i.e., dry, average, and wet). Targets are defined for the baseflow period (August, September, and October) measured at the Palisade gage, ranging from a high of 1,630 cubic feet per second (cfs) for a wet year at least 50 percent of the time, to a low of 810 cfs for a dry year 100 percent of the time (Table 1; Figure 1). The recommended flow targets are based on biological and habitat requirements of the listed fish species and do not vary in response to the amount of water available to the Recovery Program.

The 15-Mile Reach of the upper Colorado River provides important habitat for endangered fish.

The interim agreements (Section 1.4.3.2) to augment flows in the 15-Mile Reach are important components to meeting the Service's recommended flow targets. With flow augmentation, the flow targets have been met at about twice the frequency than without augmentation (Table 1).

1.3 Analysis Area

The analysis area includes reaches of streams and reservoirs potentially affected by the 10825 Project and encompasses the upper Colorado River from the Redtop Valley Ditch Diversion downstream to the 15-Mile Reach, the Fryingpan and Roaring Fork rivers from Ruedi Reservoir to the Colorado River, and several tributaries and reservoirs within these stream reaches (Figure 2). The locations of physical modification and agricultural dry-up along the Redtop Valley Ditch are also included in the

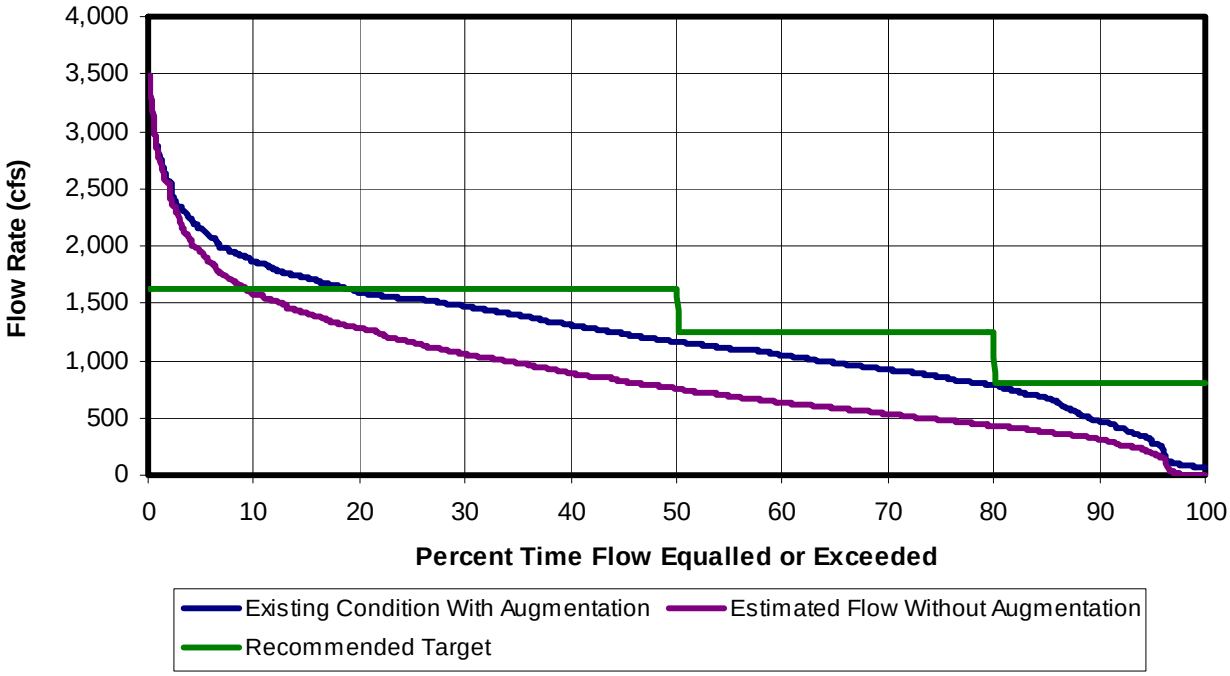


Figure 1. 15-Mile Reach Historical and Target Flow between August 1 and October 31 (Water Years 1998-2008).

analysis area. A more detailed discussion of the analysis area used to describe existing conditions and evaluate impacts is provided in Chapter 3.

1.4 Background

This section provides a description of Reclamation's existing operations within the analysis area, the Recovery Program, and the relationship between Reclamation's operations and the Recovery Program.

1.4.1 Reclamation and Granby and Green Mountain Reservoirs

The Colorado-Big Thompson Project (C-BT) stores, regulates, and diverts water from the Colorado River on the west slope of the Continental Divide to the east slope of the Rocky Mountains. C-BT provides supplemental water primarily for irrigation and municipal and industrial use. As these purposes are met, the project generates hydroelectric power, and provides water-oriented recreational opportunities.

Table 1. Service's Recommended Flow Targets on the Colorado River at the Palisade Gage.

Recommended Flow Target			Existing Flow (with Augmentation, 1998-2008)	Estimated Flow (without Augmentation, 1998-2008)
Type of Year	Flow (cfs)	Percent Time Flow Equaled or Exceeded Aug – Oct		
Wet	1,630	50	18	9
Average	1,240	80	45	23
Dry	810	100	80	47

Source: Osmundson, et al. 1995.

Granby Reservoir is the largest reservoir in the C-BT Project.

Reclamation operates power, storage, and carriage features on the west slope, and similar works on the east slope upstream of the supply canals leading from Carter Lake and Horsetooth Reservoir. All project works downstream of these two reservoirs are owned, operated, and maintained by Northern Water. The C-BT was designed to divert 310,000 AF of water annually, primarily snowmelt from the upper reaches of the Colorado River Basin west of the Continental Divide. The historical average annual diversion has been about 230,000 AF/yr.

Granby Reservoir, located on the Colorado River about 4.5 miles northeast of the town of Granby, Colorado, collects and stores spring runoff. Reclamation pumps C-BT water from Granby Reservoir into Shadow Mountain Reservoir, at the same elevation as Grand Lake, from where it can flow under the Continental Divide through the Adams Tunnel to the east slope.

Green Mountain Reservoir is about 13 miles southeast of Kremmling, Colorado on the Blue River. The reservoir's primary purposes are to provide replacement water for out-of-priority diversions in the upper Colorado River Basin by the C-BT Project and to preserve existing and future water uses and interests. The reservoir is also authorized to generate power. Spring runoff is stored in this reservoir and later released for C-BT-authorized purposes on the west slope. Green Mountain Power Plant is at the base of Green Mountain Dam; the plant uses the regulated streamflow of the Blue River and the water released from storage in Green Mountain Reservoir to generate electricity. Releases of water from the 66,000-AF Historic Users Pool (HUP) allocation within Green Mountain Reservoir are used primarily in the Grand Valley of Colorado and also indirectly result in improved flow and habitat conditions in the 15-Mile Reach.

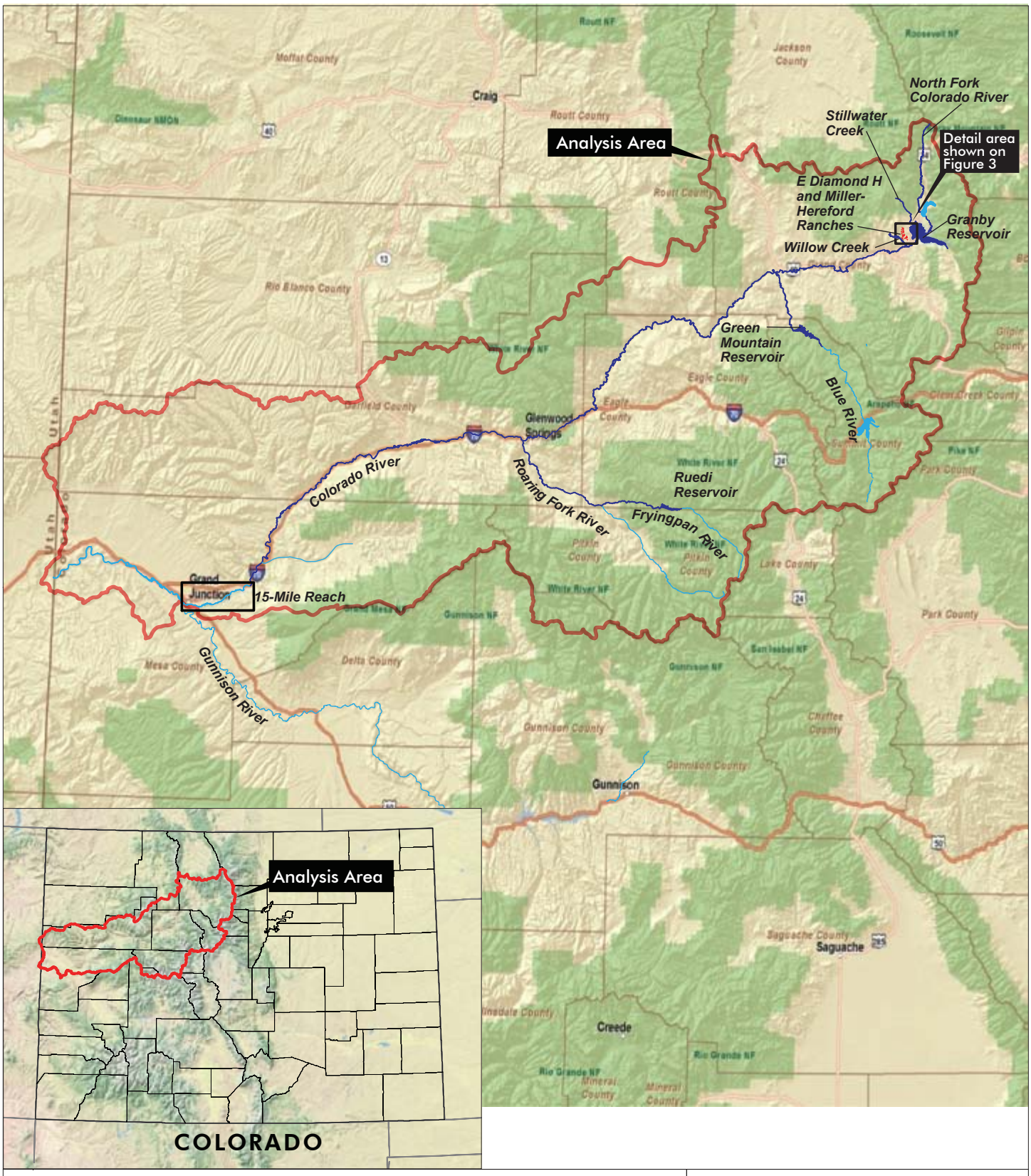
1.4.2 Reclamation and Ruedi Reservoir

Reclamation operates the Fryingpan-Arkansas (Fry-Ark) Project, which is a multipurpose transmountain diversion project. The Fry-Ark Project is authorized to divert up to 120,000 AF of water in any year, or 2,352,800 AF in any 34 consecutive years, from the Roaring Fork River Basin on the west slope to the Arkansas River on the east slope of the Rocky Mountains. The average annual diversion has been 69,000 AF.

Ruedi Reservoir, a component of the Fry-Ark Project is on the Fryingpan River about 15 miles east of Basalt, Colorado and provides storage for replacement of Fry-Ark Project out-of-priority diversions to the east slope and contract water that is used by western slope contractors primarily to augment out-of-priority diversions. The primary source of water is spring runoff, which is stored in Ruedi Reservoir during the runoff period and then released later in the year.

1.4.3 Recovery Program

Colorado pikeminnow, razorback sucker, humpback chub, and bonytail are endangered fish species inhabiting the upper Colorado River Basin. These warm water species are listed as endangered under the Endangered Species Act (ESA). The Colorado River from Rifle, Colorado downstream to the confluence with the Gunnison River, which includes the 15-Mile Reach, is designated critical habitat for the Colorado pikeminnow and razorback



10825 Environmental Assessment

Grand, Summit, Routt, Eagle, Pitkin, Gunnison, Garfield, Rio Blanco, and Mesa Counties, Colorado

Figure 2
General Analysis Area Evaluated in this EA

0 10 20 Miles

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June 2011

ERO Resources Corp.

Ruedi Reservoir provides water to the west slope to make up for water diverted to the east slope.

sucker and provides valuable spawning habitat for these species. The reach has an optimum balance between temperature and food availability for adult Colorado pikeminnow and an important refuge for endangered fishes should a catastrophic event cause a loss of populations in the Gunnison River or in the Colorado River below the Gunnison River confluence. Upstream diversions reduce spring peak flows and result in low flows during late summer and fall, both of which reduce the availability of important habitat elements.

The Recovery Program was formed in 1988 to recover these fish species in compliance with the ESA and other federal and state laws, while providing for new and existing water development in the upper Colorado River Basin. A variety of federal and state agencies and private organizations work cooperatively to implement strategies to recover the endangered fish while agricultural, hydroelectric, and municipal water needs are met in compliance with interstate compacts and applicable laws. Recovery strategies include improving physical habitat, assuring adequate streamflow, controlling nonnative fish populations, propagating and stocking endangered fish, and conducting research monitoring for adaptive management. The Service developed streamflow recommendations for the 15-Mile Reach to restore and maintain sufficient habitat and promote attainment of recovery goals (Table 1). Cooperative water resource management by Recovery Program partners results in operation of reservoirs to enhance spring peak flows and augment late summer and fall flows in the Colorado River. Agreements to meet recovery goals in the 15-Mile Reach are outlined in the 1999 PBO, Interim 10825 Agreements, and Ruedi Reservoir 2012 Agreement. These agreements are discussed briefly below.

1.4.3.1 Programmatic Biological Opinion

In 1999, the Service issued a PBO (Service 1999) for water operations by Reclamation, Western Area Power Administration, and other water users for funding and implementation of the Recovery Program in the upper Colorado River Basin upstream of the confluence with the Gunnison River. The PBO provided Section 7 compliance for all existing Reclamation depletions upstream of the Gunnison River, all nonfederal depletions in the same area, and 120,000 AF/yr of new water depletions by Reclamation and nonfederal water users. All nonfederal depletions upstream of the Gunnison River were treated as interrelated actions and, therefore, were covered by the PBO provided there is continued progress towards implementing the programs outlined in the PBO and the fish continue to recover. The PBO provides ESA compliance for these water operations. As part of the consultation, nonfederal water users agreed to provide 10,825 AF of water annually to the 15-Mile Reach from existing or new Colorado Water Division 5 (mainstem Colorado River Basin) facilities to benefit endangered fish (10825 water). Equal contributions of 5,412.5 AF/yr were to be provided by east and west slope water users. The water users were required to determine the existing or new facilities from which the water would be released and to enter into any necessary agreements. In 2011, the water users expect to execute a permanent agreement with the Service that identifies the permanent 10825 water sources.

1.4.3.2 Interim 10825 Agreements

In 2000, interim agreements were executed 1) among the City and County of Denver, acting by

and through its Board of Water Commissioners (Denver Water), the Colorado Water Conservation Board (CWCB), and the Service and 2) between the Colorado River Water Conservation District (CRWCD) and the Service. In this EA, these two agreements are collectively called "interim agreements." Under the interim agreements, Denver Water and CRWCD each provide half of the 10825 water through June 30, 2010, subject to extensions of up to 5 years if agreed to by the parties. Through these agreements, Denver Water releases water from Williams Fork Reservoir (or other available sources), and the CRWCD releases water from Wolford Mountain Reservoir or from Ruedi Reservoir pursuant to water contracts the CRWCD has with the Bureau. In 2010, the interim agreements were extended until July 1, 2013, with a possible extension for 2 more years.

The water users have indicated that if Reclamation does not complete the contracting actions, they will have to find an alternative source or sources for the 10825 water. The releases from Williams Fork and Wolford Mountain reservoirs will cease by as late as July 1, 2015 regardless of whether or not Reclamation issues the proposed contracts.

1.4.3.3 Ruedi Reservoir 2012 Agreement

In 2003, Reclamation entered into an agreement with the CWCB and the Service initially to make 21,650 AF of water available annually through 2012 for release from Ruedi Reservoir to the 15-Mile Reach of the Colorado River. This commitment was reduced to 10,825 AF when the water users entered into the interim agreements for 10,825 AF as explained in the prior section. The 2012 Agreement water is separate from the 10,825 AF of water associated with the commitment of the water users. Reclamation may contract for the Ruedi Reservoir water that is committed in the 2012 Agreement beginning in 2013, provided the demand materializes and depletions covered by the PBO will not be exceeded.

1.4.3.4 Colorado River Water Conservation District 5,000 AF Contract

In 2007, Reclamation contracted with the CRWCD for 5,000 AF/yr of Ruedi Reservoir water, which among other things, could be used to augment flows in the 15-Mile Reach in no more than 5 in 25 years and no more than 3 consecutive years in the event supply from Wolford Mountain Reservoir is not adequate to provide 5,412.5 AF. If it is projected that the contract water will not be needed for the 5,412.5 AF commitment to the 15 Mile Reach, then the CRWCD may use up to 75 percent of the uncommitted contract water to supplement winter instream flows in the Fryingpan River from January 1 to March 31. The CRWCD has not used the 5,000 AF/yr of Ruedi Reservoir water for the 15-Mile Reach. The contract is for 40 years and will remain in effect under the Proposed Action. It is not discussed further.

1.4.3.5 Coordination of Reservoir Releases

The Recovery Program relies on multiple water sources and agreements to supplement flows within the 15-Mile Reach. A team comprised of the water users, CWCB, State Division Engineer, the Service, and Reclamation has frequent communications regarding coordination of stored water releases to assist in attaining the 15-Mile Reach target flows. The Service determines when and from which reservoirs releases of its committed pools of Recovery Program water are made for the Recovery Program. Releases are made voluntarily by water users and Reclamation to enhance the magnitude and duration of spring peak flows through the Coordinated Reservoir Operations Program in a manner that does not impair the yield of these reservoirs. Late summer and fall releases to augment baseflow, which is the purpose of the 10825 water, are independent of the Coordinated Reservoir Operations Program.

Any modifications in reservoir release patterns for late summer and fall baseflow augmentation would

depend on a decision-making process that considers many factors including:

- The total amount of water available in each reservoir that stores Recovery Program water
- Existing streamflow conditions below each reservoir at the time of release
- Streamflow in the 15-Mile Reach
- Regional weather and streamflow forecasts
- Forecasted irrigation diversions above the 15-Mile Reach
- Forecasted inflow and timing of inflow into Reclamation and non-federal reservoirs

1.5 Agency and Public Involvement

Reclamation initiated a scoping process to provide an early and open process to gather information from the public and interested agencies on the issues and alternatives to be evaluated in this EA. Reclamation conducted stakeholder interviews with federal, state, and local agencies to solicit concerns and comments on the project, and determine the level of anticipated participation from each agency. During the scoping period, Reclamation held public scoping meetings on November 4, 2009 in Granby, Colorado and on November 5, 2009 in Carbondale, Colorado. The scoping period extended from October 28 to November 18, 2009. The scoping process and comments gathered by Reclamation are discussed in a Scoping Report (Reclamation 2009) and in Chapter 4, *Coordination and Consultation*.

2.0 Alternatives

2.1 Introduction

Chapter 2 describes the No Action Alternative, Proposed Action Alternative, and alternatives that were dismissed from further consideration. Direct, indirect, and cumulative effects of the Proposed Action are described in Chapter 3.

2.2 No Action Alternative

In the No Action Alternative, Reclamation would not complete any of the proposed contracting actions. Northern Water would likely sell portions of the Miller-Hereford Ranch and would not purchase the water rights of the Diamond H Ranch.

If Reclamation did not complete the contracting actions, the water users would then need to identify other feasible, permanent sources of water to provide 10,825 AF/yr to the 15-Mile Reach that would not require Reclamation contracts. If the water users were unable to provide the 10825 water as required in the PBO (Service 1999), reinitiation of ESA consultation pursuant to the PBO would be required. The Service's reconsultation process would be with the parties to the PBO (i.e., Reclamation, the Service, and Western Area Power Administration).

The eventual outcome of either the renegotiation among water users to provide another source of 10825 water or the reconsultation process with the Service cannot be reliably predicted in terms of specific institutional, operational, or structural measures. As such, potential environmental effects of the No Action Alternative cannot be determined, and are not discussed in this EA. Therefore, they cannot be used to determine the effects of the Proposed Action as directed by Reclamation's NEPA guidance. Consequently, potential effects of the Proposed Action Alternative (Section 2.3) are determined through comparison with the existing conditions, which are described in the *Affected Environment* sections in Chapter 3. Existing conditions are not anticipated or proposed to continue substantially into the future (i.e., beyond 2012) due to the interim and 2012 agreements discussed in Chapter 1, but do provide a reasonable basis for analyzing environmental consequences of the Proposed Action Alternative.

2.3 Proposed Action Alternative

The Proposed Action Alternative is comprised of the following elements:

- The permanent dry-up of a portion of the land irrigated by the Redtop Valley Ditch near Granby Reservoir through shares in the ditch that Northern Water owns or would acquire.
- The annual release of 5,412.5 AF of water from Granby Reservoir. Water not used for irrigation as a result of the dry-up would accrue to the C-BT Project consistent with the Colorado water rights system and be released from Granby Reservoir in accordance with the supplement to Contract No. 9-07-70-W0020, which would allow Northern Water to contract with a Grand Valley entity with Reclamation concurrence.
- The annual release of 5,412.5 AF of water from Ruedi Reservoir
- A periodic exchange of the water released from Granby Reservoir into Green Mountain Reservoir and the subsequent release of this water from Green Mountain Reservoir
- Contracting actions between Reclamation and the appropriate parties to implement the above actions as described in Section 1.1.

The proposed contracting actions described in Chapter 1 would allow water to be stored, released, and conveyed to augment the late summer and fall streamflow to help meet the needs of the endangered fish in the same manner that releases from Wolford Mountain and Williams Fork reservoirs met those needs.

2.3.1 Ruedi Reservoir

The proposed action includes a contract for the release of 5,412.5 AF from Ruedi Reservoir annually. The releases would be in addition to the water that Reclamation is committed to releasing from Ruedi Reservoir for the 15-Mile Reach (5 plus 5 Water – see Section 3.8.1.1.4). A long-term water supply contract with Reclamation would likely be used to provide these releases. Releases would be made for the Recovery Program as called for by the Service and would be coordinated with other supplies to benefit the 15-Mile Reach.

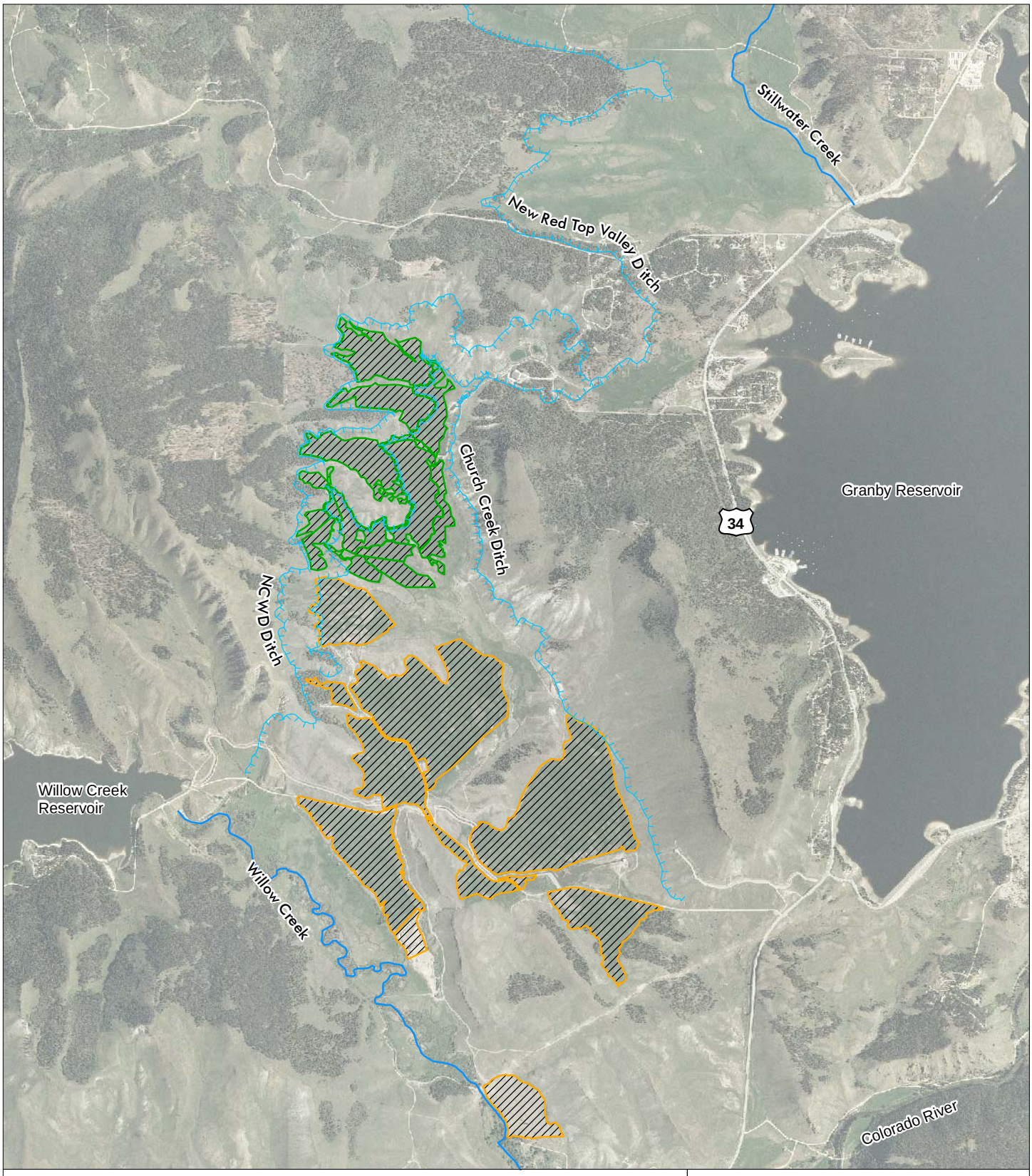
2.3.2 Granby Reservoir

Each year, a total of 5,412.5 AF of water would be released from Granby Reservoir. The water would be obtained by ceasing irrigation on 752 acres on the Miller-Hereford and E Diamond H ranches served by the Redtop Valley Ditch (Figure 3). The ditch shares associated with these ranches would be surrendered to the Redtop Valley Ditch Company, and water made available from irrigation cessation would be stored in Shadow Mountain and Granby Reservoirs under existing C-BT water rights. Shares of the Redtop Valley Ditch associated with the Miller-Hereford Ranch are currently owned by Northern Water, while Northern Water would purchase shares associated with the E Diamond H Ranch as part of the Proposed Action. Areas of both ranches not subirrigated would slowly transition to native vegetation. Northern Water would not likely use the ranches for agricultural purposes. It is expected that the Redtop Valley Ditch would be operated in the following manner:

- Northern Water's share of the ditch water would remain in the North Fork Colorado River, or would remain in the ditch to facilitate deliveries to shareholders (see description below).
- For this analysis, the total amount of diversion from the North Fork Colorado River would be limited to a maximum of 80 cfs. Actual maximum diversions may be higher or lower than this amount, but based on discussions with Northern Water, this was determined to be a reasonable estimate for analysis.
- The amount of diversions by the ditch that would otherwise be in excess of the assumed maximum diversion of 80 cfs would remain in the North Fork Colorado River. Streamflow in the North Fork would remain unchanged when flows were below the maximum diversion threshold.
- Northern Water's share of the ditch water that remained in the ditch and was used to facilitate deliveries would ultimately accrue to Stillwater Creek upstream of its confluence with Granby Reservoir. This water would be turned out of the ditch at one or more of the irrigation laterals and would eventually flow into Stillwater Creek and Granby Reservoir.

The additional inflow to Shadow Mountain Reservoir and Granby Reservoir would be diverted by the C-BT Project under the existing decreed water rights for the C-BT Project. The increased supply to the C-BT Project would include water that was historically consumed by irrigation, as well as water that was applied to irrigation and accrued to the Colorado River drainage below Granby Reservoir as irrigation return flow. All water stored in Granby Reservoir would be stored under existing decreed water rights and operational policies of the C-BT Project, including the replacement of all out-of-priority diversions into Granby Reservoir from the C-BT replacement pool in Green Mountain Reservoir.

To determine Granby Reservoir releases, an Operations Group would be established, consisting of representatives from the water users, the Service, Reclamation, and the State Division Engineer. The Operations Group would meet each spring to choose a release pattern for the 5,412.5 AF from Granby and develop a plan for releasing the 10825 water from Granby and Ruedi Reservoirs during the coming 12 months. The parties anticipate the Granby release pattern would depend on the type of hydrologic year (dry,



10825 Environmental Assessment

- Ditch
- Agricultural Dry-Up Study Area
- E Diamond H Ranch Irrigated Acreage
- Miller Hereford Ranch Irrigated Acreage

0 1,500 3,000 Feet

N

Figure 3
Lands Proposed for Agricultural Dry-Up

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June 2011

ERO Resources Corp.

average, or wet) and targeted streamflow in the Colorado River downstream of Granby Reservoir, which would normally coincide with needs in the 15-Mile Reach. Release of the 5,412.5 AF from Granby Reservoir would be pursuant to a municipal-recreation contract with a Grand Valley municipal entity to assure that the water is protected from diversion to and through the 15 Mile Reach. All releases would be made in compliance with federal and Colorado law.

For the purposes of this EA, the releases from Granby Reservoir are evaluated based on fixed schedules (Table 2), depending upon hydrologic conditions. For modeling purposes in this assessment, a dry year is considered any year when Reclamation reduces flows from Granby Reservoir in accordance with the "Principles to Govern the Release of Water at Granby Dam to provide Fishery Flows immediately Downstream in the Colorado River" signed and approved by the Secretary of the Interior on January 19, 1961. The Operations Group would determine whether releases would be made based on the average or wet year schedule. It is recognized that these schedules may be modified each year by the Operations Group, but represent a reasonable basis for evaluation of impacts.

Table 2. Granby Release Schedule Analyzed in this EA.

Date	Granby Releases (cfs)		
	Dry	Average	Wet
July 1-14	0	0	0
July 15-31	22	0	0
August 1-14	47	50	35
August 15-31	47	50	50
September 1	55	50	70
September 2-9	38	50	70
September 10-15	38	50	50
September 16-20	21	29	50
September 20-30	21	29	24

Source: Grand River Consulting 2011.

Irrigation cessation on the Redtop Valley Ditch is estimated to result in the average annual inflow to Granby Reservoir increasing by up to 6,475 AF (Grand River Consulting 2011). The disposition of Redtop Valley Ditch water in excess of 5,412.5 AF/yr has yet to be determined at this time and is not evaluated in this EA.

2.3.3 Green Mountain Reservoir

Under some hydrologic conditions, releases from Granby Reservoir may not coincide with the Service's requirements for the 10825 water at the 15-Mile Reach. In instances when water was released from Granby Reservoir, but not needed in the 15-Mile Reach, the Service would have the option of exchanging the unneeded water into Green Mountain Reservoir and storing it for later release by Reclamation. The rate of exchange would not exceed the instantaneous rate of release of 10825 water from Granby Reservoir, which is projected to be 50 cfs or less in an average year (Table 2). The decision to exchange water would be made by the Service and would be based on many factors including streamflow in the 15-Mile Reach, climatic conditions, weather forecasts, space available for additional storage, comments and concerns of Reclamation and other water diverters, and the amount of water supplies available to the Service in other reservoirs.

Any exchanges would most likely occur in either August or September during one of the following conditions:

Early August of Wet Years. In wetter than average years, releases may begin from Granby Reservoir as early as August 1. Under such conditions, streamflow in the 15-Mile Reach may be greater than the established flow targets for the Recovery Program. The Service may desire to exchange the Granby Reservoir releases into Green Mountain Reservoir until such time as streamflow receded in the 15-Mile Reach. In some of these wetter than average years, storage in Green Mountain Reservoir may be at capacity through the early part of August and the exchange of water would not be possible.

Summer Rainfall Events. Prolonged rainfall events or monsoonal weather patterns may increase the flow in the 15-Mile Reach to a level greater than the established flow targets for the Recovery Program. It may be desirable to exchange Granby Reservoir releases into Green Mountain Reservoir during these events.

For example, if 25 cfs were released from Granby Reservoir and the Service did not desire this water in the 15-Mile Reach at the time of the release, the 25 cfs would be exchanged into the Green Mountain Reservoir excess capacity account by reducing the outflow from Green Mountain Reservoir by 25 cfs. Assuming that outflow from Green Mountain Reservoir was 400 cfs, releases to the Blue River would be reduced to 375 cfs, and this water would be booked into the excess capacity account. Streamflow in the Blue River above the Colorado River confluence would be reduced by 25 cfs and streamflow below the confluence of the Blue and Colorado rivers would be unchanged.

Several conditions would be met before an exchange to Green Mountain Reservoir could be made. First, excess capacity must exist in the reservoir. If the reservoir was full, no space would exist to store water via exchange and any 10825 releases from Granby Reservoir would continue to flow downstream. Second, releases from Green Mountain Reservoir must exceed 85 cfs if Reclamation is exercising its Green Mountain Reservoir junior refill right. As a practical matter, exchanges may be made into Green Mountain Reservoir whenever releases from the reservoir were required to meet either a Shoshone or Cameo call (described in Section 3.2.4).

The exchange would be operated to consider instream flow values in the Blue River below Green Mountain Reservoir. The exchange would not be operated to the extent that instream flow water rights for the Blue River would be affected. The exchange would also be operated to ensure that required bypass flows for Dillon Reservoir and Green Mountain Reservoir are maintained at all times.

This water could be released later at the Service's request and in accordance with the appropriate contract(s) with Reclamation, to benefit the 15-Mile Reach without adversely affecting power generation at Green Mountain Reservoir. Contract(s) with Reclamation for the storage and release of this water would include the appropriate provisions to prevent the loss of electric generation at Green Mountain Reservoir.

Releases of the exchanged water would likely occur in the late summer of the year (July through October) when streamflow in the 15-Mile Reach was low. If the Service did not release all of the water in this separate "if and when" exchange pool during the summer, it could be released by the Service the following spring to increase peak streamflow in the 15-Mile Reach. Any water remaining in the excess capacity account would likely be spilled from Green Mountain Reservoir after the peak of the hydrograph the following spring, when Green Mountain Reservoir filled to capacity. Under existing conditions, this water would be the first water spilled out of Green Mountain Reservoir.

2.3.4 Potential Mitigation

The use of the Redtop Valley Ditch to supply 5,412.5 AF from Granby Reservoir would result in a portion of water that historically was diverted to the Redtop Valley Ditch being diverted into Granby Reservoir under a C-BT 1935 priority. When Redtop Valley Ditch water is stored at times when C-BT is out of priority, additional releases from the 52,000-AF C-BT replacement pool in Green Mountain Reservoir would be necessary. Because the replacement pool fills first, the out of priority diversions could impact or short required releases from Green Mountain Reservoir's contract and HUP allocations in subsequent years when Green Mountain Reservoir does not fill. In a worst-case scenario, the shortage caused by the additional C-BT replacement release would be up to an estimated 1,786 AF. In a similar fashion, storage in

Granby Reservoir and the additional C-BT replacement releases from Green Mountain Reservoir also would increase the substitution requirements of Denver Water and Colorado Springs Utilities. Operation of Green Mountain Reservoir is described in Section 3.8.1.1.3 and effects of the 10825 Project on the reservoir are described in Section 3.8.2.1.1.

To mitigate these impacts, an "insurance pool" could be established that would keep the Green Mountain Reservoir contract and HUP allocations whole and augment the Denver Water and Colorado Springs Utilities substitution supplies as needed. The insurance pool is discussed in Section 3.8.2.1.1.

2.4 Alternatives Considered but Dismissed

Prior to this EA, the water users considered a range of alternatives to provide 10,825 AF of water to the 15-Mile Reach. Additional alternatives were suggested by the public during scoping. While all of these alternatives were considered, only the Proposed Action was retained for detailed analysis in this EA. This section summarizes the alternatives considered and their basis for elimination.

2.4.1 Prior Alternatives Development and Screening

In 2007, the water users initiated a process to develop and evaluate alternatives for providing the 10825 water. The alternatives were evaluated for anticipated environmental effects, cost, engineering feasibility, ability to meet release requirements, and institutional feasibility. Details on the location, facilities, operation, and screening of the alternatives are provided in the following two reports:

- 10825 Water Supply Study Phase 1 Report: Screening of Water Supply Alternatives (Grand River Consulting 2007)
- 10825 Water Supply Study Phase 2 Report: Selected Alternative for 10,825 Acre-Feet of Water per Year for the Upper Colorado River Endangered Fish Recovery Program (Grand River Consulting 2009)

Appendix A summarizes the 24 alternatives that were evaluated and provides the primary reason why the stakeholders selected the Proposed Action (termed the "Selected Alternative" in Grand River Consulting (2009)).

Although several alternatives were judged to be viable sources for the 10825 water, the Proposed Action adequately met all of the project objectives and evaluation criteria, including providing the most benefit to headwater streams. Also, the Proposed Action was the only option that received consensus support of the water users. Reclamation and the Service participated in a consulting capacity in the evaluation process and reevaluated the results of that process during preparation of this EA. The range of alternatives developed by the water users and the water users' alternatives evaluation process were comparable to the process typically used by Reclamation to identify and screen alternatives and identify a proposed action. Consequently, the alternatives analysis process and its outcome, a recommended proposed action, is acceptable for Reclamation's NEPA compliance purposes. Therefore, only the Proposed Action is analyzed in detail in this EA.

2.4.2 Scoping Alternatives

The public and agencies suggested five alternatives during scoping; each was intended to avoid or limit the use of the Fryingpan River or Ruedi Reservoir for 10825 purposes. A description and evaluation of each alternative follows.

2.4.2.1 Releases to the Upper Roaring Fork River

This alternative would avoid use of the Fryingpan River and would enhance low flows in the upper Roaring Fork River. An alternative that would achieve these objectives, the Ruedi Reservoir to Roaring Fork Tunnels Alternative, was evaluated previously (Grand River Consulting 2007). Two

tunnel and pumping station configurations were considered. This alternative was dismissed from further consideration due to its prohibitively high cost (more than $100 million). Potential permitting concerns and a lengthy time for implementation (perhaps 10 years to permit and construct) were also noted. Consequently, this alternative was dismissed from detailed analysis in this EA.

2.4.2.2 Pipeline or Canal from Ruedi Reservoir to Basalt

Similar to the above alternative, this alternative would avoid use of the Fryingpan River. The Ruedi Reservoir to Basalt Gravity Pipeline Alternative evaluated previously (Grand River Consulting 2007) would achieve this objective. This alternative was dismissed from further consideration due to its prohibitively high cost (more than $40 million). Potential permitting concerns and a lengthy time for implementation (perhaps 5 to 10 years to permit and construct) were also noted. These prior screening issues remain and, consequently, this alternative was dismissed from detailed analysis in this EA.

2.4.2.3 Placita Reservoir and Use of Historic Storage Rights

Placita Reservoir is a proposed storage facility on the Crystal River near Redstone (Western Engineering, Inc. 1983). This new reservoir would require construction of a dam on the mainstem of the Crystal River, a tributary of the Roaring Fork River. To construct this dam on a water of the U.S. and inundate several existing wetlands would require a permit under Section 404 of the Clean Water Act. This alternative was eliminated from further consideration because of wetland impacts and the time required to permit and construct the reservoir (likely more than 10 years).

2.4.2.4 Obtain Water from Rivers Other than the Fryingpan River

This conceptual alternative would use water obtained from outside the Fryingpan River Basin to meet 10825 water needs. Several alternatives that relied on non-Fryingpan River water supplies were considered in the prior alternatives development and evaluation processes (Grand River Consulting 2007, 2009). These alternatives were eliminated for a variety of cost, logistical, and environmental reasons (Appendix A).

2.4.2.5 Subdaily Release Pattern

This alternative is identical to the Proposed Action, except releases of 5,412.5 AF from Granby Reservoir would be made only 12 hours each day. The releases would be timed so that the water is conveyed through the Colorado River below Windy Gap Reservoir at the times of the day when water temperatures are historically highest. This would improve aquatic habitat conditions for the coldwater fishery in this reach of the Colorado River.

The subdaily release pattern was not evaluated in this EA because of large streamflow fluctuations associated with the shorter release times from Granby Reservoir, difficulty in operating Windy Gap Reservoir to allow the subdaily releases to pass without attenuation, difficulty in water administration on a subdaily scale, and adverse effects on irrigators.

3.0 Affected Environment and Environmental Consequences

3.1.1 Introduction

This chapter describes the affected environment and discloses the potential environmental consequences associated with implementing the Proposed Action as described in Chapter 2. Resources evaluated in this chapter include surface water hydrology, groundwater hydrology, water quality, hydroelectric generation, aquatic resources, wetland and riparian resources, vegetation and wildlife, soil and farmland resources, recreation, and socioeconomics and land use. A summary of effects is shown in Table 4. As described in Section 3.2.11, air quality, flooding/floodplains, transportation, visual resources, noise and vibration, cultural resources, Indian trust assets, and hazardous materials would not be affected by the Proposed Action, and have been considered but eliminated from further evaluation.

10825 water is currently supplied through interim agreements (Section 1.4.3.3) that will not continue beyond 2013, with a possible extension for 2 more years. This existing condition provides a baseline condition, which was used to evaluate the level of potential impact resulting from the implementation of the Proposed Action. Impact thresholds used to analyze the Proposed Action are defined in the next section.

3.1.2 Impact Thresholds

Direct, indirect, and cumulative effects were analyzed for each resource topic and are described in terms of type, duration, and intensity, with general definitions of each provided below.

3.1.2.1 Duration

Duration describes the length of time an effect would occur as short- or long-term.

Short-term: effects lasting up to 2 years.

Long-term: effects lasting more than 2 years and up to the length of the proposed contracts, which is up to 40 years.

All effects described in this chapter would be long term unless otherwise noted.

3.1.2.2 Type

Type describes the classification of the effect as beneficial or adverse, and direct, indirect or cumulative.

Beneficial: positive change in the condition or appearance of the resource, or a change that moves the resource toward a desired condition.

Adverse: negative change that detracts from the resource's appearance or condition, or a change that moves the resource away from a desired condition.

All effects described in this chapter would be adverse unless otherwise noted.

Direct: effects caused by the Proposed Action and occurring in the same time and place as the Proposed Action activities.

Indirect: effects caused by the Proposed Action but occurring later in time or farther removed in distance than the Proposed Action activities.

Cumulative: incremental effects caused by the Proposed Action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions (40 CFR 1508.7). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over time.

Several reasonably foreseeable actions are anticipated to occur in the future regardless of the implementation of the Proposed Action. The cumulative effects analysis evaluates reasonably foreseeable actions that, when combined with the Proposed Action, result in a cumulative effect on the environment. Potential future actions were

considered reasonably foreseeable and were included in the cumulative effects analysis if they met all of the following criteria:

- The action would occur within the same geographic area where effects from the Proposed Action are expected to occur.
- The action would affect the same environmental resources as the Proposed Action, and contribute to the total resource impact.
- There is reasonable certainty as to the likelihood of the action occurring (e.g., actions that are funded or permitted for implementation or are included in firm near-term plans).

Potential future actions were identified through available data on known projects or actions under consideration in the vicinity of the analysis area. Future actions meeting the criteria described above are described in Section 3.2. Because the Proposed Action would result in limited new infrastructure or ground disturbance in remote areas, reasonably foreseeable actions were limited to those water-based actions that would have overlapping effects with the Proposed Action on water resources.

3.1.2.3 Intensity

Intensity of the effect describes the degree, level, or strength of an effect using qualitative terms of no impact, negligible, minor, moderate, or major. The following explains the thresholds used to determine intensity. Effects other than major effects are insignificant.

No effect: no discernable effect.

Negligible: effect is at the lowest level of detection and causes very little or no disturbance.

Minor: effect is slight, but detectable, with some perceptible effects of disturbance.

Moderate: effect is readily apparent and has measurable effects of disturbance.

Major: effect is readily apparent and has significant effects of disturbance.

3.2 Reasonably Foreseeable Actions

Water-based actions refer to proposed water storage and diversion projects, water rights changes, or other activities requiring authorization under Section 404 of the Clean Water Act. The cumulative effects analysis focused on water-based actions because the Proposed Action involves very limited land-disturbing activities or other on-the-ground changes. All of the following reasonably foreseeable water-based actions were considered in the evaluation of cumulative effects.

3.2.1 Orchard Mesa Irrigation District–Efficiency Improvements

The Orchard Mesa Irrigation District (OMID) is a major supplier of irrigation water in the Grand Valley area, located just east of Grand Junction. OMID provides irrigation water to a 9,200-acre area south of the Colorado River, adjacent to the 15-Mile Reach. Water management techniques will be implemented to improve irrigation efficiency and reduce irrigation spills to the Colorado River from the OMID canal system. The improvements could reduce OMID's Colorado River diversions by an average 17,000 AF each year, without affecting local crop production. Reduced OMID irrigation diversions will be replaced with increased utilization of the Grand Valley Power Plant and associated water right. The power plant discharges water back to the Colorado River directly above the 15-Mile Reach thereby increasing flows in the reach. This operation may also result in reduced demand on the Green Mountain Reservoir HUP which would contribute to more frequent and larger magnitude surplus water declarations in some years.

3.2.2 Northern Water–Windy Gap Firming Project

The Municipal Subdistrict of the Northern Colorado Water Conservancy District (Subdistrict), is proposing to improve the firm yield of the existing Windy Gap Project. The Proposed Action identified in the draft EIS is construction of a 90,000 AF Chimney Hollow Reservoir just west of Carter Lake on the east slope. This project is anticipated to result in additional average annual depletions of 21,317 AF from the Colorado River upstream of the Gunnison. Reclamation completed a draft Environmental Impact Statement (EIS) for the project in 2008 (Reclamation 2008a). Completion of the final EIS is anticipated in 2011.

In conjunction with the environmental evaluation of the Windy Gap Firming Project, the Subdistrict prepared a Fish and Wildlife Mitigation Plan and a Fish and Wildlife Enhancement Plan. Both plans were approved by the Colorado Wildlife Commission on June 9, 2011 and subsequently by the CWCB on July 13, 2011. The mitigation plan includes measures on the West Slope in the Colorado River basin in addition to East Slope mitigation measures. Components of the mitigation and enhancement plans with potential direct effects on the Colorado River below Windy Gap Reservoir include higher streamflow in the Colorado River and lower temperatures when specified temperature values are exceeded between July 15 and August 31. The Subdistrict is also participating with Denver Water on the Upper Colorado River Habitat Project. The goal of the Habitat Project is to design and implement a stream restoration program to improve the existing aquatic environment from the Windy Gap diversion at Windy Gap Reservoir to the lower terminus of the Kemp-Breeze State Wildlife Area, about 2 miles downstream from the confluence with the Williams Fork.

3.2.3 Denver Water–Moffat Collection System Project

Denver Water's total system demand is anticipated to grow to 363,000 AF/yr on average by 2030. Denver Water's current demand is 285,000 AF/yr on average; therefore, an average increase in demand of 78,000 AF/yr is anticipated by 2030. The Moffat Collection System Project is proposed by Denver Water to develop 18,000 AF of new annual yield to Denver Water's collection system to meet future water demands on the east slope. The remainder of the deficit would be fulfilled by savings from implementing various conservation measures and by using existing infrastructure.

Denver Water proposes to enlarge its existing Gross Reservoir by 72,000 AF for Denver Water needs and 5,000 AF for an environmental pool, resulting in a total storage capacity of approximately 119,000 AF. The environmental pool would not increase diversions from the west slope. Using existing collection system infrastructure, water from the Fraser River, Williams Fork River, and South Boulder Creek would be diverted and delivered during average to wet years via the Moffat Tunnel and South Boulder Creek to Gross Reservoir. There would be no additional diversions in dry years because Denver Water already diverts the maximum amount physically and legally available under their existing infrastructure and water rights even without the proposed additional storage in their system. The U.S. Army Corps of Engineers released a draft EIS for this project in 2009 (Corps 2009).

In conjunction with the environmental evaluation of the Moffat Project, Denver Water prepared a Fish and Wildlife Mitigation Plan and a Fish and Wildlife Enhancement Plan. Both plans were approved by the Colorado Wildlife Commission on June 9, 2011 and subsequently by the CWCB on July 13, 2011. The mitigation plan includes measures on the West Slope in the Fraser, Williams Fork, and Colorado River basins in addition to East Slope mitigation measures. Components of the mitigation and enhancement plans with potential direct effects on the Colorado River below Windy Gap Reservoir include higher streamflow in the Fraser and Colorado River at times specified by Grand County. Denver Water is also participating

with the Subdistrict on the Upper Colorado River Habitat Project as described in Section 3.2.2.

3.2.4 Colorado River Cooperative Agreement

As part of negotiations between Denver Water and West Slope interests, Denver Water and Grand County (the parties) have developed a proposed agreement that addresses some of the issues related to Denver Water's existing operations in Grand County and downstream impacts on the mainstem of the Colorado River to the state line. In the proposed Colorado River Cooperative Agreement, Denver Water has committed to provide environmental enhancements to benefit the aquatic environment in the Fraser, Williams Fork, and upper Colorado rivers. These commitments are contingent on the issuance and acceptance by Denver Water of the permits necessary for implementation of the Moffat Project.

As part of the Agreement, the parties also will work toward implementing a "Shoshone Outage Protocol" during an unscheduled outage of the Shoshone Power Plant to mitigate the potential adverse effects of the absence of the Shoshone call. Denver Water, the Middle Park Water Conservancy District and the CRWCD agree to operate their water collection and storage systems as if the senior Shoshone Power Plant right were in priority during specified times when the plant is not operational. The parties will cooperate to manage flows in the Colorado River based on historical conditions and will work with Reclamation to achieve operation of Green Mountain Reservoir based on the Outage Protocol. Reclamation has not yet taken a position on participation in the Outage Protocol, but has operational flexibility to participate with or without a formal agreement on how releases from Green Mountain Reservoir are managed during an outage. Reclamation has used this operational flexibility in recent years to participate in ad hoc flow management that is similar to the Shoshone Outage Protocol, and it is reasonably foreseeable that Reclamation will participate in the Shoshone Outage Protocol.

The parties agree to not oppose the existing 2007 Shoshone call relaxation agreement between Denver Water and Xcel Energy (see next section) and to support renewal of the agreement.

3.2.5 Xcel Energy–Reduction in Shoshone Call

The Shoshone Power Plant, which is owned by Xcel Energy, has two water rights to divert a total of 1,408 cfs from the Colorado River 8 miles east of Glenwood Springs. Denver Water and Xcel Energy have negotiated an agreement to invoke a relaxation of the Shoshone call at limited times when river flows are less than 1,408 cfs at the point of diversion. The agreement to relax the call could result in a call of 704 cfs, which would be managed to prevent injury to irrigation users in the Cameo/Grand Valley area. The Cameo call refers to a suite of senior water rights near Grand Junction. The Shoshone call would be increased above 704 cfs as needed to keep the Cameo water rights satisfied. The Shoshone call relaxation could be invoked if, in March, Denver Water predicts its total system storage to be at or below 80 percent on July 1 that year, and the March 1 Natural Resources Conservation Service forecast for Colorado River flows at Kremmling or Dotsero are at or below 85 percent of average. The Shoshone call relaxation could be invoked between March 14 and May 20. The term of this agreement is from January 1, 2007 through February 28, 2032.

3.2.6 Colorado Springs Utilities Continental-Hoosier System Exchanges

Colorado Springs Utilities has absolute and conditional rights of exchange in Case No. 03CW314 in connection with the Continental-Hoosier System. These exchange rights would allow Colorado Springs Utilities to divert additional water at the Continental-Hoosier System when their rights are out of priority (e.g., Xcel Energy's Shoshone Power Plant rights are calling) and exchange potential exists in the Blue River Basin. These exchange rights would typically be exercised in late summer/early fall after Colorado

Springs Utilities has completed diverting under the Blue River Decree. The circumstances under which these exchanges could occur are varied and difficult to predict since they depend on the physical availability of water at the Continental-Hoosier System and intervening water rights in the exchange reach including Denver Water's rights at Roberts Tunnel and Dillon Reservoir. The operation of these exchanges also depends on Colorado Springs Utilities' operational needs and potential benefits to its system. Although Colorado Springs Utilities may have the physical and legal ability to exercise an exchange, it may choose not to do so based on other factors related to their overall system operation. Reclamation completed a final EA and Finding of No Significant Impact (FONSI) for this project in 2008 (Reclamation 2008b).

3.2.7 Colorado River Water Conservation District–Increases in Wolford Mountain Reservoir Contract Demands

The CRWCD projects that the demand for contract water out of Wolford Mountain Reservoir will increase in the future. Currently, there is about 8,750 AF/yr of available contract water in Wolford Mountain Reservoir. (Colorado Springs has a lease for contract water from Wolford Mountain Reservoir that reduces the firm yield of the contract pool from 10,000 AF/yr to 8,750 AF/yr.) The CRWCD indicates that the full 8,750 AF/yr will likely be contracted for by 2030. In addition, MPWCD has 3,000 AF/yr of storage in Wolford Mountain Reservoir, of which 613 AF/yr is owed to Denver under the Clinton Reservoir Agreement. The CRWCD indicated that the remaining 2,387 AF/yr will likely be contracted for by 2030. Therefore, the total additional future demand for contract water from Wolford Mountain Reservoir is assumed to be 11,137 AF/yr by 2030.

3.2.8 Denver Water–Expiration of Big Lake Ditch Contract

The Big Lake Ditch is a senior irrigation right in the Williams Fork Basin that diverts below Denver Water's Williams Fork collection system and above Williams Fork Reservoir. Big Lake Ditch diversions are currently delivered for irrigation above Williams Fork Reservoir and for use in the Reeder Creek drainage, which is a tributary of the Colorado River. Return flows associated with irrigation in the Reeder Creek drainage return to the Colorado River below the confluence with the Williams Fork.

In 1963, Denver Water entered into a contract with Bethel Hereford Ranch Inc., which owned and operated the Big Lake Ditch, whereby Denver Water purchased the ranch's water rights. Bethel Hereford was granted a 40-year lease to continue its operation under the condition that the Big Lake Ditch water rights are not called if needed by Denver Water. The 1963 agreement was superseded by a 1998 agreement, which extended the operation of the Big Lake Ditch through 2013, and provided more detail on the conditions under which Denver Water would need the water. The 1998 agreement expires in 2013 and Denver Water does not plan to extend the existing contract. After the contract expires in 2013, diversions by the Big Lake Ditch may be substantially reduced.

3.2.9 Grand and Summit Counties–Increased Water Use

The population in Grand and Summit counties is expected to more than double over the next 25 years, from a year-round population of about 39,000 in 2005 to about 79,000 in 2030 (ERO Resources Corporation and Harvey Economics 2005). Most growth in Grand County is likely to occur in the Fraser River Basin while future increases in water use in Summit County are expected to occur in that portion of the Blue River Basin downstream of Dillon Reservoir. Build-out municipal and industrial demands are estimated to be 16,168 AF for Grand County and 17,940 AF for Summit County as identified in the Upper

Colorado River Basin Study (Hydrosphere 2003). The timing of the growth in demand depends upon economic development trends in the respective service areas of the individual water providers. Increased water use and wastewater discharges are expected to result in changes in the quantity and timing of streamflows and water quality.

3.2.10 Climate Change

Numerous studies have been conducted on the relationship between climate change and water resources in the West. Recently, the CWCB evaluated the potential influence of climate change on streamflow in the Colorado River Basin in the Final Draft of the Colorado River Water Availability Study (AECOM 2010).

In 2011, Reclamation released the SECURE Water Act Section 9503(c) – Reclamation Climate Change and Water 2011 report (Reclamation 2011a). Much of this report was based on synthesizing available literature and summarizing key findings from peer-reviewed studies. New data focusing on climate change implications for snowpack and natural hydrology, were introduced. The report presented assessments of risk across eight river basins, including the Colorado River Basin. Reclamation considers climate change reasonably foreseeable; however, currently there is no consensus regarding changes in streamflow that may occur in the future. Accordingly, hydrologic changes in response to global climate change have been qualitatively assessed.

3.2.11 Mountain Pine Beetle-Killed Trees

Severe mountain pine beetle infestation in Colorado is significantly impacting the extensive lodgepole pine forest that dominates the higher elevations of the upper Colorado River Basin. Many trees have been killed and remaining large areas of trees are likely to die in the near future. The loss of these trees has several implications in the upper Colorado River watershed within the analysis area depending on harvest activities, the composition and age class of the forest, forest fire, and other factors. A reduction in live tree cover in even-aged stands is likely to result in an increase in water yield through reduced consumptive use losses until replacement vegetation is established (Stednick et al. 2010). In mixed-age forests, other vegetation may replace dying lodgepole pines and water yield could decrease. Where trees are harvested or killed by beetles, soils can warm increasing the rate of nitrification, which could increase nitrate concentrations in runoff (Stednick et al. 2010). The potential for wildfire also increases in pine beetle-damaged forests, which could result in increased runoff along with sediment and nutrient increases in streams in the Colorado River Basin.

Because the hydrologic and water quality implications of the pine beetle epidemic would be very similar for existing conditions and the Proposed Action, and because evaluating the effects would require a substantial number of assumptions on likely conditions in the watershed, a detailed analysis of the range of potential effects of this reasonably foreseeable action was not conducted in the EA.

3.2.12 Actions Not Considered Reasonably Foreseeable

Table 3 presents actions suggested during the scoping process that Reclamation has determined are not reasonably foreseeable.

3.3 Issues Considered but Eliminated from Further Evaluation

Issues were dismissed from further evaluation if impacts do not have the potential to occur because they are not related to the Proposed Action or if impacts would clearly be negligible. Topics dismissed from analysis based on these guidelines are discussed below.

3.3.1 Air Quality, Noise, and Transportation

The Proposed Action would not require construction activities. Thus, no temporary noise impacts from construction activities would occur. Similarly, temporary air quality impacts resulting from fugitive dust emissions generated from construction activity would not occur. Traffic associated with operation and maintenance of the Proposed Action would be negligible.

3.3.2 Cultural Resources and Indian Trust Assets

Cultural resources include significant historic and prehistoric sites that constitute an important part of the legacy of human presence on the land. Because no land disturbances would occur as a result of the Proposed Action, there would be no effects on cultural resources.

Indian trust assets are owned by American Indians but are held in trust by the United States. Requirements for managing Indian trust assets are included in the Secretary of the Interior's Secretarial Order 3206, American Indian Tribal Rites, Federal-Tribal Trust Responsibilities; the Endangered Species Act; and Secretarial Order 3175, Departmental Responsibilities. There are no known Indian trust assets within the area potentially affected by the Proposed Action; therefore, there would be no effects on that resource.

3.3.3 Floodplains

Anticipated flows in all analysis area streams and rivers are anticipated to be below channel forming flows and floodplains are not anticipated to be affected by the Proposed Action.

Table 3. Actions Not Considered Reasonably Foreseeable.

Action Suggested During Scoping	Reason Considered Not Reasonably Foreseeable
Future of Xcel Energy's Shoshone call (i.e., if the call were off for an extended period, it could be detrimental to the endangered fish at times of the year when the proposed 10825 Project would not result in releases)	River operations at times of the year when proposed 10825 operations or effects would not occur are not germane to this NEPA process
Future Ruedi Reservoir contracts	There are no outstanding requests for new contracts from Reclamation for water stored in Ruedi Reservoir
Planned policies of the Colorado Statewide Water Supply Initiative (SWSI)	SWSI has no firm plans or policies that could be analyzed at this time
Increased water demand from Wolcott Reservoir (i.e., a proposed new reservoir on a tributary to the Eagle River)	The project is at the conceptual stage; project proponents have made no requests for permitting or other approvals
Oil shale development	There are no firm quantifiable plans for oil shale development; Reclamation has received no requests for related water contracts
Multibasin Water Supply Project (Yampa River Project)	The project is at the conceptual stage; project proponents have made no requests for permitting or other approvals
Ruedi Reservoir Pumpback Project (i.e., pumping from Ruedi Reservoir upstream to the Boustead Tunnel)	The project is at the conceptual stage; project proponents have made no requests for Reclamation action
"Around the Horn" alternative to Moffat Collection System Project	The alternative was dismissed from further consideration during alternatives analysis for the Moffat Collection System Draft EIS

3.3.4 Hazardous Materials

Hazardous materials are defined in various ways under a number of federal and state regulatory programs (e.g., Environmental Protection Agency [EPA] and Colorado Department of Public Health and Environment [CDPHE]). Sites with recognized environmental conditions of concern are those where known, existing, or past releases of hazardous substances, including petroleum products and other organic substances, metals, and other inorganic substances have been released to soil or groundwater. Risks to human health and the environment may occur when these materials are not managed properly. No hazardous materials are anticipated to be affected by the Proposed Action.

3.3.5 Visual Resources

In general, streams in the area potentially affected by the Proposed Action occur in high-quality scenic or visually sensitive locations. Water levels fluctuate diurnally and seasonally as a result of natural hydrologic cycles, reservoir management, irrigation practices, and diversions for other purposes. Even in a natural state, Colorado streams are characterized by substantial variations in flow, typically reaching the highest flow levels in May or June and then rapidly dropping off through the remainder of the year until they reach the low flows that predominate during the winter months. As a result, a stream is a dynamic system that rarely remains static and the viewer has an expectation of observing change over the course of the seasons. The Proposed Action would result in primarily negligible to minor flow and reservoir level changes and, thus, would not impact the visual quality of streams and reservoirs.

3.4 Summary of Effects

Table 4 presents a summary of the environmental consequences of the Proposed Action. These effects are discussed in greater detail in the subsections below for each resource.

Table 4. Summary of Direct and Indirect Environmental Effects.

Affected Resource	Direct and Indirect Effects from the Proposed Action
Surface Water Hydrology	Moderate long-term increase in North Fork Colorado River flow between the Redtop Valley Ditch and Shadow Mountain Reservoir and in Stillwater Creek between the Redtop Valley Ditch and Granby Reservoir during May, June, and July. Minor long-term decrease in Willow Creek flow during May, June, and July. Moderate long-term increase in Colorado River flow between Granby Reservoir and 15-Mile Reach during August and September. Minor, long-term infrequent changes in Blue River flow if an exchange of water was made from Granby Reservoir to Green Mountain Reservoir.
Groundwater Hydrology	Minor to negligible long-term reduction in groundwater levels near the Redtop Valley Ditch and agricultural dry-up area due to flow reductions in the Redtop Valley Ditch.
Water Quality	Minor long-term reduction in temperatures in Colorado River below Windy Gap when reservoir releases were made. Negligible effect on stream water quality. No effect on reservoir water quality.
Reservoir Operations and Hydroelectric Generation	No effect on Shadow Mountain Reservoir and Grand Lake storage levels and minor effect on Granby Reservoir storage levels. Minor, long-term infrequent increase in Green Mountain Reservoir storage levels if an exchange of water was made from Granby Reservoir to Green Mountain Reservoir. Minor decreased summer reservoir levels in Green Mountain Reservoir in dry years only. Potential reduction in the contract and HUP allocations in Green Mountain Reservoir and potential increase in the amount of water Denver Water and Colorado Springs Utilities "owes" Green Mountain Reservoir to complete a first fill (see mitigation discussion in Section 3.8.2.1.1). No effect on hydroelectric generation.
Aquatic Resources	Minor to negligible long-term beneficial effect in North Fork Colorado River and Stillwater Creek. Minor to moderate long-term adverse effect in Willow Creek. Minor long-term reduction in August and September stream temperatures and improvement in fish habitat in Colorado River below Windy Gap. Negligible effect on other rivers, streams, and reservoirs.

Affected Resource	Direct and Indirect Effects from the Proposed Action
Wetland and Riparian Resources	Increased riparian and wetland vegetation along Stillwater Creek long-term. Negligible effect on wetlands along Willow Creek, Colorado River, and Blue River. About 62 acres of wetlands occur within the agricultural dry-up area. Wetlands that are supported solely by irrigation would be permanently lost; wetlands supported by a naturally occurring high water table or streamflows that existed before development of irrigated agriculture would remain. No effect on wetlands associated with Granby or Green Mountain reservoirs.
Vegetation and Wildlife Resources	No effect on federally threatened and endangered wildlife or plant species or Colorado plant species of concern. Minor long-term habitat reduction for sandhill crane, greater sage grouse, boreal toad, and wood frog. Negligible effect on raptor foraging habitat and no effect on known raptor nests or on large game. Minor change in species composition in agricultural dry-up area.
Soils and Farmland	Permanent loss of 479 acres of farmland of statewide importance in agricultural dry-up area.
Recreation	Negligible to minor long-term effects on reservoir recreation in Granby and Green Mountain. Negligible effects on boating and fishing in the Blue River and Colorado River.
Socioeconomics and Land Use	Negligible to minor long-term effects on water-based recreation economies. Negligible adverse effect on the agricultural portion of the Grand County economy. No disproportionately high and adverse human health or environmental effects on minority and low-income populations.

3.5 Surface Water Hydrology

3.5.1 Affected Environment

3.5.1.1 North Fork Colorado River below Redtop Valley Ditch

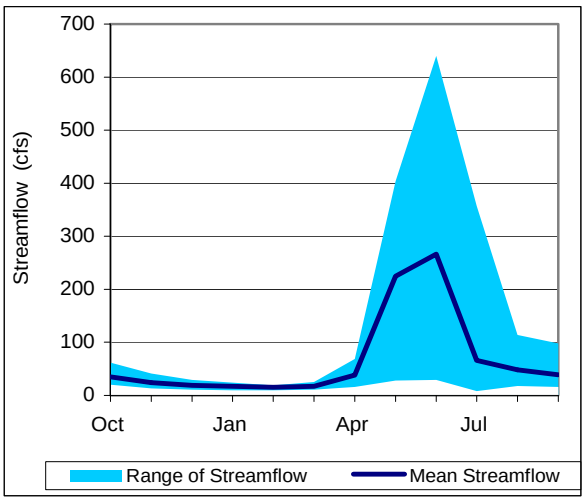
The North Fork Colorado River is a tributary to the Colorado River that flows into Shadow Mountain Reservoir. The North Fork Colorado River watershed is 102 square miles and originates north of the Town of Grand Lake within Rocky Mountain National Park. The potentially affected river segment of the North Fork Colorado River extends downstream of the Redtop Valley Ditch diversion 3 miles to Shadow Mountain Reservoir (Figure 2). Northern Water maintains a stream gage on the North Fork Colorado River at the inlet to Shadow Mountain Reservoir.

The Redtop Valley Ditch diverts water for irrigation use in an area generally to the west of Shadow Mountain and Granby reservoirs. The ditch is decreed a total of 150 cfs for diversion from the North Fork Colorado River. As reported by the Colorado Division of Water Resources, diversions into the ditch have historically averaged 11,708 AF/yr, over the period from 1975 to 2010 with most of the water diverted from the North Fork Colorado River. Private diversion records maintained by the ditch owners reflect an average annual diversion of 11,418 AF/yr for the period extending from 1991 through 2010. The ditch commonly diverts between 140 cfs and 150 cfs of water. Maximum diversions by the Redtop Valley Ditch are coincident with peak streamflow of the North Fork Colorado River. During peak snowmelt runoff, the flow of the North Fork Colorado River exceeds the capacity of the Redtop Valley Ditch. The amount of water diverted by the ditch typically decreases in late June and July as streamflow of the North Fork Colorado River declines to an amount that is less than the capacity of the ditch. The Redtop Valley Ditch often dries up the North Fork Colorado River below the ditch headgate from late June through the end of the irrigation season in July. Irrigation return flows from the ditch accrue to either Granby Reservoir or Willow Creek at a location downstream of Willow Creek Reservoir.

Historical streamflow of the North Fork Colorado River at the inlet to Shadow Mountain Reservoir is summarized in Figure 4. Upstream diversions by the Grand River Ditch affect streamflow. Diversion records maintained by the Division of Water Resources indicate the historical average diversion from the Grand River Ditch is 19,000 AF. Smaller water diversions from the North Fork supply a limited amount of residential and irrigation use. Diversions by these structures are small in comparison to the diversions by the Redtop Valley Ditch and Grand River Ditch.

An instream flow water right has not been decreed for the North Fork Colorado River below the Redtop Valley Ditch because of the lack of streamflow to maintain such a water use. The CWCB has a decreed instream flow water right of 18 cfs from May through September, and 10 cfs from October through April, for the stream segment above the Redtop Valley Ditch diversion.

Figure 4. North Fork Colorado River below Redtop Valley Ditch, Mean Monthly Historical Streamflow (1991-2008)



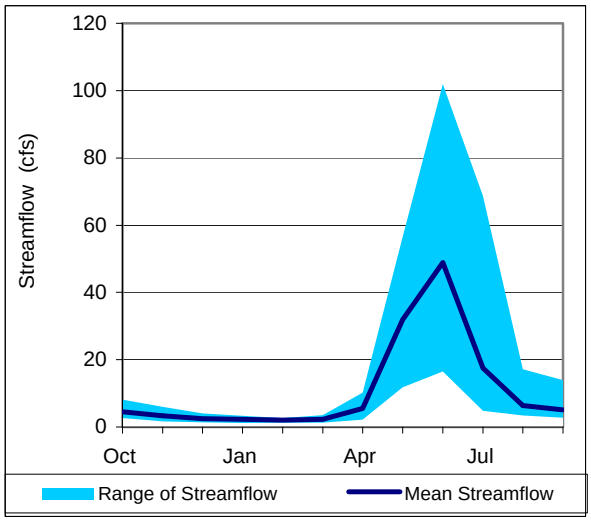
Source: Grand River Consulting 2011.

3.5.1.2 Stillwater Creek below Redtop Valley Ditch

Stillwater Creek is a tributary to the Colorado River that flows into Granby Reservoir. The affected segment of Stillwater Creek extends downstream of the Redtop Valley Ditch diversion 2 miles to Granby Reservoir (Figure 2). The drainage area at the U.S. Geological Survey (USGS) gage 09018000 (Stillwater Creek above Granby Reservoir near Grand Lake) is 17.5 square miles. Additional information on historical streamflow of Stillwater Creek at the inlet to Granby Reservoir is shown in Figure 5.

The Redtop Valley Ditch is decreed 150 cfs from the North Fork Colorado River and an alternate point of diversion for 10 cfs from Stillwater Creek. The ditch can also divert another 12 cfs of water at the Stillwater intake pursuant to water rights associated with other ditches in the area. The Redtop Valley Ditch is the primary diversion facility that reduces the streamflow of Stillwater Creek, although several other smaller irrigation structures are also located on the stream. A year-round instream flow water right of 3 cfs was decreed to the CWCB for Stillwater Creek upstream of the Redtop Valley Ditch headgate. An instream flow right has not been decreed for the segment of the stream below the Redtop Valley Ditch.

Figure 5. Stillwater Creek below Redtop Valley Ditch, Mean Monthly Historical Streamflow (1991-2008).



Source: Grand River Consulting 2011.

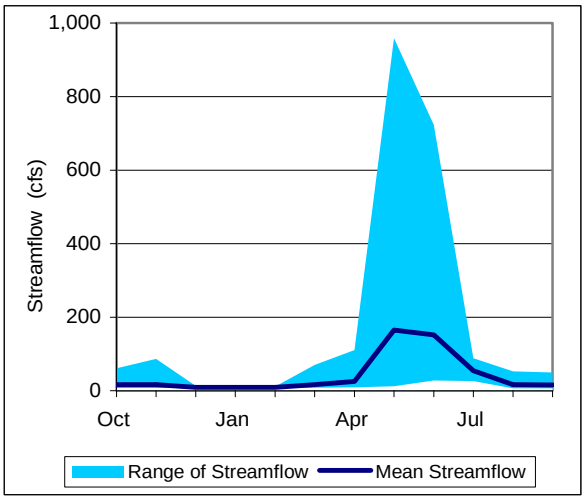
3.5.1.3 Willow Creek

Willow Creek flows into the Colorado River about 4 miles downstream of the outlet from Granby Reservoir (Figure 2). The drainage area at the USGS gage on Willow Creek (ID 09021000, Willow Creek below Willow Creek Reservoir) is 134 square miles. Willow Creek Reservoir and the Willow Creek Pump Station and Canal are part of the C-BT Project. The C-BT Project stores water in Willow Creek Reservoir and diverts water from Willow Creek Reservoir to Granby Reservoir via the Willow Creek Pump Canal. A portion of the return flows from irrigation on lands downslope of the Redtop Valley Ditch is tributary to Willow Creek downstream of Willow Creek Reservoir. As a result, streamflow of Willow Creek below the reservoir is influenced by C-BT Project operations and historical Redtop Valley Ditch irrigation. Historically, the C-BT Project has diverted 30,000 AF/yr on average from Willow Creek to Granby Reservoir (Reclamation 2007). About 2,364 AF of Redtop Valley Ditch irrigation return flows have historically accrued to Willow Creek below the reservoir, which comprises 8 percent of the flow in the creek.

The affected reach of Willow Creek extends from the Willow Creek Reservoir outlet to the confluence of the Colorado River. This 1-mile segment of lower Willow Creek currently receives irrigation return flow from the Redtop Valley Ditch. Willow Creek Reservoir is operated to maintain a flow of at least 7 cfs below the reservoir from October 1 to April 30.

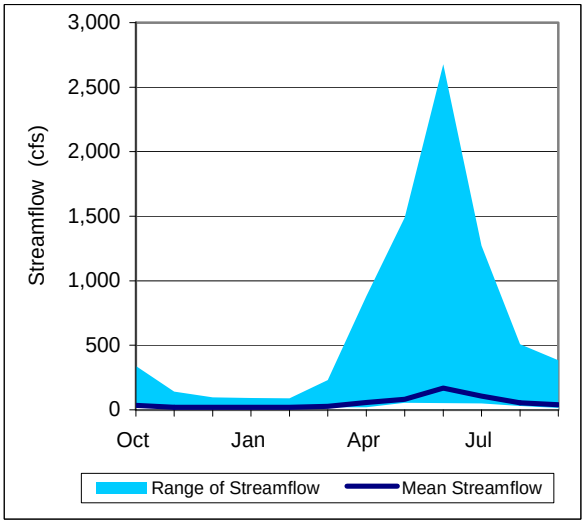
The 10825 Project would affect flow in Willow Creek only during the May through July irrigation season. Peak flow in the creek occurs between late May and early July and is about 500 cfs in an average year (Figure 6).

Figure 6. Willow Creek, Mean Monthly Historical Streamflow (1991-2008)



Source: Grand River Consulting 2011.

Figure 7. Colorado River below Granby, Mean Monthly Historical Streamflow (1991-2008).



Source: Grand River Consulting 2011.

3.5.1.4 Colorado River below Granby Reservoir

Granby Reservoir stores water for the C-BT and Windy Gap projects that is eventually diverted through the Adams Tunnel to the east slope of Colorado. Flows in the Colorado River below Granby Reservoir are a function of reservoir releases, instream flow requirements and Granby Reservoir spills. The historical streamflow of the Colorado River below Granby Reservoir is illustrated on Figure 7. During infrequent wet periods, Granby Reservoir may fill to capacity and spill water, which increases streamflow above the minimum bypass requirements in this segment.

Bypass requirements below Granby Reservoir are specified in a U.S. Department of the Interior memorandum titled "Principles to Govern the Release of Water at Granby Dam to Provide Fishery Flows Immediately Downstream in the Colorado River" (USDI 1961). The bypass requirement is 20 cfs from September through April, 75 cfs from May through July, and 40 cfs in August. The bypass requirement below Granby Reservoir may be reduced from May through September when the advance forecast of inflow to Shadow Mountain and Granby reservoirs (less the decreed irrigation rights in the reach of the Colorado River between Granby Reservoir and the confluence with the Fraser River) and the water capable of being pumped from Willow Creek Reservoir is less than 230,000 AF. The allowable reductions in bypasses are shown in Table 5.

Table 5. Percent Reduction for Forecast Inflow.

Forecast Inflow (thousand AF)	Percent Reduction
220-230	15
210-220	20
195-210	25
Less than 195	30

In recent years, additional water has periodically been released from Granby Reservoir in coordination with Grand County. Grand County has periodically paid the Subdistrict to pump water from the Colorado River through the Windy Gap pumping plant into Granby Reservoir. This pumping has occurred when the Subdistrict has excess capacity in the Windy Gap pumping plant, when no downstream river calls have been in place, and when storage space in Granby Reservoir is

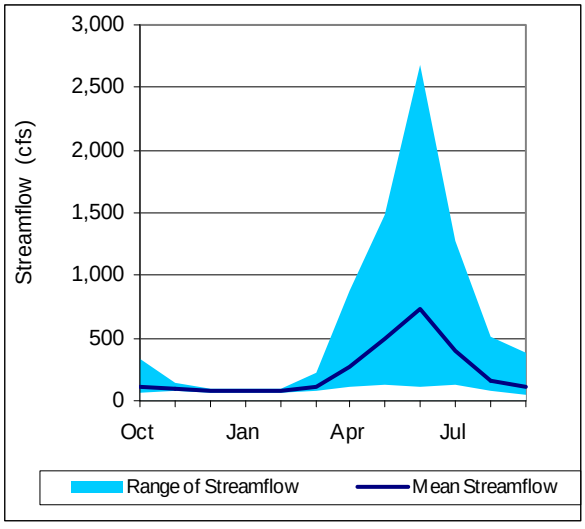
available. The Windy Gap water pumped into Granby Reservoir for Grand County has been subsequently released to the Colorado River to improve temperatures and enhance flows in the Colorado River downstream of the Windy Gap diversion.

3.5.1.5 Colorado River at Windy Gap Reservoir

Windy Gap Reservoir is on the Colorado River downstream of the confluence with the Fraser River west of Granby. Windy Gap Reservoir serves as a forebay for the Windy Gap pumping plant, which pumps water into Granby Reservoir. The historical streamflow of the Colorado River at Windy Gap Reservoir is illustrated on Figure 8. The gage is directly below the Windy Gap Reservoir.

A 1980 Memorandum of Understanding (MOU) between the Colorado Division of Wildlife (CDOW) and the Subdistrict established minimum streamflow requirements on the reach of the Colorado River downstream of the Windy Gap diversion to the confluence with the Blue River, which were subsequently decreed by the CWCB.

Figure 8. Colorado River at Windy Gap Reservoir, Mean Monthly Historical Streamflow (1991-2008).



Source: Grand River Consulting 2011.

These instream flow requirements are:

- 90 cfs from the Windy Gap diversion point to the mouth of the Williams Fork River
- 135 cfs from the mouth of the Williams Fork River to the mouth of Troublesome Creek
- 150 cfs from the mouth of Troublesome Creek to the mouth of the Blue River

The instream flows for this segment of the Colorado River have a priority that is junior to the water rights of the C-BT Project. The instream flow rights do not affect diversions of the C-BT Project; however, consistent with the MOU, the minimum streamflows in the 1980 MOU do affect diversions by the Windy Gap Project.

3.5.1.6 Blue River below Green Mountain Reservoir

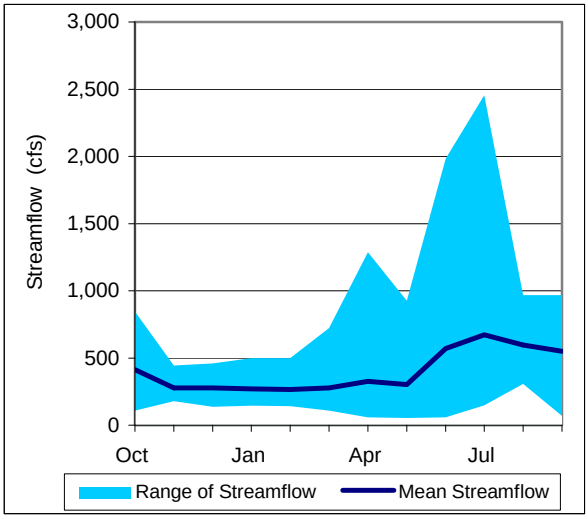
The Blue River flows generally northwest from its headwaters in southern Summit County to Dillon Reservoir, Green Mountain Reservoir, and then to the Colorado River near Kremmling. The river forms a long valley between the Williams Fork Mountains to the north and east and the Tenmile Range and Gore Range to the south and west. The drainage area of the basin is 599 square miles at USGS gage 09057500 (Blue River below Green Mountain Reservoir). The average annual precipitation varies with elevation across the Blue River Basin, ranging from 15.5 inches at Green Mountain Reservoir dam in the lower Blue River Basin to nearly 24 inches at Climax Mine near Fremont Pass. Streamflows are highly variable by season across the basin. Most of the annual streamflow results from snowmelt from May to July. The potentially affected river segment in the Blue River Basin is downstream of Green Mountain Reservoir. Streamflow within the analysis area is heavily influenced by storage and releases from the upstream reservoirs and transmountain diversion projects.

A CWCB instream flow right was decreed in 1987 for the river reach below Green Mountain Reservoir. This instream flow right is for 60 cfs

from May 1 through July 15, and 85 cfs from July 16 through April 30.

The mean monthly historical streamflow and the range of historical monthly streamflows for the 1991 through 2008 study period for the Blue River below Green Mountain Reservoir USGS gage 09057500 are shown in Figure 9. The flow of the Blue River below Green Mountain Reservoir USGS gage 09057500 is typically greater than natural conditions from mid-summer through the end of October. The increase in flow is associated with Green Mountain Reservoir releases for a variety of downstream uses.

Figure 9. Blue River below Green Mountain Reservoir, Mean Monthly Historical Streamflow (1991-2008).



Source: Grand River Consulting 2011.

3.5.1.7 Colorado River near Kremmling

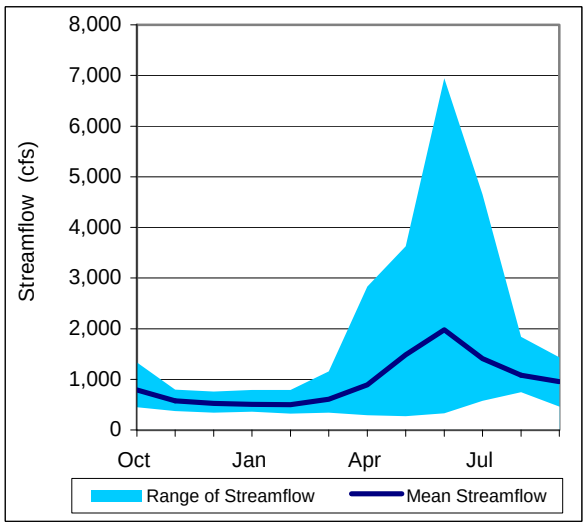
Historical streamflow of the Colorado River below Kremmling is measured at USGS gage 09058000. This site is downstream of the Blue River and Muddy Creek. Historical streamflow conditions for this site are illustrated in Figure 10.

As with the Blue River, streamflow below Kremmling is typically greater than natural conditions from mid-summer through the end of October. Historically, the increase in flow has been associated with the following reservoir releases:

- Green Mountain Reservoir releases for a variety of downstream uses
- Temporary releases of 10825 water from Williams Fork Reservoir from 2000 through 2008
- Temporary releases of 10825 water from Wolford Mountain Reservoir in 2000, 2001, 2005, 2006, 2007, and 2008
- Releases from the 6,000-AF mitigation pool in Wolford Mountain Reservoir beginning in 1998, but not in 2004, 2005, or 2007

From 2000 through 2008, an average of 2,999 AF of the temporary 10825 water was released from Wolford Mountain Reservoir (Grand River Consulting 2011), while an average of 4,045 AF was released from Williams Fork Reservoir. The total historical release of temporary 10825 water from these two reservoirs has averaged 7,044 AF. The releases have been less than 10,825 AF in several years pursuant to provisions in the interim

Figure 10. Colorado River near Kremmling Reservoir, Mean Monthly Historical Streamflow (1991-2008).



Source: Grand River Consulting 2011.

agreements that allow a reduction in releases during drought periods, and pursuant to operational decisions by the Service. The releases of 10825 water under interim agreements have primarily occurred in August and September. Instream flow rights have not been adjudicated for the reach of the Colorado River below the Blue River.

3.5.1.8 Fryingpan River below Ruedi Reservoir

The Fryingpan River flows generally west from the Continental Divide to the confluence with the Roaring Fork River near Basalt. The total drainage area of the basin is 237 square miles at the Fryingpan River near Ruedi stream gage (USGS gage 09080400). The average annual precipitation exceeds 30 inches near the headwaters of the basin. The area potentially affected by the Proposed Action extends from Ruedi Reservoir downstream 13 miles to the confluence of the Roaring Fork River.

Flows in the Fryingpan River are influenced by Ruedi Reservoir operations and releases. Ruedi Reservoir must bypass 39 cfs or the total inflow, whichever is less, from November through April. The bypass requirement increases to 110 cfs or inflow from May through October. The Rocky Fork Creek tributary flow is included in the bypass measurement (U.S. House of Representatives 1961). Ruedi Reservoir releases are also made based on the terms of the 2012 Agreement (Reclamation 2003):

1. Reclamation will generally release water upon the request of the Service between early July and late October, up to the amount needed to contribute toward meeting target flows in the 15-Mile Reach

2. Reclamation will determine the amount, timing, and rate of releases in consultation with the Service

3. Reclamation will notify the CWCB and the Division 5 Engineer of the date, time, and amount of the water released. The Service and Reclamation will consult with the CWCB during the release period to achieve the objectives of Reclamation, the Service and the CWCB.

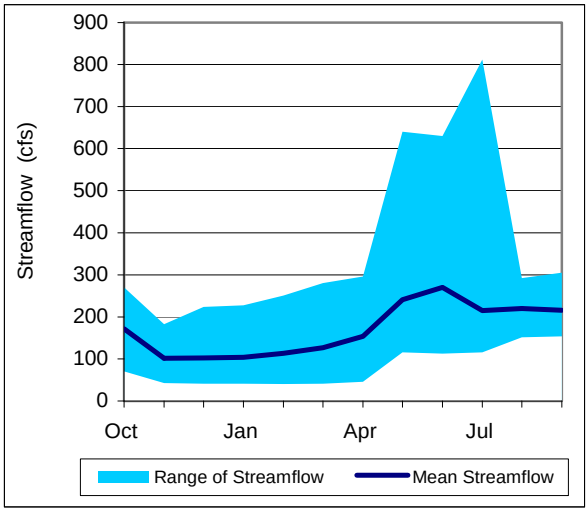
4. Reclamation will continue to attempt to make release adjustments of no more than 50 cfs increments when feasible and consistent with the multiple Fry-Ark Project purposes.

5. Reclamation will continue to attempt to make release adjustments of no more than 50 cfs increments when feasible and consistent with multiple Fry-Ark Project purposes

6. Efforts will be made to limit cumulative flows to 250 cfs or less when consistent with the multiple Project purposes and reasonable to do so, and so long as future fishery research does not indicate that flows in excess of 250 cfs are important for Fryingpan or Roaring Fork River fishery maintenance or enhancement.

The mean monthly historical streamflow and the range of historical monthly streamflow for the Fryingpan River near Ruedi Reservoir are shown in Figure 11. The streamflow of this river segment is substantially affected by reservoir releases for the Recovery Program.

Figure 11. Fryingpan River below Ruedi Reservoir, Mean Monthly Historical Streamflow (1991-2008).



Source: Grand River Consulting 2011.

3.5.1.9 Roaring Fork River near Glenwood Springs

The Roaring Fork River Basin is bounded by the Eagle River Basin to the north and the Gunnison River Basin to the south. The total drainage area of the basin is 1,451 square miles at the USGS gage 09085000 (Roaring Fork River at Glenwood Springs, Colorado). The average annual precipitation varies with elevation across the basin, ranging from 16 inches near the confluence with the Colorado River at Glenwood Springs to 30 inches near Independence Pass.

The analysis area for the Roaring Fork River is from its confluence with the Fryingpan River, downstream to the Colorado River. Historical streamflow conditions for this segment are shown in Figure 12.

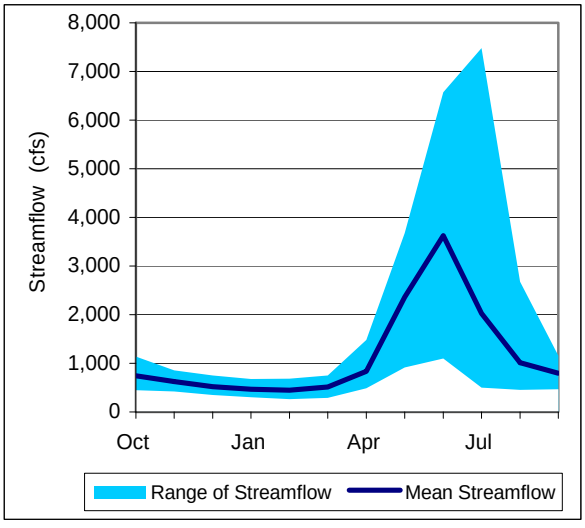
A CWCB instream flow right was decreed for the Roaring Fork River from the confluence with the Fryingpan River downstream to the confluence with the Crystal River. This instream flow right is for 145 cfs from April through September and 75 cfs from October through March. The instream flow right for the Roaring Fork River does not affect the operation of Ruedi Reservoir. The streamflow of this segment of the Roaring Fork River exceeds the instream flow right on a year-round basis.

3.5.1.10 15-Mile Reach of Colorado River

The 15-Mile Reach of the Colorado River extends from the Grand Valley Irrigation Company (GVIC) diversion dam downstream to the Gunnison River confluence (Figure 1). The streamflow in this segment is recorded at the USGS gage below the GVIC diversion (09106150). Historical streamflow at this site is shown in Figure 13. Streamflow in this river segment is substantially modified by upstream diversions, water uses, and reservoir releases.

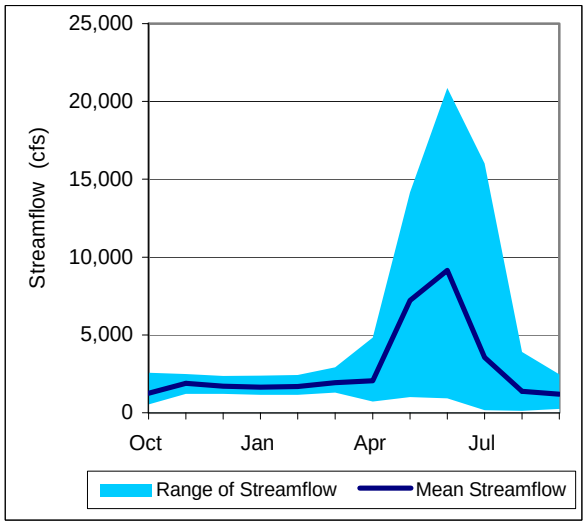
The Service directs the release of water from its pools in upstream reservoirs in accordance with the numeric targets described in Chapter 1 and other considerations. In addition, voluntary releases have been made under Coordinated Reservoir Operations. Reservoir releases for the Recovery Program have historically occurred primarily from Green Mountain Reservoir, Williams Fork Reservoir, Wolford Mountain Reservoir, and Ruedi

Figure 12. Roaring Fork River near Glenwood Springs, Mean Monthly Historical Streamflow (1991-2008).



Source: Grand River Consulting 2011.

Figure 13. Colorado River below Grand Valley Diversion near Palisade, Mean Monthly Historical Streamflow (1991-2008).



Source: Grand River Consulting 2011.

Reservoir. Granby, Willow Creek and Windy Gap have also made releases. These historical releases have averaged 43,438 AF/yr for the study period and 58,375 AF/yr from 2000 through 2008. The extremes have ranged from 15,032 to 97,654 AF depending on water availability. Historical streamflow in this river segment is commonly less than the Service's biological flow targets, even with the release of water from upstream storage (Grand River Consulting 2011).

Natural streamflow, coupled with the amount of reservoir water available to the Recovery Program, is commonly insufficient to meet the biological targets established by the Service, particularly during snowmelt runoff and during late summer of dry years. As a result, the Service, in consultation with Reclamation and others, often manages reservoir releases to maintain a 15-Mile Reach flow that is substantially less than the biological targets, but that is judged to provide the best habitat conditions given the amount of water available for release.

3.5.2 Environmental Consequences

Direct effects were assessed for the following streams that would be affected by the Proposed Action only. These resources would not be affected by the expiration of the interim agreements.

- North Fork Colorado River
- Stillwater Creek
- Willow Creek
- Colorado River below Granby Reservoir
- Colorado River at Windy Gap Reservoir
- Blue River below Green Mountain Reservoir
- Granby Reservoir
- Shadow Mountain Reservoir
- Green Mountain Reservoir

Shadow Mountain and Green Mountain Reservoir are discussed under Section 3.8.

The expiration of the interim agreements, in combination with the Proposed Action, was quantitatively analyzed as a cumulative effect for the following streams:

- Colorado River near Kremmling
- Fryingpan River below Ruedi Reservoir
- Roaring Fork River near Glenwood Springs
- 15-Mile Reach of Colorado River
- Ruedi Reservoir

Methods for determining direct, indirect, and cumulative effects on hydrology can be found in the Water Resources Assessment Report (Grand River Consulting 2011). For quantitative streamflow evaluations, both monthly and daily time step streamflow modeling was performed. Monthly average changes in streamflow were estimated for an 18-year study period extending from water year 1991 through 2008. Daily changes in streamflow were analyzed for specific representative years including drought (2002), below average (2006), average (2005), above average (1998), and wet (2008) years. The daily and monthly analyses were performed using a simple mass balance calculation in a Microsoft Excel spreadsheet at each gage that adds and subtracts component flows.

The Division Engineer administers transit losses to all reservoir releases between their point of release and ultimate delivery point, including the 15-Mile Reach. To simplify the discussion in this section, these transit losses are ignored (e.g., it is assumed that a 50 cfs release from Granby Reservoir would result in an additional 50 cfs of flow in the Colorado River at the Blue River). However, actual operations would include administration of these losses.

3.5.2.1 Direct and Indirect Effects

3.5.2.1.1 North Fork Colorado River below Redtop Valley Ditch

A change in streamflow under the Proposed Action is expected to occur at those times when Redtop

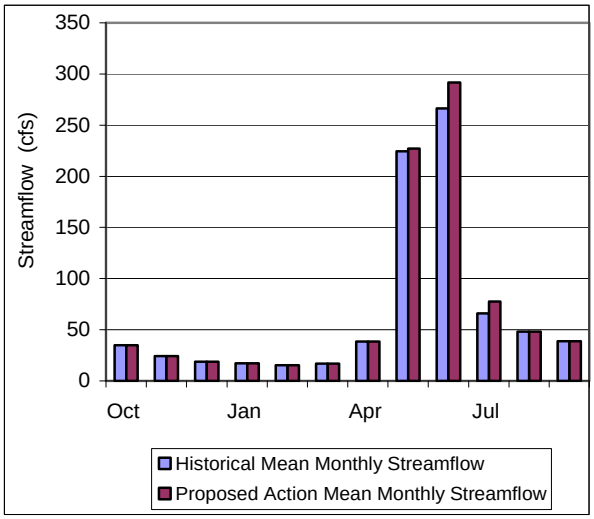
Valley Ditch diversions from the North Fork Colorado River would otherwise be greater than 80 cfs. The change would occur because future diversions by the Redtop Valley Ditch would be reduced. The amount of reduction in Redtop Valley Ditch diversions is difficult to predict. For analysis purposes, future Redtop Valley Ditch diversions were limited to 80 cfs for the Proposed Action. Because Redtop Valley Ditch diversions are unlikely to exceed 80 cfs, an increase in streamflow of the North Fork Colorado River would occur equal to the difference between historical Redtop Valley Ditch diversions and 80 cfs. The 80 cfs of water expected to be diverted through the Redtop Valley Ditch under the Proposed Action would be comprised of the minority shareholder water that has been historically diverted plus a portion of Northern Water's shares that would be diverted to facilitate deliveries to remaining shareholders.

Streamflow is estimated to increase primarily in June, although increases in flow during May and July may also occur (Figure 14). With the assumed maximum Redtop Valley Ditch diversion of 80 cfs, an increase in streamflow of the North Fork up to 70 cfs would typically occur during the height of snowmelt runoff when diversions by the ditch have historically exceeded 80 cfs. Modeled increases in stage range from 0.0 to 0.2 feet. Streamflows in the North Fork would remain unchanged when flows were below the maximum diversion threshold.

Changes in streamflow would not occur during August through April, which is outside of the irrigation season for the Redtop Valley Ditch. Regardless of the maximum diversion threshold, streamflows in the North Fork Colorado River under the Proposed Action are not expected to be less than historical streamflow.

The assumptions used in this assessment may underestimate the actual increases in streamflow of the North Fork Colorado River that may occur with the Proposed Action. It is possible that minority shareholders in the ditch can receive a full supply of water with Redtop Valley Ditch diversions less than 80 cfs. Such operation would result in additional water remaining in the North Fork Colorado River during the irrigation season, and slightly higher streamflows than described.

Figure 14. North Fork Colorado River below Redtop Valley Ditch, Historical and Proposed Action Mean Monthly Streamflow.

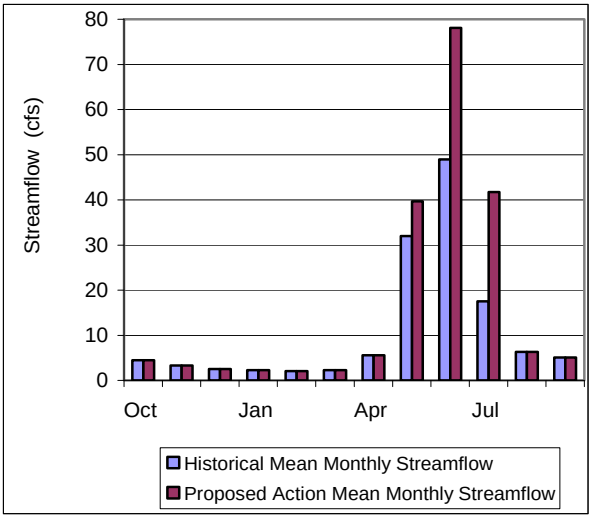


Source: Grand River Consulting 2011.

3.5.2.1.2 Stillwater Creek below Redtop Valley Ditch

With the Proposed Action, streamflow of Stillwater Creek is estimated to increase during the irrigation season (Figure 15). Streamflow would increase because a portion of the Redtop Valley Ditch diversions from the North Fork Colorado River would flow into Stillwater Creek, and subsequently flow to Granby Reservoir. Average monthly flow from May through July would increase by up to 51 cfs. Estimated increases in stage range from 0.0 to 1.7 feet. Due to regional topography and local irrigation practices, much of the additional flow would likely accrue to Stillwater Creek at a location near Granby Reservoir.

Figure 15. Stillwater Creek below Redtop Valley Ditch, Historical and Proposed Action Mean Monthly Streamflow.



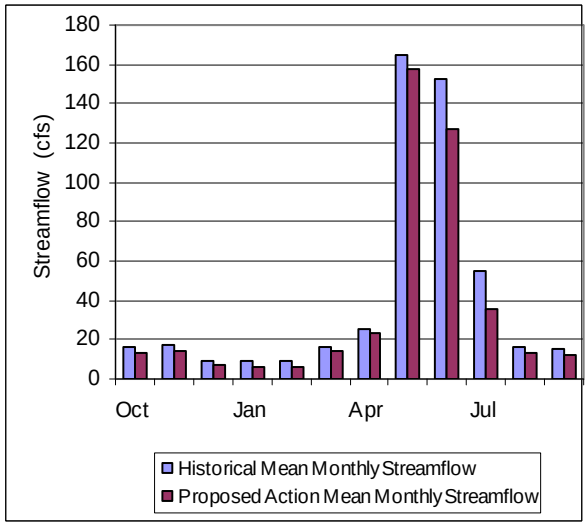
Source: Grand River Consulting 2011.

Operating assumptions used in this assessment may overestimate the amount of Redtop Valley Ditch water that is diverted from the North Fork Colorado River and flows into Stillwater Creek. If the diversion of less water to minority shareholders was required, less water would be diverted into the Redtop Valley Ditch, and the flow of Redtop Valley Ditch water to Stillwater Creek would also be less.

3.5.2.1.3 Willow Creek

Streamflow in the lower 1-mile segment of Willow Creek is estimated to decrease as a result of the Proposed Action (Figure 16). Historically, irrigation return flows from the E Diamond H and Miller-Hereford ranches have contributed to Willow Creek streamflow throughout the year. The Proposed Action would result in the permanent dry-up of these irrigated areas, resulting in a reduction in irrigation return flows to Willow Creek, and a subsequent reduction in Willow Creek streamflow. The decrease in streamflow would occur throughout the year and would be the largest during the summer irrigation months of June and July. Estimated decreases in stage range from 0.0 to 0.5 feet

Figure 16. Willow Creek below Redtop Valley Ditch, Historical and Proposed Action Mean Monthly Streamflow.



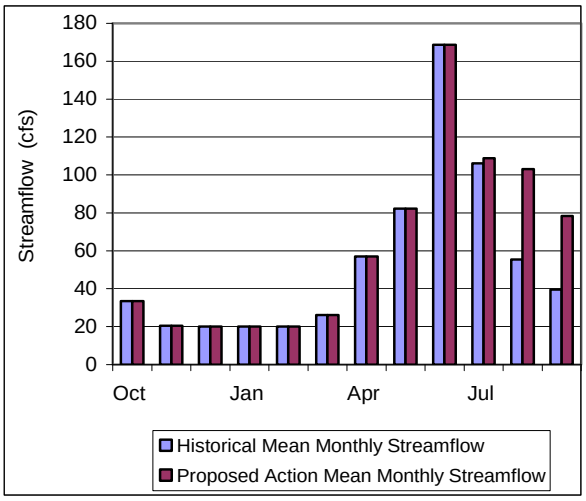
Source: Grand River Consulting 2011.

3.5.2.1.4 Colorado River below Granby Reservoir and at Windy Gap Reservoir

Streamflow in the Colorado River below Granby Reservoir would increase during late summer and early fall in all years as a result of the annual releases of 5,412.5 AF from Granby Reservoir. The mean monthly streamflow in this segment is shown in Figure 17.

An increase in the depth of water of the Colorado River below Granby Reservoir would occur as a result of increased streamflow. The increase in depth of water would vary throughout the affected reach, depending upon the morphology of the stream. Estimated increases in stage range from 0.0 to 0.1 feet from July to September (Grand River Consulting 2011).

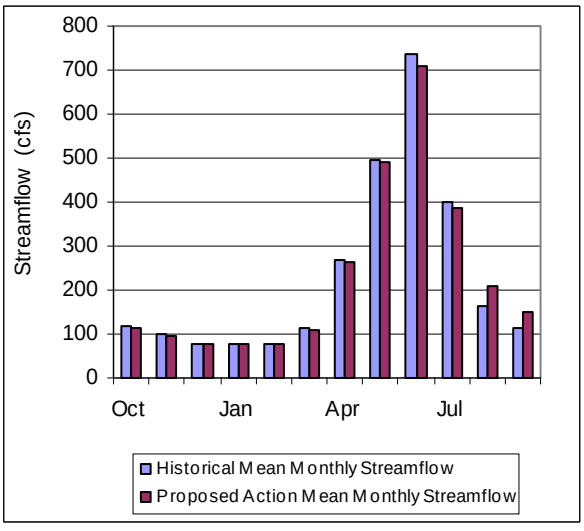
Figure 17. Colorado River below Granby Reservoir, Historical and Proposed Action Mean Monthly Streamflow.



Source: Grand River Consulting 2011.

Streamflow in the Colorado River at Windy Gap Reservoir would increase during August and September in response to releases of 10825 water from Granby Reservoir. The mean monthly streamflow in this segment is shown in Figure 18. Estimated river stage would increase by up to 0.1 feet as a result of increased streamflow (Grand River Consulting 2011). From October through July, streamflow would decrease in response to the reduction in delayed irrigation return flows from the Willow Creek watershed. Below Granby, average July flow would increase slightly because in dry years, anticipated releases of 10825 water would begin in mid-July. Below Windy Gap, average July flows would decrease slightly because the average reduction in delayed irrigation return flows from Willow Creek would be greater than the average increase associated with the release of 10825 water.

Figure 18. Colorado River at Windy Gap, Historical and Proposed Action Mean Monthly Streamflow.



Source: Grand River Consulting 2011.

3.5.2.1.5 Blue River below Green Mountain Reservoir

Streamflow of the Blue River below Green Mountain Reservoir may be altered in response to two actions: (1) the exchange of water from Granby Reservoir to Green Mountain Reservoir, and (2) additional releases from the C-BT replacement pool in Green Mountain Reservoir.

Granby Reservoir/Green Mountain Reservoir Exchange

The 10825 water releases from Granby Reservoir would almost always occur at a time when streamflow in the 15-Mile Reach was less than the minimum baseflow targets established by the Service. As a result, it is anticipated that the Granby Reservoir releases would typically be routed directly to the 15-Mile Reach, at the time and amount in which the releases from Granby Reservoir were made. However, there are times when releases from Granby Reservoir would not be made at the same time water is needed in the 15-Mile Reach. During these times, Granby releases could be exchanged into Green Mountain Reservoir, if all conditions are met for later release to the 15-Mile Reach. This exchange would occur by reducing Green Mountain Reservoir releases (being made for other purposes) by the same amount as Granby 10825 releases in the Colorado.

The flow of the Blue River below Green Mountain Reservoir has historically averaged 500 cfs during the potential exchange periods, and an exchange

would typically reduce the flow of the Blue River during these periods by 10 percent or less. The releases from Green Mountain Reservoir for CWCB's 1987 instream flow right would not be affected by the exchange.

Increased Releases from the C-BT Replacement Pool

Additional releases from the C-BT replacement pool would occur to offset the amount of Redtop Valley Ditch water that was stored in Granby Reservoir whenever a mainstem river call curtails diversions by the C-BT Project. The estimated out-of-priority diversions associated with Redtop Valley Ditch water from the Miller-Hereford and the E Diamond H ranches are summarized in Table 6. Based on C-BT operating principals and Colorado water law, this water would be stored out-of-priority in Granby Reservoir, and a commensurate release of water from the C-BT replacement pool in Green Mountain Reservoir would occur. Table 6 is based on historical diversions by the Redtop Valley Ditch and historical river calls. The modeled increase in replacement releases in individual years would vary from a low of 0 AF to a high of 1,873 AF. In 2001 through 2004, the modeled additional replacement release from Green Mountain Reservoir was a total of 5,651 AF, which averaged 1,413 AF/yr over that four-year period (Table 6).

The estimates in Table 6 are based on the assumption that whenever a river call occurred, the storage of Redtop Valley Ditch water in Granby Reservoir would also be out-of-priority. This assumption represents a worst-case scenario, and in actuality, the relatively senior water rights of Granby Reservoir would remain in-priority during some portion of a mainstem water right call. The out-of-priority diversion estimates outlined in Table 6 likely overstate the actual amount of additional replacement that may be required from Green Mountain Reservoir. Section 3.8.2.1.1, *Green Mountain Reservoir* discusses the effect of the project on reservoir operation in additional detail.

Reduced irrigation return flows from the Redtop Valley Ditch would decrease flow in the Colorado River (primarily in May, June, and July) by an average monthly amount of up to 28 cfs. If streamflow was reduced to the extent that a mainstem Colorado River water right call occurred earlier in the year, C-BT replacement requirements and other Green Mountain Reservoir releases could increase. The likelihood that this magnitude of a reduction in streamflow would cause the Shoshone

Table 6. Estimated Redtop Valley Ditch Out-of-Priority Diversions.

Year	Total Historical Ditch Diversions during a Mainstem Call† (AF)	Out-of-Priority Diversions into Granby Reservoir Associated with Miller-Hereford and E Diamond H Ranches§ (AF)
1991	0	0
1992	1,428	743
1993	0	0
1994	2,867	1,491
1995	0	0
1996	0	0
1997	0	0
1998	0	0
1999	0	0
2000	643	335
2001	2,736	1,423
2002	3,602	1,873
2003	3,435	1,786
2004	1,095	569
2005	0	0
2006	0	0
2007	585	304
2008	0	0

†Amount of total ditch diversions that occurred during historical out-of-priority periods.
§Amount of out-of-priority storage in Granby Reservoir. Estimated to be 52 percent of total diversions by the Redtop Valley Ditch (6,476 AF of additional Granby supply out of 12,440 AF of total ditch diversions).
Source: Grand River Consulting 2011

or Cameo call to occur earlier in the year is negligible.

The additional C-BT replacement pool releases would increase the flow of the Blue River by an equal amount. These additional releases would occur in June and July of dry years when a mainstem call occurred while the Redtop Valley Ditch would otherwise be diverting its full amount. The releases would occur when Green Mountain Reservoir was out-of-priority to a mainstem call and would not affect peak flows or spills from the reservoir. The increased releases from the C-BT replacement pool would result in either (1) a commensurate decrease in Green Mountain Reservoir releases to the Blue River during the following winter or spring months if the reservoir fills, or (2) a commensurate reduction in the amount of water stored in the contract or HUP allocation, if the reservoir did not fill the following year. Section 3.8.2.1.1, *Green Mountain Reservoir* discusses this operation in additional detail.

3.5.2.2 Cumulative Effects

Cumulative effects for surface water hydrology due to expiration of interim agreements that provide water for the Recovery Program were evaluated quantitatively and are discussed first in the next section. Because expiration of these interim agreements will affect stream reaches in different ways, cumulative effects due to expiration of the interim agreements are presented by stream reach. Other reasonably foreseeable actions are evaluated qualitatively and are presented at the end of this section.

3.5.2.2.1 Colorado River near Kremmling

Anticipated changes in the streamflow of the Colorado River near Kremmling that are associated with the Proposed Action and the expiration of the interim agreements are typically 10 percent or less. July through October streamflow is estimated to increase for those historical years when releases of 10825 water from Williams Fork Reservoir or Wolford Mountain Reservoir did not occur. For those study years when 10825 water was historically released from Williams Fork or Wolford Mountain reservoir, a slight decrease in streamflow would occur from July through October. Winter streamflow (November through April) is estimated to decline by 2 cfs in response to the loss of delayed return flows associated with the Redtop Valley Ditch. The estimated changes in river stage are 0.2 feet or less (Grand River Consulting 2011).

3.5.2.2.2 Fryingpan River below Ruedi Reservoir

The Proposed Action, coupled with the expiration of the 2012 Agreement, would allow the maximum annual release of up to 15,412.5 AF of water from Ruedi Reservoir for the Recovery Program instead of the current maximum release of 20,825 AF in a typical year (Table 7). Ruedi Reservoir releases associated with the Proposed Action would be made in a manner consistent with the interim releases of water approved for the 2012 Agreement (see Section 3.5.1.8). A detailed daily assessment of the streamflow of the Fryingpan River and the storage content in Ruedi Reservoir was included in the 2012 Agreement EA. This analysis was completed for a dry, moderate, and wet year. The 2012 Agreement EA recognized that the primary concerns associated with the 2012 Agreement were related to 1) high summertime streamflow in the Fryingpan River when releases are made, and 2) reduced summertime reservoir levels in response to the releases.

Table 7. Summary of Maximum Annual Ruedi Reservoir Releases for Recovery Program Purposes.

Water	Existing Conditions (AF)	Proposed Action + Expiration of 2012 Agreement (AF)
5+5 Water	10,000	10,000
2012 Agreement Water	10,825	0
10825 Water		5,412.5
Total	**20,825**	**15,412.5**

The hydrologic changes to the Fryingpan River that would be associated with the Proposed Action, coupled with expiration of the 2012 Agreement, are within the range of changes that were previously assessed in the 2012 Agreement EA. The Proposed Action would release water at times and rates consistent with the releases that were assessed in the 2012 Agreement EA. Because the Proposed Action would release less water than is allowed under the 2012 Agreement, summertime Ruedi Reservoir storage levels would remain higher than the levels assessed in the 2012 Agreement EA, and the number of days that the flow in the Fryingpan River exceeds 250 cfs would be fewer. These effects are described below.

Streamflow in Excess of 250 cfs

Under the Proposed Action, and with the expiration of the 2012 Agreement, the number of days that streamflow would exceed 250 cfs in the Fryingpan River would be reduced. The 2012 Agreement EA recognized that releases for Recovery Program purposes would commonly range from 150 to 250 cfs. Assuming a typical reservoir release of 200 cfs, the average number of days in which the flow of the Fryingpan River exceeded 250 cfs would decline by 14 days (Reclamation 2002). If reservoir releases were made at a rate of 250 cfs, the number of days in which flow of the Fryingpan River exceeded 250 cfs would typically decline by 11 days. This analysis is consistent with the analysis disclosed in the 2012 Agreement EA, which estimates a 9-day reduction in flow above 250 cfs when reservoir releases were reduced by 5,412.5 AF.

Winter Streamflow Increase

Water is typically released from Ruedi Reservoir during the winter months to provide reservoir storage space for the upcoming snowmelt runoff. The specific winter releases are determined by Reclamation on a year-by-year basis, and vary in response to several factors including specified drawdown targets and snowpack conditions. An exception to this operation occurs in dry years (or the years following a dry year), when reservoir storage is already low at the end of the summer and additional reservoir drawdown is not desired.

The Proposed Action, coupled with the expiration of the 2012 Agreement, would increase the end-of-summer storage in Ruedi Reservoir. Cumulatively, reservoir storage would typically be 5,412.5 AF higher at the end of October. In average and wetter than average years, when Reclamation desires to reduce reservoir storage levels to prevent uncontrolled spills in the spring, this additional 5,412.5 AF in storage would be released to the river over the winter months. Assuming a winter release season of 150 days, the flow in the Fryingpan River would increase by 18 cfs. Average monthly flows in the river during November through March range from 102 to 127 cfs. If the release season was shorter, the increase in Fryingpan River streamflow would be greater than this amount. Reclamation typically sets a conservative release from Ruedi in the fall and increases the releases as necessary and as spring runoff forecasts are developed. This prevents adverse impacts to eggs of brown trout that are spawned in the fall. The Proposed Action is not anticipated to increase winter flow of the Fryingpan River in those years that follow an exceptionally dry year, such as 1954, 1977 and 2002. In those years, additional reservoir drawdown may not be desired, even with the increase in reservoir storage that would occur with the Proposed Action. The additional water stored in Ruedi Reservoir following an exceptionally dry year probably would not be released, but carried over for winter release in an average or wetter than average year.

3.5.2.2.3 Roaring Fork River near Glenwood Springs

Streamflow of the Roaring Fork River between the Fryingpan River and the Colorado River would also be affected by the Proposed Action, expiration of the interim agreements and the 2012 Agreement. As with the Fryingpan River, no change in the annual volume of flow in this river segment would occur. Summer flow would decrease by a total of

5,412.5 AF and winter flow would typically increase by the same volume.

Releases of 10825 water from Ruedi Reservoir would commonly occur from July through October. With the Proposed Action and the expiration of the 2012 Agreement, flow of the Roaring Fork River from July through October would typically decrease by 5,412.5 AF. Historical flow of the Roaring Fork River at Glenwood Springs from July through October has averaged 1,150 cfs, with a total volume of flow of 279,700 AF during this four-month period. A reduction in releases of 5,412.5 AF would reduce the July through October flow at this location by 1.9 percent, or from 150 to 250 cfs during the period it was being released from Recovery Program purposes. Actual streamflow reductions on a given day would vary in response to the timing and magnitude of releases of 10825 water.

Assuming a winter release season from Ruedi Reservoir of 150 days, the flow in the Roaring Fork River would increase by 18 cfs during the winter months. Historical flow of the Roaring Fork River at Glenwood Springs from November through March has averaged 515 cfs, with a total volume of flow of 154,000 AF during this five-month period. Increased Ruedi Reservoir releases of 5,412.5 AF would increase the November through March flow at this location by 3.5 percent.

3.5.2.2.4 15-Mile Reach of Colorado River

The Proposed Action, coupled with reasonably foreseeable actions, would change the amount of water available for release to the 15-Mile Reach of the Colorado River. As discussed below, interim releases of 10825 water from Williams Fork Reservoir and Wolford Mountain Reservoir have averaged 7,044 AF/yr since these releases were initiated in 2000. With the Proposed Action, a total of 10,825 AF would be available for release every year, which would be an annual increase from historical conditions. The largest increases would occur in dry years when drought provisions associated with the interim agreements historically resulted in reduced reservoir releases of 10825 water.

With the expiration of the 2012 Agreement, the average annual amount of water released for the Recovery Program would decline from 58,375 AF/yr to 51,331 AF/yr. This net decrease results from the loss of 10,825 AF associated with the expiration of the 2012 Agreement, and from a lesser increase in the amount of 10825 water available for release. Historical releases of 10825 water have on average been less than 10,825 AF/yr (Table 8) because the interim agreements allowed the release of a lesser amount of water in dry years. With the Proposed Action, 10,825 AF of water would be available for release in all years including dry years, and accordingly an increase in the amount of available 10825 water would occur in dry years.

The streamflow in the 15-Mile Reach is the result of a complex and cooperative decision-making process that considers many variables. As a result, it is difficult to assess the specific change in the rate of streamflow that may result from the Proposed Action or from the expiration of the 2012 Agreement. The average volume of streamflow in the 15-Mile Reach from July through October (1991–2008) has historically averaged 450,300 AF (an average of 1,844 cfs). The Proposed Action, coupled with the expiration of the 2012 Agreement, would decrease July through October flow by about 6,340 AF (7,044 AF minus a 10% transit loss)to an average of 1,820 cfs (a decrease of 1.4 percent) (Table 8).

3.5.2.2.5 Other Reasonably Foreseeable Actions

Orchard Mesa Irrigation District-Efficiency Improvements

The OMID efficiency improvement project would increase irrigation efficiency in the OMID. The efficiency improvements would typically reduce OMID diversions, which in turn would typically increase streamflow in the 15-Mile Reach. An operational study of the OMID proposal was completed in 2008 (Grand River Consulting 2008).

Table 8. Average Annual Change in Historical Recovery Program Releases from Upstream Reservoirs (2000–2008).

Type of Release	Average Annual Volume (AF)
Total Historical Releases	58,375
Cessation of Interim Williams Fork Reservoir Releases	-4,045
Cessation of Interim Wolford Mountain Reservoir Releases	-2,999
Permanent 10825 Water (Proposed Action)	10,825
Expiration of Ruedi Reservoir 2012 Agreement Water	-10,825
Total Recovery Program Releases under Future Conditions	51,331

Source: Grand River Consulting 2011.

The results of the study indicate the OMID improvements would typically increase flow by 40 cfs at the head of the 15-Mile Reach. This increase would occur during free river conditions and also when the 119 cfs water right of the GVIC is the calling water right on the river. In most years, the period of increased streamflow would extend through the entire April through October irrigation season.

During very dry conditions (typically August and September of dry years), the calling right on the Colorado River at Cameo is the senior 730-cfs right decreed to the United States and provided to the Grand Valley Water Users Association (GVWUA). When this right is calling for water, the water saved by the OMID improvements would be diverted by the GVWUA. Prior to the OMID improvements, a portion of this water would have accrued to the 15-Mile Reach via return flows from the USA Power Plant. When the 730 cfs GVWUA water is calling for water, return flows to the 15-Mile Reach would be diminished and flow in the 15-Mile Reach would decline by 66 cfs (Grand River Consulting 2009).

The decreased irrigation demand of the OMID system, coupled with the increased irrigation supply to the GVWUA, would commonly allow either a reduction in the Green Mountain Reservoir HUP releases for irrigation, or a reduction in the amount of water diverted by the Orchard Mesa Check. Additional water retained in the HUP could be used to reduce Grand Valley irrigation water shortages that can occur in dry years, and under surplus conditions, could be used to provide additional water to the 15-Mile Reach. Additional water retained in the HUP could be approximately 19,000 AF in dry years such as 1977 or 2002 (Grand River Consulting, 2008).

In summary, the OMID efficiency improvements would change streamflow in the 15-Mile Reach during the irrigation season. Streamflow would be increased by 40 cfs during free river conditions and when the 119 cfs GVIC water right is calling. Streamflow would be decreased by 66 cfs during dry conditions when the 730 cfs GVWUA water is calling. In dry years, up to 19,000 AF of additional HUP water would be available for irrigation use or for delivery to the 15-Mile Reach. The changes in streamflow may cause the Service to alter the timing of water released for Recovery Program purposes from upstream reservoirs (primarily Green Mountain Reservoir, Wolford Mountain Reservoir fish pool, and Ruedi Reservoir). The actual changes in streamflow associated with this action are not known and cannot be reliably simulated. Any modifications in reservoir release patterns would be directed by the Service from its pools and would depend on a decision-making process that considers many factors including:

- The total amount of water available in each reservoir that stores Recovery Program water
- Existing streamflow conditions below each reservoir at the time of release
- Streamflow in the 15-Mile Reach
- Regional weather and streamflow forecasts

- Forecasted irrigation diversions above the 15-Mile Reach

The OMID improvements would likely affect streamflow conditions downstream of Wolford Mountain Reservoir, Green Mountain Reservoir, and Ruedi Reservoir. Streamflow of the North Fork Colorado River, Stillwater Creek, and Willow Creek would not be altered.

Northern Water–Windy Gap Firming Project

The Windy Gap Firming Project would allow the Windy Gap Project to divert additional Colorado River water mostly during average and wetter than average years. The additional diversions would be made possible by construction of additional reservoir storage on the east slope that would be dedicated to the storage of Windy Gap water. The additional diversions would occur at times when the existing Windy Gap pumping plant would otherwise not divert all physically available water because of a lack of reservoir space to store the water. As mentioned earlier, the Windy Gap Firming Project would allow the Windy Gap project to increase its diversions by an average of 21,317 AF annually.

The additional diversions would seasonally decrease streamflow in the Colorado River below Windy Gap Reservoir, commonly during the May through July snowmelt runoff period. No additional streamflow depletions are anticipated in dry years since the project currently diverts all available water during these years. Further, no additional stream depletions would occur when a downstream water right call is in-place from either the Shoshone or Cameo call. A mainstem water right call is typically in-place from August through April.

Reclamation released a Draft EIS for the Windy Gap Firming Project in 2008 (Reclamation 2008a). Changes in streamflow would occur for the Colorado River from Granby Reservoir through the 15-Mile Reach. Changes in the streamflow of Willow Creek would also occur, with decreases in average annual streamflow from Existing Conditions (as defined in the Windy Gap Firming Project Draft EIS) for the Action Alternatives ranging from 20,900 AF to 21,700 AF/yr. Streamflow would not be affected in the North Fork Colorado River, Stillwater Creek, the Blue River, the Fryingpan River, or the Roaring Fork River.

Denver Water–Moffat Collection System Project

The Moffat Collection System Project would divert additional Colorado River water during average and wetter than average years. The additional diversions would be associated with the construction of additional reservoir storage in Gross Reservoir on the east slope. The additional diversions would occur at times when the existing Moffat Collection System would otherwise not divert all legally and physically available water because of a lack of reservoir space to store the water.

The Corps released a Draft EIS for the Moffat Collection System Project in 2009 (Corps 2009). Alternatives referred to in this discussion refer to the 2009 Corps' Draft EIS, not the 10825 EA. According to the Draft EIS, additional Denver Water diversions would occur in average and wet years and would be highly concentrated during the runoff months primarily in May, June, and July. Typically, additional diversions would be greatest in wet years following dry year sequences. For all action alternatives, there would be no additional diversions in dry years because Denver Water currently diverts the maximum amount physically and legally available under existing water rights without additional storage in their system.

Flows in the Fraser River and Williams Fork River basins would decrease in average and wet years during the runoff months due to Denver Water's additional diversions. Average annual flows in the Fraser River at the Granby gage would decrease about 1,900 AF (2 percent) under the No Action Alternative, 8,400 AF (9 percent) under the Proposed Action, and between 7,500 AF and 8,300 AF (8 to 9 percent) for the other action alternatives.

Average annual flows in the Williams Fork River below Williams Fork Reservoir would decrease about 200 AF (less than 1 percent) under the No Action Alternative, 1,700 AF (2 percent) under the Proposed Action, and between 1,400 AF and 1,700 AF (1 to 2 percent) for the other action alternatives. Flows in the Blue River Basin would decrease in average and wet years during summer months and increase slightly during winter months due to differences in Roberts Tunnel diversions and spills at Dillon Reservoir. Flow changes in the Blue River Basin would be driven primarily by the seasonal shift in water treatment plant operations. Under all action alternatives there would be a reduction in winter operations of Foothills and Marston water treatment plants because the Moffat water treatment plant would operate at a minimum level during the winter. Average annual flows in the Blue River at the confluence with the Colorado River would decrease about 10,200 AF (4 percent) under the No Action Alternative, 4,800 AF (2 percent) under the Proposed Action, and between 4,300 AF and 5,200 AF (2 percent) for the other action alternatives.

Flows along the Colorado River would decrease in average and wet years during the runoff months due to changes in surface water flows in the Fraser, Williams Fork, and Blue River basins, which would be translated downstream and into the Colorado River. Average annual flows in the Colorado River near the Kremmling gage would decrease about 12,100 AF (2 percent) under the No Action Alternative, 14,400 AF (2 percent) under the Proposed Action, and between 12,700 AF and 14,600 AF (2 percent) for the other action alternatives.

Xcel Energy-Reduction in Shoshone Call

Key projects/water rights that will benefit from a reduction of the Shoshone call include the Continental-Hoosier Project; Green Mountain Reservoir; Wolford Mountain Reservoir; Williams Fork Reservoir, Blue River Project (Roberts Tunnel, and Dillon Reservoir); Windy Gap; and the Homestake Project. The relaxation of the Shoshone call would allow diverters that would otherwise be called out to divert water in-priority even if they are junior to the Shoshone Power Plant water rights. Because more diversions would be made in-priority, releases from reservoirs such as Green Mountain, Wolford Mountain, and Williams Fork for exchange or substitution purposes would be less. Increased in-priority diversions and reduced reservoir releases for exchange and/or substitution would decrease flows primarily in the Williams Fork River, Muddy Creek, the Blue River, and the Colorado River mainstem below the Windy Gap diversion during the relaxation period. Colorado River flows at Dotsero would be increased outside of the relaxation period if additional water diverted to storage during the relaxation period is released to the Colorado River. The magnitude and timing of flow reductions attributable to a Shoshone call relaxation could vary widely from year to year and would depend on many factors including streamflows, storage contents, project operations, and bypass/instream flow requirements.

A relaxation in the Shoshone call in the early runoff season (March 14 to May 20) could allow Green Mountain Reservoir, the Windy Gap Project, Wolford Mountain Reservoir, Williams Fork Reservoir, and other upstream junior water rights to divert additional water during that time. The call relaxation, consistent with its terms, could result in a moderate reduction in flow in March, April, and the first half of May of those years in which a call relaxation occurs.

A Shoshone call reduction would affect streamflow conditions upstream of the Shoshone Power Plant and in the Colorado River from the power plant through the 15-Mile Reach. Streamflow of the Fryingpan River and the Roaring Fork River would not be affected.

Grand and Summit Counties–Increased Water Use

As population continues to increase in Grand and Summit counties, water use in those areas will continue to increase. Additional diversions and water use in Grand and Summit counties would

reduce streamflow in the entire analysis area, with the exception of the Fryingpan River and the Roaring Fork River. The change in streamflow would occur throughout the year, but would likely be minor since most of the water diverted for the increased use would return to local streams and rivers as wastewater or irrigation return flows.

Colorado Springs Utilities Continental-Hoosier System Exchanges

Colorado Springs Utilities is seeking to exchange water from its Homestake Reservoir to the Continental-Hoosier System at the headwaters of the Blue River during times that a Shoshone or Cameo call is in place. When a mainstem river call from either Shoshone or Cameo would otherwise curtail diversions by the 10825 Project, the utility would divert water out-of-priority at the Continental-Hoosier System and release a like amount of water from Homestake Reservoir, which is within the Eagle River watershed.

This exchange would cause a minor reduction in streamflow in the Blue River from the Continental-Hoosier System to the confluence with the Colorado River and in the Colorado River from the Blue River to the confluence with the Eagle River. This reduction in flow would occur in the late summer months (typically August or September) and would occur only during those infrequent times when Denver Water is not diverting all available water physically available at Dillon Reservoir. Streamflow in the Colorado River watershed upstream of the Blue River and downstream of the Eagle River, would not be affected.

Colorado River Water Conservation District–Increase in Wolford Mountain Reservoir Contract Demands

As population continues to increase in the Colorado River watershed, water use in the basin in Colorado will continue to increase. The additional water use would cause an increased demand for contract water from Wolford Mountain Reservoir. Additional contract releases from Wolford Mountain Reservoir would likely occur to augment depletions both upstream and downstream of Wolford Mountain Reservoir. The additional releases could cause a minor change in streamflow of the Colorado River from Grand and Summit counties downstream through the 15-Mile Reach. The specific change in streamflow would vary in response to the actual location and amount of water use of future contracts from Wolford Mountain Reservoir and changes in the amount of water stored by the reservoir during snowmelt runoff. Streamflow of the Fryingpan River and the Roaring Fork River would be unaffected by this reasonably foreseeable action.

The additional releases for contract demands may result in a minor increase in streamflow during the time that a Shoshone call is in-place (typically from August through April). These releases would be offset by additional water use by the Wolford Mountain Reservoir contractees and increases in streamflow would be negligible.

An increase in contract releases would reduce storage contents of Wolford Mountain Reservoir, and, in turn, the reservoir would typically store additional water in-priority during the following snowmelt runoff season. The additional storage would cause a minor reduction in streamflow of the Colorado River below Muddy Creek from April through June in most years. In dry years, Wolford Mountain Reservoir does not fill to capacity and additional water is not available for in-priority storage by the reservoir. During these dry years, streamflow during the snowmelt runoff season would not be affected.

Denver Water–Expiration of Big Lake Ditch Contract

The expiration of the Denver Water-Big Lake Ditch Contract may reduce the amount of water consumed by irrigation use within the Reeder Creek watershed. The reduction in consumptive use would cause a minor increase in streamflow at this location during the May through September irrigation season. The loss of delayed irrigation return flows would cause a minor decrease in streamflow during the winter months.

Streamflow in the Colorado River watershed downstream of the Williams Fork River would be affected by the expiration of the Denver Water-Big Lake Ditch Contract. Streamflow of the Fryingpan River and the Roaring Fork River would not be altered.

Climate Change

Climate change projections for the analysis area have recently been developed in a draft water availability study of the Colorado River Basin prepared for the CWCB (AECOM 2010). This study evaluated the potential effects of multiple climate change models. As outlined in this study, some climate change models predict an annual reduction in streamflow in the area, while other climate change models predict an annual increase in streamflow. Any effects of climate change would likely influence streamflow conditions in the entire analysis area. There is not a consensus regarding the magnitude of effects of climate change on streamflow. Climate change model results do show consensus that peak runoff events will occur earlier, as will lower summer flows. Historical average annual flows in the Colorado River at Cameo are just over 3.5 million AF. Climate change models estimate that this value could decrease by about 17 percent to just under 3.0 million AF (AECOM 2010).

Mountain Pine Beetle Epidemic

Pine beetle infestation is causing a regional die-off of pines throughout the analysis area. It is estimated that this infestation will generally increase streamflow during the time between die-off and the regeneration of the forest canopy.

Stednick and Jensen (2007) studied the effects of beetle infestations on water yield and water quality in northern Colorado. They concluded that changes in hydrologic processes after an insect infestation would alter streamflow responses. In forested watershed areas with even-aged forest stands (i.e., forests without much understory), water yield would increase as the forest canopy decreases in response to pine beetle defoliation. Other impacts to hydrologic processes from pine beetle kills are presumed to be similar to those effects from timber harvesting, including increases in late summer and fall streamflows, and earlier timing of peak flows. Stednick and Jensen (2007) also observed beetle kill would increase peak flows since the deforested areas allow for greater accumulation of snow, decreases in sublimation, and accelerated snowmelt. These impacts are estimated to be long-term and may last up to 60 years (Stednick and Jensen 2007).

The actual change in streamflow that may be associated with pine beetle infestation is not known. Any effects of pine beetle infestation would likely influence streamflow conditions in the entire analysis area.

3.6 Groundwater Hydrology

Changes in groundwater accrual to Willow Creek and local groundwater levels associated with agricultural dry-up of the Miller-Hereford and E Diamond H ranches were identified as key groundwater issues.

3.6.1 Affected Environment

The Redtop Valley Ditch diverts water from the North Fork Colorado River northeast of Shadow Mountain Reservoir and conveys irrigation water south to irrigated lands northwest of Granby Reservoir. Based on ditch records, historical flow at the Hudler flume, which primarily serves all of the E Diamond H and Miller-Hereford ranches plus 35.9 acres on the Lambright Property, is about 7,300 AF/yr. Flow at the Northern Water flume, which serves the Miller-Hereford Ranch and portions of the E Diamond H Ranch, is about 5,000 AF/yr (Boyle/AECOM 2008; Rademacher 2008).

No estimation of canal seepage was performed as part of available studies. However, a 90 percent delivery efficiency is reported between the Northern Water flume and irrigated fields (Boyle/AECOM 2008). Of the 5,000 AF/yr at the Northern Water flume, about 500 AF is lost during conveyance to irrigated land, primarily as seepage into shallow groundwater (evaporation losses are

likely minimal), which is primarily tributary to Willow Creek.

The Proposed Action would require the dry-up of about 844 irrigated acres, of which 92 are subirrigated. Historical deliveries to these lands average about 6,785 AF/yr. Of this total delivery, about 1,354 AF is consumptively used by crops that are not subirrigated, while the remaining 5,431 AF are return flows to the Willow Creek subbasin (Grand River Consulting 2011). Of these return flows, 500 AF are the conveyance losses previously described. A small amount is also consumptively used by subirrigated lands prior to returning to Willow Creek.

Return flows from use of irrigation water accrue as either short-term surface returns or long-term subsurface (or groundwater) returns. Based on historical data, it is estimated that 54 percent of return flows accrue as surface returns and 46 percent accrue as subsurface returns (Boyle/AECOM 2008). In addition, about 96 percent of the surface and subsurface return flows are tributary to Willow Creek via Church Creek, while the remaining return flows are tributary to Granby Reservoir via the Willow Creek Pump Canal. Therefore, of the 5,400 AF of return flows from the Miller-Hereford and E Diamond H ranches, about 2,500 AF/yr (or 3.3 AF per acre) is introduced into the local groundwater system. Of this, about 2,400 AF is tributary to Willow Creek and 100 AF is tributary to Granby Reservoir.

Some groundwater investigations were performed in the agricultural dry-up area as part of geotechnical investigations of the Jasper North Reservoir site for the Windy Gap Firming Project in 2001 and 2003 (Boyle/AECOM 2003). Saturated thickness (or the thickness of the aquifer from the very bottom to the top of the water table) within the Miller-Hereford Ranch ranged from 2 to 31 feet, with an average of 11 feet (Boyle/AECOM 2008). Although groundwater modeling has not been performed, it is likely that subsurface irrigation return flows contribute to the aquifer in this area.

Four wells are within the agricultural dry-up area (Colorado Decision Support System 2009). Three of these wells are owned by Northern Water (two are permitted for domestic use and one is permitted for construction dewatering). The fourth well was previously permitted for domestic use, but the permit has since been cancelled. There are also several wells south of the irrigated lands along Willow Creek and the Colorado River below Granby Reservoir. It is unknown whether groundwater levels at these wells are influenced by irrigation return flows from the Miller-Hereford and E Diamond H ranches. Based on surface contours, it is likely that any groundwater from these irrigated areas is tributary to surface water in Willow Creek upstream of the aquifers that supply these wells. However, flows in Willow Creek could be the source of some water within the aquifer at these locations.

3.6.2 Environmental Consequences

3.6.2.1 Direct and Indirect Effects

Flow in the Redtop Valley Ditch would generally be lower under proposed operations than for historical operations. This would result in a slight reduction in ditch seepage upstream of the Hudler flume for the Proposed Action, which would result in negligible reduction in groundwater levels in downgradient areas adjacent to the ditch.

No delivery efficiencies were estimated for the Redtop Valley Ditch upstream of the Northern Water flume. Ditch seepage upstream of the Northern Water flume is primarily tributary to Supply Creek, Soda Creek, and Stillwater Creek. Although there would be some reductions in flow in the Redtop Valley Ditch upstream of the Northern Water flume, the ditch would continue to convey water in this portion of the ditch, and changes in seepage rates would likely be minimal.

Downstream of the Hudler flume, the Proposed Action would result in a minor decrease in groundwater levels due to cessation of flow in the Redtop Valley Ditch and downstream private ditches and due to dry-up of irrigated lands on the

Miller-Hereford and E Diamond H ranches. About 500 AF/yr of ditch seepage and 2,500 AF/yr of irrigation return flows would cease to accrue to local shallow groundwater within these areas, likely leading to decreased saturated thickness and increased depth to water. Additionally, the 92 acres of subirrigated lands adjacent to the irrigated acreages would cease to be irrigated.

Groundwater levels in wells within the agricultural dry-up area would decrease. This would be a minor beneficial effect for the Northern Water dewatering well, while it would be a minor adverse effect for the permitted domestic wells. For the wells south of the dry-up area along Willow Creek and the Colorado River, it is likely that effects would be negligible. Although streamflow in Willow Creek would decrease, the effects on localized groundwater levels would be negligible.

3.6.2.2 Cumulative Effects

None of the reasonably foreseeable actions would have a cumulative effect on groundwater resources.

3.7 Water Quality

3.7.1 Affected Environment

Water quality effects are the result of changes in the amount or sources of surface water flows described in Section 3.6, *Surface Water Hydrology*. Therefore, the water quality analysis area was the portion of the surface water hydrology analysis area for which flow or reservoir level changes were anticipated. The water quality analysis excludes the Colorado River below its confluence with the Roaring Fork River because effects are anticipated to be negligible downstream of this location. The Proposed Action, coupled with expiration of the 2012 Agreement, would result in minor flow reductions from July through October and minor increases in flow during the winter months. This relatively small change in streamflow, along with source water quality that is similar to existing conditions, would result in negligible water quality effects in this portion of the Colorado River.

Three analysis area segments are on Colorado's 2010 303(d) list of Impaired Waters and Monitoring and Evaluation List in the Analysis Area (CDPHE 2010c): mainstem of the Colorado River from Granby Reservoir to the Roaring Fork River, Shadow Mountain Reservoir, and Granby Reservoir. The Colorado River within the study area had 35 exceedences of the chronic temperature standard (18.2ºC in June–September) and 27 exceedences of the acute temperature standard (23.8ºC in June–September) within the last 5 years. Most exceedences were recorded in July and August in 2005 through 2008 (CDPHE 2009). Exceedences occurred at several locations along the Colorado River:

- Below Windy Gap Reservoir
- Above Hot Sulphur Springs
- Above Kid Pond (below Parshall)
- Below Byers Canyon
- County Road 3 (near Parshall)
- Lone Buck (downstream of Hot Sulphur Springs)
- Upstream of Blue River at Kremmling

All other stream segments in the analysis area meet water quality standards for temperature.

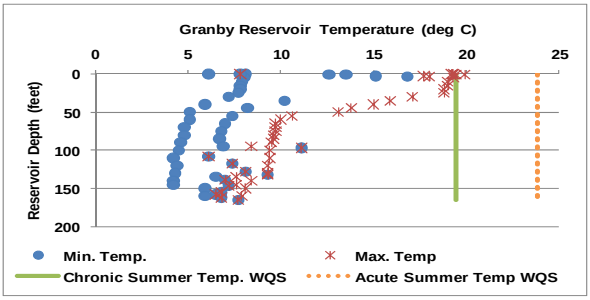
Shadow Mountain Reservoir is on the 303(d) list for concentrations of dissolved oxygen below the Water Quality Standard (WQS) for aquatic life of 6.0 mg/L. Based on data from three different sources, dissolved oxygen concentrations were not in attainment from top to bottom of the reservoir for four dates.

CDPHE issued an advisory in 2009 regarding fish consumption from Granby Reservoir because of a public health risk from high mercury levels. Lake trout exceeded CDPHE's mercury action level of 0.5 parts per million. CDPHE's issuance of a fish consumption advisory indicates impairment of an aquatic life use classification. The source of the mercury in Granby Reservoir has not been identified. Suspected sources are past mining activities, atmospheric deposition from nearby and

distant sources, and naturally occurring local geologic formations and soils.

Exceedences of applicable WQS for dissolved oxygen, dissolved manganese (for drinking water quality), and chronic summer temperature have been documented in Granby Reservoir (Reclamation 2008a). A profile of summer temperatures in Granby Reservoir is shown in Figure 19.

Figure 19. Summer Temperature Profile of Granby Reservoir.



Source: USGS 2011.

3.7.2 Environmental Consequences

3.7.2.1 Direct and Indirect Effects

3.7.2.1.1 North Fork Colorado River and Stillwater Creek below Redtop Valley Ditch

Moderate seasonal increases in streamflow are expected to occur in the North Fork Colorado River below the Redtop Valley Ditch and Stillwater Creek below the Redtop Valley Ditch. The largest increase in flow would occur in Stillwater Creek because water previously diverted by the Redtop Valley Ditch would flow to Granby Reservoir during the irrigation season. Water quality in Stillwater Creek may be slightly beneficially affected during the irrigation season because the source of the increased water in Stillwater Creek would be the North Fork Colorado River, which meets WQS. Increased flow in these segments may provide dilution for nonpoint sources of discharge that adversely affect water quality.

3.7.2.1.2 Willow Creek

Streamflow in lower Willow Creek would decrease slightly as a result of the Proposed Action due to cessation of irrigation return flows from the E Diamond H and Miller-Hereford ranches. These decreases would be largest during June and July. Water quality in Willow Creek is generally good and in attainment of WQS. A reduction in irrigation return flows, which may reduce temperatures, sediment, nutrient, and pesticide loadings and mineral leaching from the soils (Spahr et al. 2000), would likely result in a minor beneficial effect in water quality in Willow Creek. The Three Lakes Wastewater Treatment Plant is permitted to discharge 2,000,000 gallons per day to Church Creek, a tributary of Willow Creek. A reduction in flow in Willow Creek would decrease dilution flows for the plant's effluent, which may cause a minor increase in parameters such as ammonia, copper, and iron (Reclamation 2008a).

3.7.2.1.3 Colorado River below Granby Reservoir

In the last 5 years, exceedences of the temperature standard in the Colorado River below Windy Gap Reservoir occurred in July and August. The Proposed Action would make additional releases from Granby Reservoir in late summer and early fall. Summer hypolimnion (bottom-most layer) temperatures ranged from 4.2 to 11.1ºC in Granby Reservoir (USGS 2011), compared to the acute temperature standard in the Colorado River below Granby Reservoir of 23.8ºC and chronic temperature standard of 18.2ºC. Releases of additional reservoir water from the hypolimnion would decrease the likelihood of future exceedences of the chronic temperature standards in summer and early fall.

3.7.2.1.4 Blue River below Green Mountain Reservoir

In the Blue River below Green Mountain Reservoir, flow would typically not be altered because minor changes in flow would occur infrequently. This is because the 10825 water releases from Granby Reservoir would almost

always occur at a time when streamflow in the 15-Mile Reach was less than the minimum baseflow targets established by the Service. Exchanges of 10825 water from the Colorado River to Green Mountain Reservoir would commonly be 50 cfs or less in August and September, which would reduce flow in the Blue River during these periods by 10 percent or less. Because the source of water in the Blue River would not change, these short-term changes in streamflow would have a negligible effect on water quality in this reach.

3.7.2.1.5 Shadow Mountain Reservoir

Storage levels in Shadow Mountain Reservoir would not appreciably change. The amount of water pumped from Granby Reservoir into Shadow Mountain Reservoir would be reduced by an annual average of 710 AF, which is equal to a 0.45 percent reduction in the total amount of pumped water. Because the amount and source of water into Shadow Mountain Reservoir would not change, there would be no effect on water quality in Shadow Mountain Reservoir due to the Proposed Action.

3.7.2.1.6 Granby Reservoir

Storage levels in Granby Reservoir would typically increase from May through September due to the Proposed Action. The increase in inflow to the reservoir from the North Fork Colorado River and Stillwater Creek would have similar quality to water that currently flows to the reservoir from these drainages. Therefore, because the source water quality would not change, and the change in storage contents from the Proposed Action would be about 1 percent of the volume of Granby Reservoir, the Proposed Action would have a negligible change on concentrations of pollutants of concern (mercury, dissolved oxygen, and manganese) within Granby Reservoir.

3.7.2.1.7 Green Mountain Reservoir

Green Mountain Reservoir would have a minor increase in storage of up to 3,000 AF annually if 10825 water released from Granby Reservoir is not needed in the 15-Mile Reach and exchanged into Green Mountain Reservoir, although this would occur infrequently. The overall change in water quality in Green Mountain Reservoir would likely remain similar to historical conditions.

3.7.2.2 Cumulative Effects

Cumulative water quality effects were estimated based on the cumulative effects on surface water hydrology and reservoir storage levels.

3.7.2.2.1 Colorado River near Kremmling

Minor changes in streamflow during July to October would occur in the Colorado River near Kremmling. Anticipated changes associated with the Proposed Action and expiration of the interim agreements are typically 10 percent or less. Changes in flow result from cessation of releases from Williams Fork and Wolford Mountain reservoirs and loss of return flows from the Redtop Valley Ditch, resulting in negligible to minor changes in water quality.

3.7.2.2.2 Fryingpan River below Ruedi Reservoir

Streamflow in the Fryingpan River below Ruedi Reservoir and Roaring Fork River near Glenwood Springs would be retimed due to expiration of the 2012 Agreement. Summer flows would typically decrease and winter flows would increase. Summer discharge temperatures from Ruedi Reservoir range from about 4 to 12ºC (Reclamation 1989). Water temperature in the Fryingpan River for the same period range from 6 to 17ºC (USGS 2011). Temperatures on the Fryingpan River below Ruedi Reservoir and the Roaring Fork River would be influenced by the magnitude and temperature of the releases. Because summer water temperature in Ruedi Reservoir is typically lower than temperature in the Fryingpan River, stream temperature would decrease with releases of reservoir water cooler than the stream temperature. Wintertime discharge temperatures from Ruedi Reservoir were not available. However, an increase in flow in the Fryingpan River during winter may decrease instances of icing in the river.

3.7.2.2.3 Ruedi Reservoir

End of summer storage levels in Ruedi Reservoir would typically increase by 5,412.5 AF from existing conditions due to the Proposed Action, in combination with expiration of the 2012 Agreement. Because water quality in Ruedi Reservoir is generally good and source water into the reservoir would not change, water quality is not expected to change appreciably.

Any changes in streamflow and reservoir contents due to the Proposed Action under cumulative effects would follow a pattern similar to direct effects. The incremental hydrologic effect of the Proposed Action would be negligible, as would the water quality effects. In general, the reasonably foreseeable actions (Section 3.2) would result in additional water diversions in the future, which would reduce streamflows and reservoir contents in the analysis area. Therefore, while the magnitude of hydrologic changes under the Proposed Action would be similar under direct effects and cumulative effects, the percentage change in water quality conditions under the Proposed Action may be slightly higher under cumulative effects than described for direct effects.

3.8 Reservoir Operations and Hydroelectric Generation

The operation of Shadow Mountain and Grand Lake, Granby, Green Mountain, and Ruedi reservoirs may be affected by the Proposed Action. The Green Mountain Reservoir, Shoshone, and Ruedi Reservoir hydroelectric plants may be affected by changes in the timing of discharge through their generating units. Changes in operations at the Shoshone and Ruedi Reservoir hydroelectric plants would be negligible and are not discussed.

3.8.1 Affected Environment

3.8.1.1 Reservoir Operations

3.8.1.1.1 Shadow Mountain Reservoir

Shadow Mountain Reservoir is a component of the C-BT Project. Shadow Mountain Reservoir is on the Colorado River between Grand Lake and Granby Reservoir and has a total capacity of 18,400 AF. Water is delivered to Shadow Mountain Reservoir from the Farr Pumping Plant, which lifts water 125 feet in elevation from Granby Reservoir into Shadow Mountain Reservoir. Shadow Mountain Reservoir also captures natural inflow above the pumping plant, including inflow from the North Fork Colorado River.

Shadow Mountain Reservoir is connected to Grand Lake and both water bodies have the same water surface elevation. Senate Document 80 requires that water elevations in Grand Lake be maintained within the range of normal fluctuations. As a result, Shadow Mountain Reservoir and Grand Lake water levels are managed and held at a relatively constant level. The average storage contents of C-BT Project water in Shadow Mountain Reservoir and Grand Lake for the 1991 through 2008 study period is 17,750 AF with a range of 13,580 AF in November 2007 to 21,440 AF in October 1991. The annual fluctuation of storage contents (i.e., difference between maximum and minimum storage contents within the year) is between 385 and 4,400 AF, with an annual median fluctuation of 560 AF (Grand River Consulting 2011).

3.8.1.1.2 Granby Reservoir

Granby Reservoir is a 539,800 AF reservoir northeast of the Town of Granby in Grand County. The reservoir, which was completed in 1949, is the second largest reservoir in Colorado and serves as the primary storage reservoir in the C-BT system. Major tributary inflows to the reservoir include Arapaho Creek, Stillwater Creek, Columbine Creek, and the Colorado River. Water is also pumped to Granby Reservoir from Willow Creek Reservoir via the Willow Creek Pump Canal and

from the Windy Gap Reservoir via the Windy Gap pipeline. Most of the water stored in Granby Reservoir is pumped to Shadow Mountain Reservoir via the Farr Pumping Plant and the Granby Pump Canal and is ultimately delivered through the Adams Tunnel to the east slope. Releases from Granby Reservoir accrue to the Colorado River.

The average storage contents of Granby Reservoir for the 1991 through 2008 study period is 373,910 AF with a range of 538,200 AF in July 1995 to 90,250 AF in March 2003. The annual fluctuation of storage contents is between 91,900 and 311,900 AF, with an annual median fluctuation of 138,250 AF (Grand River Consulting 2011).

3.8.1.1.3 Green Mountain Reservoir

Green Mountain Reservoir is a 153,639 AF reservoir on the Blue River 13 miles upstream of the confluence with the Colorado River. The reservoir was completed in 1943 as a component of the C-BT Project. The reservoir's primary purposes are providing replacement storage for diversions of the C-BT Project and for power purposes. Of the total reservoir capacity, 52,000 AF are dedicated to replacement of C-BT Project out-of-priority diversions, and the remaining 100,000 AF are for power generation. The 1983 Operating Policy for Green Mountain Reservoir (Reclamation 1983) further clarified the use of water from the 100,000-AF power pool. The policy states that water released from the reservoir for irrigation and domestic uses whose water rights were perfected by use prior to October 15, 1977 would be limited to 66,000 AF. This allocation is referred to as the HUP. The balance of the 100,000-AF power pool may be used for contracting purposes and for dead/inactive storage. The Blue River Decree specifies the relative priorities of the storage and hydroelectric water rights for Green Mountain Reservoir and the upstream water rights at Dillon Reservoir, the Roberts Tunnel, and Colorado Springs Utilities' Continental-Hoosier System.

Green Mountain Reservoir stores inflow during runoff from the Blue River and water diverted from Elliot Creek, which is delivered to the reservoir via the Elliot Creek Feeder Canal. Releases from the reservoir are typically made through the Green Mountain power plant for power generation (Section 3.8.1.2.1). Releases of HUP surplus water are typically made from June 15 through October 31. Depending on the drawdown of the HUP, surplus HUP water can be available for endangered fish in the 15-Mile Reach. The first release of surplus HUP water was made for the 15-Mile Reach in 1998. The terms and conditions under which surplus HUP water is made available to the 15-Mile Reach are defined in the stipulation and agreement for the Orchard Mesa Check water right case (State of Colorado 1996). HUP surplus water is typically not declared and made available until after August 1. Historical releases of surplus HUP water for the Recovery Program range from 119 AF in 2004 to 61,433 AF in 2008 and a mean of 19,307 AF from 1991 to 2008 (Grand River Consulting 2011).

The average storage contents of Green Mountain Reservoir for the 1991 through 2008 study period is 109,220 AF with a range of 36,170 AF in March 2003 to 155,645 AF in December 1996. The annual fluctuation of storage contents is between 35,510 and 116,580 AF, with an annual median fluctuation of 87,245 AF (Grand River Consulting 2011). Since 1990, Green Mountain Reservoir filled in all years except 1994, 2001, 2002, and 2004.

3.8.1.1.4 Ruedi Reservoir

Ruedi Reservoir, a component of the Fry-Ark Project, is a 102,373 AF reservoir on the Fryingpan River 14 miles upstream of its confluence with the Roaring Fork River. Construction of Ruedi Dam was completed in 1968. Three primary pools exist within Ruedi Reservoir: the replacement pool, the recreation pool, and the west slope pool. The replacement pool is 28,000 AF and is available to replace out-of-priority diversions associated with the Fry-Ark Project. The recreation pool consists of 20,000 AF of storage that has been set aside for

recreation uses. The west slope pool is the remainder of the active storage in Ruedi Reservoir. Water from the west slope pool is available for sale under temporary and long-term contracts and is used for irrigation, municipal and industrial supplies, and fish and wildlife enhancement.

The initial contracts for water, called "Round I sales," consist of four, long-term (40-year) contracts for a total of 7,850 AF of water from Ruedi Reservoir. Due to additional requests for contract water after Round I, Reclamation initiated studies to determine the impacts of the proposed Ruedi Round II Water Marketing Program, or "Round II program." Reclamation completed NEPA compliance on Round II in 1990. In 1991, the razorback sucker was listed as endangered and in 1994, critical habitat was listed for all four Colorado River endangered fish. With the 1991 and 1994 listings, Reclamation reinitiated Section 7 consultation on Round II contracting. In 1995, Reclamation received a jeopardy biological opinion on the marketing of up to 17,000 AF of Round II water. The biological opinion contained two reasonable and prudent alternatives (RPAs) for Reclamation to implement prior to proceeding with Round II water contracts. Reclamation was to: (1) continue the 5,000 AF annually and 5,000 AF in 4 out of 5 years commitments; and, (2) make the remaining uncommitted portion of the marketable yield (estimated at 21,650 acre feet) available through an interim agreement with the Service and CWCB for up to 15 years to enhance flows in the 15 Mile Reach. Reclamation was unable to implement one of the RPAs (an interim agreement to which all parties could agree) so in 1997 Reclamation reinitiated consultation to develop a new RPA.

In 1997, water users, environmentalists, Reclamation, and the Service began discussing the elements of a Programmatic Biological Opinion (PBO) to address the effects of all historic depletions affecting the 15 Mile Reach, including those from Ruedi Reservoir. Rather than proceed with developing a separate RPA for the Round II program, Reclamation decided to pursue a new RPA through the PBO process. However, development of the PBO took longer than originally anticipated and west slope water users were urging Reclamation to reinitiate Round II contracting to address immediate water sale needs. As a result, in 1998 Reclamation again reinitiated consultation with the Service to develop a new RPA for the Round II program. In 1999, Reclamation received and accepted a final amendment to the May 1995 Biological Opinion on the Round II program, which allowed contracting for up to 6,135 AF to meet immediate needs out of a total projected demand of 17,000 AF of Ruedi Reservoir water. Reclamation proceeded with this contracting.

In late 1999, agreement was reached and the PBO finalized. The PBO superseded previous biological opinions on Ruedi Reservoir operations. Reclamation committed to continue to provide 5,000 AF per year and 5,000 AF in 4 out of 5 years (referred to as "5 plus 5 Water,") and to seek an agreement to provide up to 21,650 AF of Ruedi Reservoir water to the Recovery Program through 2012 to improve flows in the 15 Mile Reach. The PBO states that when the east and west slope water users dedicate a total of 10,825 AF to the Recovery Program, Reclamation's commitment will be reduced from 21,650 AF to 10,825 AF of Ruedi Reservoir water. This occurred in 2000. Finally, when a long term (through 2012) agreement is signed committing Reclamation to make 10,825 AF of Ruedi water available to enhance flows in the 15 Mile Reach thru 2012, Reclamation may, per the PBO, contract for the 10,865 AF remainder of the 17,000 AF (17,000 AF minus the 6,135 AF to meet immediate needs). The 2012 Agreement is discussed in Section 1.4.3.4.

A total of 19,002 AF (7,850 AF under Round I and 11,152 AF under Round II) has been contracted for water supply purposes, not including the reservoir water allocated for Recovery Program purposes. The total remaining amount available for contract is 16,673 AF until the 2012 agreement between Reclamation, CWCB and the Service for release of 10,825 AF of water expires, at which time

additional water will be available for contract from Ruedi Reservoir.

Ruedi Reservoir is normally operated to offset out-of-priority diversions, store spring runoff, accommodate recreational interests, and provide for downstream fishery requirements. Through releases for fish flow purposes and contract water releases, the reservoir is typically drawn down during the winter months through March in an attempt to "fill without spill" during the summer based on forecasted runoff. Historically, the reservoir has typically filled by late June or July. Following the fill, the reservoir is operated to enhance recreational uses until it becomes necessary to make releases to meet contract demands and demands for fish flow releases. The Division Engineer assesses a transit loss of 7.5 percent and a 2-day lag for Ruedi Reservoir releases to the 15-Mile Reach.

The Water Resources Assessment Report (Grand River Consulting 2011) provides an annual summary of historical Recovery Program releases from Ruedi Reservoir in the late summer and fall. The average storage contents of Ruedi Reservoir for the 1991 through 2008 study period is 84,740 AF with a range of 32,810 AF in April 1996 to 103,160 AF in June 2000. The annual fluctuation of storage contents is between 27,810 and 66,240 AF, with an annual median fluctuation of 37,280 AF (Grand River Consulting 2011).

3.8.1.2 Hydroelectric Generation

3.8.1.2.1 Green Mountain Reservoir Power Plant

The Green Mountain Reservoir power plant is a 26-MW facility at the base of Green Mountain Reservoir Dam and is federally owned and operated by Reclamation. Green Mountain Reservoir was constructed for the primary purposes of providing replacement storage for diversions by the C-BT Project and for power purposes. Releases from the reservoir are made through the Green Mountain Reservoir power plant. The power plant has a decree of 1,726 cfs.

In most years, all outflow from Green Mountain Reservoir is routed through the power plant. In wet years, the reservoir may spill, and outflow to the Blue River can exceed the capacity of the power plant. During the analysis period, outflow from the reservoir exceeded the capacity of the power plant for the following periods:

- 1995—June 28 to July 24
- 1996—June 19 to July 8
- 1997—June 14 to July 1
- 1999—July 3 to July 4
- 2007—June 18 to June 25
- 2008—July 7 to July 9

3.8.2 Environmental Consequences

Because Granby Reservoir, Shadow Mountain Reservoir, and the Green Mountain Reservoir and power plant would be affected by the Proposed Action only, and not the expiration of the interim agreements, direct effects were assessed. The expiration of the interim agreements, in combination with the Proposed Action, was analyzed as a cumulative effect on Ruedi Reservoir for this EA.

3.8.2.1 Direct and Indirect Effects

3.8.2.1.1 Reservoir Operations

Shadow Mountain Reservoir

The Proposed Action would bypass a portion of the water that has historically been diverted by the Redtop Valley Ditch to the North Fork Colorado River. The flow would accrue to Shadow Mountain Reservoir. Additional inflow to the reservoir from the North Fork Colorado River is estimated to average 2,404 AF/yr (Grand River Consulting 2011).

Because of the Senate Document 80 requirement to keep Shadow Mountain Reservoir and Grand lake at a nearly constant level, any change in storage contents of the reservoir would be negligible. The increased volume in the reservoir would be released to the Colorado River from Granby Reservoir. It is anticipated that a portion of the

additional water available to Shadow Mountain Reservoir would be directly diverted through Grand Lake to the Adams Tunnel, thereby reducing the amount of water that would have to be pumped from Granby Reservoir to Shadow Mountain Reservoir (likely in July). For the month of July, inflow to the reservoir from the North Fork Colorado River would increase by 710 AF (Grand River Consulting 2011) and the amount of water pumped to Shadow Mountain Reservoir from Granby Reservoir would decrease by a commensurate amount. Average annual diversions by the Farr Pumping Plant are 180,731 AF. Annual pumping would decrease by 0.4 percent of the total annual amount of water pumped by the Farr Pumping Plant.

Granby Reservoir

With the Proposed Action, storage levels in Granby Reservoir would typically increase from May through September. The increase in storage would be associated with an increase in inflow to the reservoir from the North Fork Colorado River and Stillwater Creek. The increase in reservoir inflow would be equal to the amount of water that has historically been supplied for irrigation on the E Diamond H and Miller-Hereford ranches.

Granby Reservoir contents would increase in May, June, and July with the increase of Redtop Valley Ditch water. Storage in the reservoir would typically increase by an average of 6,475 AF during this period. The amount of actual increase would vary from year to year (Grand River Consulting 2011). The water surface elevation of Granby Reservoir would typically increase 0.9 to 1.4 feet by the end of July.

In late July, August, and September, the release of 5,412.5 AF of water would be made from Granby Reservoir. These releases would be in addition to other Granby Reservoir releases that occur in July, August, and September. Disposition of the remaining estimated 1,062.5 AF of Redtop Valley Ditch water that would accrue to the C-BT Project has yet to be determined. As a result, average storage volumes in Granby Reservoir at the end of September could be slightly higher as a result of the Proposed Action.

Green Mountain Reservoir

Two components of the Proposed Action may affect Green Mountain Reservoir: the exchange of water from the Colorado River and increased releases from the C-BT replacement pool.

Exchange from the Colorado River

An exchange between the Colorado River and Green Mountain Reservoir would be operated infrequently and would occur for relatively short periods. Any exchanges would most likely occur in either August or September of wet years when water released from Granby Reservoir was not desired in the 15-Mile Reach because of high streamflow at this downstream location.

An exchange is predicted to affect Green Mountain Reservoir storage levels in the following manner:

- Water exchanged to Green Mountain Reservoir would increase reservoir storage in an amount equal to the exchanged volume of water.
- Reservoir storage would remain at a higher level until the water was subsequently released for Recovery Program purposes later in the year or in the following spring.
- Following the release of water, Green Mountain Reservoir contents would decline to the level that would have occurred without the exchange.
- At no time would the exchange of water decrease Green Mountain Reservoir storage levels.

The maximum amount of a Colorado River-to-Green Mountain Reservoir exchange is anticipated to be less than 3,000 AF/yr. The average storage content for Green Mountain Reservoir at the end of August is 129,000 AF. If a maximum exchange of 3,000 AF occurred, and if the exchanged water had not yet been released from Green Mountain Reservoir, the average storage contents of Green

Mountain Reservoir would increase by an estimated 2.3 percent at the end of August.

Similarly, the average storage content of Green Mountain Reservoir at the end of September is 109,000 AF. If a maximum exchange of 3,000 AF occurred, the average storage contents of Green Mountain Reservoir would increase by 2.8 percent at the end of September. Both of these changes in storage would increase the reservoir elevation by about 1.8 feet.

Increased Releases from C-BT Replacement Pool and Effect on Other Contracted Uses

Additional releases from the C-BT replacement pool would occur to offset the amount of Redtop Valley Ditch water stored in Granby Reservoir whenever a mainstem river call was in place. These additional releases would often reduce reservoir carry-over storage into the following year. In certain dry years, Green Mountain Reservoir does not fill to capacity. The additional C-BT replacement releases from the prior year would increase the reservoir's fill deficit in dry years, which in turn may affect the amount of substitution water owed to Green Mountain Reservoir by Denver Water and by Colorado Springs Utilities. This deficit may affect the yield of the Green Mountain Reservoir power pool, including the contract and HUP allocations.

The potential impact to Green Mountain Reservoir would occur only in dry years when Green Mountain Reservoir did not fill. For example, if the additional C-BT replacement pool releases resulted in a lower end-of-year storage content in Green Mountain Reservoir, and the reservoir did not achieve a fill in the following year, the reservoir supply available to some water users may be reduced.

Estimates of the amount of out-of-priority diversions in Granby Reservoir are based on historical diversions by the Redtop Valley Ditch and historical river calls. The actual increase in replacement releases from Green Mountain Reservoir in individual years would vary from a low of 0 AF to a high of 1,873 AF. From 2001 through 2004, the additional replacement release from Green Mountain Reservoir was a total of 5,651 AF, for an average of 1,413 AF/yr during that 4-year period. Under current water right administration, each year from 2001 through 2004 would have been a substitution year and would have required additional substitution by Denver Water and Colorado Springs Utilities.

The estimates of the amount of out-of-priority diversions in Granby Reservoir are based on the assumption that when a mainstem river call occurred, the storage of Redtop Valley Ditch water in Granby Reservoir would also be out-of-priority. This assumption represents a worst-case scenario and in actuality, the relatively senior water rights of Granby Reservoir would remain in-priority during some portion of a mainstem water right call. Accordingly, the out-of-priority diversion estimates may overstate the actual amount of additional replacement that would be required from Green Mountain Reservoir.

Reclamation recently modeled Green Mountain Reservoir operation for a 54-year period (water years 1952 to 2005). Two scenarios were modeled: current levels of contracting (9,644 AF) and full level of contracting (20,000 AF). The modeling did not include additional C-BT replacement releases due to the 10825 Project. If, and when, Green Mountain Reservoir contracts total the full 20,000 AF, contract deliveries can only be fully met if the reservoir fills to 149,680 acre-feet. Without the additional C-BT Granby replacement releases and under the full contract condition, shortages to contract deliveries can be expected 4 of 54 years. Of those 4 years, in one year (2002) there is a 100 percent shortage with or without the additional C-BT replacement releases and the other 3 years result in only partial shortages without the additional C-BT replacement releases. Therefore, to the extent that additional C-BT replacement releases in the preceding year resulted in a lower carryover storage (March 31) in the reservoir, the modeling indicated the amount of water available for contractors would be reduced by that amount in

up to 3 out of 54 years, 1954, 1981 and 2004 under full contracting.

The modeling indicated that 8,176 AF was available for contracting in 1954. The shortage would have been equivalent to the 1953 additional C-BT replacement releases, which are not known. In 1981, the modeling indicated 13,445 AF was available for contracting. The total modeled contract delivery requirement for 1981 was 13,286 AF, leaving a balance of 157 AF. Therefore, the shortage would have been equivalent to the 1980 additional C-BT replacement releases (which is not known) minus 157 AF under full contracting. In 2004, the model indicated 8,937 AF was available. The shortage caused by the C-BT replacement release would have been equal to the 2003 release of 1,786 AF (Table 6), under full contracting. Reclamation recently began accepting requests for new Green Mountain Reservoir water service contracts. All new contracts likely will require a back-up source equivalent to the amount contracted for.

Historical vs. Current Reservoir Operations, and Discretionary Power Releases. Historical reservoir operations may not be indicative of current and future operations of Green Mountain Reservoir. In many past years, it was common that a portion of the 66,000 AF HUP allocation was not released during the irrigation season because of a lack of demand by HUP beneficiaries. In those historical years, the end-of-irrigation season storage content of the reservoir often was higher than the desired start-of-year reservoir content for the following year. In order to draw the reservoir down to a desired pre-snowmelt runoff content, Reclamation commonly made discretionary power releases throughout the winter months.

With the settlement of the Orchard Mesa Check water right case, and the resulting use of the HUP allocation for the Recovery Program, the operation of Green Mountain Reservoir has changed. The entire 66,000 AF HUP allocation is now commonly released each year and the end-of-irrigation season content of Green Mountain Reservoir has declined in many instances. Reclamation (2011b) estimates that with the existing operational criteria for Green Mountain Reservoir, the end-of-irrigation season storage contents will be such that required winter releases will draw the reservoir down to less than the desired start-of-fill contents about two-thirds of the time. Accordingly, discretionary power releases during the winter months will not be as common as they have been historically, and they may not occur in about two-thirds of the years. The reduced start-of-year storage contents may increase the frequency that Green Mountain Reservoir has either a legal or physical fill deficit in subsequent dry years.

Change in Substitution Demands. If Green Mountain Reservoir does not achieve a fill in a given year, junior water diverters upstream of Green Mountain Reservoir (Denver Water and Colorado Springs Utilities) are required to provide "substitution water" to offset the impact of their upstream diversions on Green Mountain's ability to fill. These types of years are referred to as "substitution years." In substitution years, Denver Water and Colorado Springs Utilities must provide substitution water to Reclamation to the extent needed to allow Green Mountain Reservoir to fill. Denver Water typically replaces 90 percent of the substitution demand and Colorado Springs Utilities provides the remaining 10 percent. The amount owed to Green Mountain Reservoir is the minimum of 1) the shortage in the Green Mountain fill, or 2) the amount of water diverted by Denver Water and Colorado Springs Utilities. Any additional substitution requirements caused by additional C-BT replacement releases from Green Mountain Reservoir would be offset by the potential mitigation described in the next section.

Potential Mitigation for Green Mountain Reservoir's Contract and HUP Allocations. The effects of additional C-BT replacement releases on the contract and HUP allocations could be mitigated through any combination of the three options that form an insurance pool (see Section 2.3.4).

1. An "if and when" storage pool in Wolford Mountain Reservoir that could be filled by exchange from Grand County environmental water supplies if and when they were not needed for environmental purposes on the Colorado River below the confluence with the Blue River, as determined by Grand County. This pool would be the first to spill in the event that Wolford Mountain Reservoir filled and thus may not be available in all years.

Under terms of the Colorado River Cooperative Agreement (see Section 3.2.4), a negotiated but not formally approved agreement between Denver Water and a group of West Slope interests, Grand County will receive 1,000 AF of water supply from Denver's Moffat Collection system and up to 1,000 AF from Denver's Williams Fork Reservoir, which will be used to improve stream flows in the Upper Colorado River. Additionally, negotiations are currently underway with the Municipal Subdistrict of the Northern Colorado Water Conservancy District related to the Windy Gap Firming Project. Additional environmental water supplies may be made available to Grand County as the result of these negotiations. Collectively, these releases are called "Grand County environmental water."

2. Similar to option 1 above, Grand County environmental water could be exchanged to Green Mountain Reservoir and held in an "if and when" storage pool or simply used to offset the releases from the 52,000-AF C-BT replacement pool caused by the 10825 water being stored in Granby Reservoir.

3. The CRWCD could obtain 2,000 AF water supply contract in Ruedi Reservoir that would back-up the Wolford Mountain Reservoir and Green Mountain Reservoir pools in years when they were not available or sufficient. A new contract for Ruedi Reservoir water would be consistent with the Ruedi Reservoir Round II Water Marketing EIS (Reclamation 1989), which required appropriate site-specific NEPA compliance by Reclamation on a case-by-case basis before any Ruedi water sales contracts can be executed. Any water sales contract with a prospective water user will contain environmental compliance requirements in relation to mitigating site-specific impacts of water sales that must be met as a part of the water sales contracting process.

The mitigation commitment is to develop a plan to mitigate the adverse effects of storing Redtop Valley Ditch water out of priority in the C-BT Project system. The mitigation plan will be developed through the cooperative efforts of Reclamation, Northern Water, Denver Water, the CRWCD and possibly others.

3.8.2.1.2 Hydroelectric Generation

Green Mountain Reservoir Power Plant

Hydroelectric production at the Green Mountain Reservoir power plant would be affected by the exchange of water from Granby Reservoir to Green Mountain Reservoir and additional C-BT Project replacement releases.

Granby Reservoir to Green Mountain Reservoir Exchange

The Proposed Action would affect the timing of power production from the Green Mountain Reservoir power plant when an exchange of water from Granby Reservoir is implemented. During the infrequent periods when an exchange occurs, the Proposed Action may cause a minor change in the timing of reservoir releases, which would result in a minor change in the timing of a small portion of the power that was produced.

The maximum annual exchange of water to Green Mountain Reservoir is estimated to total 3,000 AF. This exchange would typically occur in August during wet years. The average discharge through the power plant is 36,600 AF during August. The exchange could reduce outflow (and power production) from the reservoir an average of 8.2 percent during August if the full 3,000 AF of water was exchanged. When the water exchanged into Green Mountain Reservoir was subsequently released from the reservoir for Recovery Program purposes (typically in September or October), the

additional water would be discharged through the power plant and the prior loss in power production would be offset. This release would typically occur during the fall or in the spring of the following year.

Release of Additional Water from C-BT Replacement Pool

Additional C-BT replacement releases could occur in June and July of dry years when an exchange of water from Granby Reservoir is implemented (see prior discussion on Green Mountain Reservoir operations). Winter discretionary power releases from Green Mountain Reservoir may decline a like amount, and the annual change in power production would be negligible.

3.8.2.2 Cumulative Effects

3.8.2.2.1 Reservoir Operations

Ruedi Reservoir

The Proposed Action, in combination with the expiration of the 2012 Agreement, would increase summer reservoir levels in Ruedi Reservoir from current levels. The increase would be associated with a typical reduction in Ruedi Reservoir releases of 5,412.5 AF/yr.

The Proposed Action would result in an increase in the end-of-summer storage in Ruedi Reservoir. Reservoir storage would typically be 5,412.5 AF higher at the end of October. The reservoir water surface elevation would be 6.5 feet higher. The additional 5,412.5 AF in storage would be released to the Fryingpan River over the winter months in average and wetter than average years when Reclamation desires to reduce reservoir storage levels prior to the snowmelt runoff period. It is projected that reservoir levels prior to the beginning of snowmelt runoff would generally be unaffected by the Proposed Action.

Reclamation previously estimated storage conditions for Ruedi Reservoir in the EA for the 2012 Agreement (Reclamation 2002). Alternative A from the 2012 EA is representative of typical existing conditions at Ruedi Reservoir in which 10,825 AF of water is released annually pursuant to the 2012 Agreement. Under the Proposed Action, and with the expiration of the 2012 Agreement, reservoir storage would typically increase by 5,412.5 AF from the storage projected in the EA for the 2012 Agreement. Based on this anticipated change, late summer reservoir storage in dry years would increase from 65,000 AF to 70,500 AF, or a 6.5 ft increase in average reservoir stage. In a moderate year, late summer reservoir storage would increase from 81,000 AF to 86,500 AF or 6.5 feet. In a wet year, late summer reservoir storage would increase from 83,000 AF to 88,500 AF or 6.5 feet (Grand River Consulting 2011).

Other Reasonably Foreseeable Actions

For all reasonably foreseeable actions, the Proposed Action would likely result in the same volumetric change in storage as previously described in the direct effects analysis regardless of the future outcome of the reasonably foreseeable action (Grand River Consulting 2010).

3.8.2.2.2 Hydroelectric Generation

Cumulative effects on hydroelectric power generation at the Shoshone and Ruedi Reservoir power plants would be negligible. For all reasonably foreseeable actions, the Proposed Action would likely result in the same volumetric change in hydroelectric generation as previously described regardless of the future outcome of the reasonably foreseeable action.

3.9 Aquatic Resources

3.9.1 Affected Environment

3.9.1.1 North Fork Colorado River to Shadow Mountain Reservoir

The segment of the North Fork Colorado River below the Redtop Valley Ditch diversion is classified as an Aquatic Life Cold 1 stream (CDPHE 2010a). At a sampling site in 1993, brown trout and mottled sculpin were common in this section of the river with low numbers of brook

and rainbow trout (CDOW 2010b, unpublished data). No other data are available for this section of the river.

At sites upstream of the Redtop Valley Ditch sampled by USGS in 1996, 1997, and 1998, brown trout, brook trout, cutthroat trout, mottled sculpin, and longnose suckers were collected (Deacon et al. 1999). Community composition was similar among the 3 years with brown trout the dominant species each year and one cutthroat trout collected in 1996. Benthic macroinvertebrates were also sampled (Deacon et al. 1999). Overall, the data indicate healthy fish and benthic macroinvertebrate communities upstream of the ditch. Similar conditions are likely found in the section of the river downstream of the ditch, if sufficient water is present to support fish populations, based on the similarities in the fish data. The Redtop Valley Ditch often dries up the North Fork Colorado River from late June through the end of the irrigation season in July (Grand River Consulting 2011), which would limit the fish population in this reach.

3.9.1.2 Shadow Mountain Reservoir

Shadow Mountain Reservoir is managed as a recreational fishery by CDOW to provide angling opportunities for coldwater game fish (Reclamation 2008a). Seven species were collected from Shadow Mountain Reservoir during the sampling events in 1995 through 2001. Five of the seven species are salmonid game species. The remaining two species collected were longnose suckers and white suckers, of which the white suckers comprised the greatest percentage of the fish community in each year. Brown trout or rainbow trout were the second and third most abundant species. Natural reproduction of game fish in Shadow Mountain Reservoir is inadequate to support the level of recreational fishing, thus fish are stocked by CDOW (Reclamation 2008a). Over the last 10 years, rainbow trout and kokanee salmon have been stocked annually, brown trout have been stocked in most years, and Snake River cutthroat trout have been stocked occasionally (CDOW 2010b, unpublished data).

3.9.1.3 Stillwater Creek-Redtop Valley Ditch to Granby Reservoir

No sampling data are available for Stillwater Creek downstream of the Redtop Ditch. Stillwater Creek is on private property and is not open to public access. This stream likely contains several species of trout, suckers, and mottled sculpin like other streams in the area. Cutthroat trout are found in the upper sections of Stillwater Creek (J. Ewert, CDOW, pers. comm. 2010), and it is not known if they are present in the section of the stream in the analysis area.

3.9.1.4 Granby Reservoir

Granby Reservoir provides recreational fishing opportunities for coldwater game species (Reclamation 2008a). Fish data from samples in 2001, 2007, and 2008 indicate white suckers and longnose suckers were the most abundant species sampled (CDOW 2010b, unpublished data). Kokanee salmon, brown trout, lake trout, and rainbow trout were each collected during all three sampling events and comprised 1 to 12 percent of the fish sampled at a site. In addition, brook trout, cutthroat x rainbow trout hybrids, Snake River cutthroat trout, and mottled sculpin were collected in low abundances in at least one of the samples.

The lake trout and brown trout populations in Granby Reservoir are maintained through natural reproduction (Reclamation 2008a). Rainbow trout are capable of some natural reproduction in Granby Reservoir and kokanee salmon exhibit little or no reproduction (Reclamation 2008a). The kokanee population in Granby Reservoir is used as a source for kokanee eggs in the CDOW hatchery program (Reclamation 2008a). A review of stocking records indicate rainbow trout and kokanee salmon have been stocked annually for at least the last 10 years (CDOW 2010b, unpublished data). Cutthroat x rainbow trout hybrids and Snake River cutthroat trout have also been stocked periodically.

Lake trout prey upon kokanee salmon and the balance between the two populations in Granby Reservoir is dependent upon water levels

(Reclamation 2008a). The two species are thermally separated when water elevations are lower because kokanee are more tolerant of the warmer surface levels and lake trout are in the cooler lower levels (Reclamation 2008a). During periods of high reservoir levels, survival of lake trout is higher than at low reservoir levels and the two species are not as thermally separated, resulting in increased predation on kokanee and eventually a reduced lake trout population because of a limited kokanee prey base (Reclamation 2008a). The CDOW manages for balanced kokanee salmon and lake trout populations through stocking and angling regulations (Reclamation 2008a).

3.9.1.5 Willow Creek–Willow Creek Reservoir to Colorado River

The study reach of Willow Creek from Willow Creek Reservoir downstream to the Colorado River is classified as an Aquatic Life Cold 1 stream (CDPHE 2010a). Fish data were available for three sites on Willow Creek, downstream of Willow Creek Reservoir. Eight species were collected at the three sites (CDOW 2010b, unpublished data). Brown trout were the dominant trout species at each site. Longnose suckers and white suckers were also abundant at one of the sampling sites. Rainbow trout, mottled sculpin, creek chub, fathead minnow, and longnose dace were present in at least one of the three sites at low densities. Chadwick Ecological Consultants, Inc. also sampled Willow Creek in this section for several years in the mid- to late 1990s with similar results (Chadwick Ecological Consultants, Inc. 1999).

Benthic macroinvertebrate samples were also collected and evaluated for the three sites downstream of Willow Creek Reservoir (Reclamation 2008a). Index values used to evaluate the health of the benthic macroinvertebrate community were calculated and indicated some stress to the aquatic benthic macroinvertebrate community. However, the high number of individuals, number of taxa, and presence of some pollution-intolerant taxa indicates that pollution was not the cause of the stress. Instead, the stress was more likely related to water temperature fluctuations and/or rapid changes in discharge because of releases from the upstream reservoir or local land use activities (Reclamation 2008a).

Miller Ecological Consultants (in Tetra Tech et al. 2010) developed PHABSIM habitat relationships for Willow Creek downstream of Willow Creek Reservoir as part of the Grand County Stream Management Plan. The relationship for adult brook trout indicates high levels of habitat occur between flows of 3 cfs and 20 cfs. Adult and juvenile brown trout habitat levels were highest from 25 cfs to 150 cfs. Environmental target flow ranges were developed based on adult habitat availability (weighted usable area [WUA]) for trout in summer (April through September) and trout spawning and incubation habitat availability in winter (October through March) in the Grand County Stream Management Plan (Tetra Tech et al. 2010). Recommended flows are 7 to 10 cfs in summer and winter for this reach (Tetra Tech et al. 2010). A flushing flow was recommended of at least 50 cfs for a three-day period and a recurrence of once every 2 years (Tetra Tech et al. 2010). There is no CWCB minimum instream flow for Willow Creek.

3.9.1.6 Colorado River–Granby Reservoir to Windy Gap Reservoir

The Colorado River from Granby Reservoir downstream to Windy Gap Reservoir is classified as an Aquatic Life Cold 1 stream (CDPHE 2010a). This reach of the Colorado River is managed by CDOW as a trout fishery (CDOW 2009). Rainbow trout were the dominant species in 1999, 2000, and 2002. Cutthroat x rainbow trout hybrids were also abundant in 2000 and 2002. From 1994 through 1996, brown trout were the dominant species and rainbow trout comprised a small percentage of the fish sampled in each year. Mottled sculpin were also present in 1996. The rainbow trout collected in this reach from 1994 through 2002 are likely

mostly stocked fish as this reach is stocked heavily with rainbow trout (CDOW 2010b, unpublished data).

PHABSIM habitat relationships were developed for rainbow trout, brown trout, and trout spawning for the Colorado River downstream of Granby Reservoir (Tetra Tech et al. 2010). The PHABSIM relationships indicate that habitat is at relatively high levels for all modeled life stages of trout from 75 to 300 cfs. The CWCB adopted minimum flows of 40 cfs in summer and 20 cfs in winter for this section of the Colorado River. Environmental flow target ranges were recommended at 90 to 160 cfs in summer and from 40 to 100 cfs in winter (Tetra Tech et al. 2010). A flushing flow of at least 200 cfs was recommended for a three-day period and a recurrence of once every 2 years (Tetra Tech et al. 2010).

3.9.1.7 Colorado River–Windy Gap Reservoir to Williams Fork River

The Colorado River from Windy Gap Reservoir downstream to the Williams Fork River is classified as Aquatic Life Cold 1 (CDPHE 2010a). This river segment is managed as a trout fishery and the entire segment is considered a Gold Medal Water (CDOW 2009). Fish data are available at a number of sites in this segment of the Colorado River. Brown trout were the dominant trout species in this reach of river from 2001 through 2008 (CDOW 2010b, unpublished data). Rainbow trout were collected at high densities in 2003, 2006, and 2007. However, this reach of stream is routinely stocked with rainbow trout and the high densities observed in these years are likely the result of collecting stocked rainbows (J. Ewert, CDOW, pers. comm. 2010).

Brook trout, Snake River cutthroat trout, cutthroat x rainbow hybrid trout, and kokanee salmon were collected only occasionally in low numbers from 2001 through 2008, generally representing less than 1 percent of the catch. Although density data were not always available for mottled sculpin and speckled dace, these species were collected frequently, sometimes at moderate to high abundances. Longnose suckers and white suckers were also collected frequently, but at low densities. Creek chub, longnose dace, and johnny darter were collected only occasionally at low abundances. Of all the species collected, only mottled sculpin and speckled dace are native to the Colorado River Basin (Nesler 1997).

Long-term research in this study segment has documented a shift from a trout population dominated by rainbow trout to a population dominated by brown trout. Whirling disease is considered the primary factor for the decline in the rainbow trout population from the levels observed in the 1980s (Nehring et al. 2000). There is some evidence that brown trout have also been affected by whirling disease (Nehring et al. 2000). Although the current trout population in this segment is dominated by brown trout, the total trout density remains high and is similar to densities prior to whirling disease. Overall, based on the high trout densities observed in recent years and the Colorado River's Gold Medal Water status, the current trout population appears healthy. Long-term research also indicates that mottled sculpins and salmon fly nymphs have been reduced in density in the first few miles of the river reach downstream of Windy Gap Reservoir in recent years (Nehring et al. 2010).

Three sets of PHABSIM relationships were available for this reach of the Colorado River based on information from 1985, 2006, and 2008 (Tetra Tech et al. 2010). The relationships indicate relatively high habitat availability for trout at flows ranging from 75 cfs up to 700 cfs, depending on the dataset and life stage of trout. The CWCB adopted minimum flows of 90 cfs year-round for this section of the river with a high flow target of 450 cfs for 50 hours once every 3 years. Environmental flow range targets were recommended at 200 to 400 cfs in summer and between 125 to 250 cfs in winter (Tetra Tech et al. 2010). A flushing flow of at least 600 cfs was recommended for a three-day period and a recurrence of once every 2 years (Tetra Tech et al. 2010).

3.9.1.8 Colorado River–Williams Fork River to Blue River

The Colorado River from the Williams Fork confluence downstream to the Blue River confluence is classified as an Aquatic Life Cold 1 river (CDPHE 2010a). This segment of the Colorado River is managed as a trout fishery and upstream of Troublesome Creek the Colorado River is classified as a Gold Medal Water (CDOW 2009). The current fish community is dominated by brown trout, as evidenced by data collected by CDOW from 1998 to 2008 at the Parshall-Sunset Site (CDOW 2010b, unpublished data). Rainbow trout were the next most abundant species in most years. Snake River cutthroat trout, mottled sculpin, longnose dace, speckled dace, longnose suckers, and white suckers were collected at low abundances in some years. CDOW has stocked this reach with large numbers of 4- to 5-inch rainbow trout in recent years; however, successful survival and recruitment has been limited (J. Ewert, CDOW, unpublished report). Long-term research in this study segment has also documented a shift from a trout population dominated by rainbow trout to a population dominated by brown trout (Nehring et al. 2000).

Three sets of PHABSIM habitat relationships were available for this section of the Colorado River from the Grand County Stream Management Plan (Tetra Tech et al. 2010). The relationships indicate that habitat for several life stages of brown and rainbow trout is relatively high at flows of 200 cfs to 600 cfs. The CWCB adopted minimum flows of 135 cfs year-round for the section of the river upstream of the KB Ditch and 150 cfs downstream of the ditch. Environmental flow range targets were recommended at 250 to 500 cfs in summer and from 150 to 250 cfs in winter (Tetra Tech et al. 2010). A flushing flow of at least 800 cfs was recommended upstream of the KB Ditch and at least 850 cfs downstream of the KB Ditch for a three-day period and a recurrence of once every 2 years (Tetra Tech et al. 2010).

3.9.1.9 Green Mountain Reservoir

Longnose suckers and white suckers were the dominant species in Green Mountain Reservoir of the fish sampled in 1995, 1998, and 2006. Kokanee salmon, brown trout, lake trout, and rainbow trout were the game fish present. The lake trout population in Green Mountain Reservoir is self-sustaining through natural reproduction, while the remaining game species are sustained through stocking (Reclamation 2007). Rainbow trout have been stocked annually for at least the last 10 years in Green Mountain Reservoir (CDOW 2010b, unpublished data). Kokanee salmon, Snake River cutthroat trout, and cutthroat x rainbow trout hybrids have been stocked frequently over the 10-year period.

3.9.1.10 Blue River–Green Mountain Reservoir to Colorado River

The Blue River study segment from the Green Mountain Reservoir downstream to the Colorado River is classified as Aquatic Life Cold 1 (CDPHE 2010a), is managed as a trout fishery, and is classified as a Gold Medal Water (CDOW 2009). Fish data were available for five locations from 2000 through 2006. Nine fish taxa were collected including one unknown warmwater species and one cutthroat x rainbow trout hybrid over the seven different sampling events. Brown trout were the dominant species in four of the seven samples and rainbow trout were the dominant species in the remaining three samples. The remaining species were collected only occasionally at low abundances. The relatively large proportions of rainbow trout collected are largely attributed to stocked fish as this reach is stocked annually with large numbers of rainbow trout (CDOW 2010b, unpublished data). Snake River cutthroat have also been stocked within this reach in the past (CDOW 2010b, unpublished data).

Benthic invertebrate data were available since 1993 and population numbers and diversity metrics were considered excellent during the early years of the time period (Reclamation 2007). In the last 6 years of the study period, the numbers and diversity were

dramatically lower (Reclamation 2007). The cause of the decline is unknown; however, it may be related to an increase in the alga didymo, which can form continuous mats over the substrate and may increase with decreasing flushing flows (Reclamation 2007).

PHABSIM relationships were developed for the Blue River downstream of Green Mountain Reservoir at five sites in 2007, 2008, and 2009 (Tetra Tech et al. 2010). Habitat availability for brown and rainbow trout is relatively high at flows of 150 to 400 cfs. The CWCB adopted minimum flows of 85 cfs in summer and 60 cfs in winter for this section of the Blue River. Environmental flow range targets were recommended at 200 to 300 cfs in summer and winter (Tetra Tech et al. 2010). A flushing flow of at least 1,150 cfs was recommended for a three-day period and a recurrence of once every 2 years (Tetra Tech et al. 2010).

3.9.1.11 Colorado River–Blue River to Eagle River

The Colorado River from the Blue River downstream to the Eagle River is classified as Aquatic Life Cold 1 (CDPHE 2010a). This segment of the Colorado River is managed as a trout fishery (CDOW 2009). The current fish community in this reach of the Colorado River is dominated by brown trout, longnose suckers, and white suckers as shown by the data collected from 1982 through 2008 (CDOW 2010b, unpublished data). Fifteen species and three hybrids were collected from the six sampling events. Of the 15 species, 6 are native to the Colorado River drainage including the 2 species of concern, mountain sucker and roundtail chub, as well as speckled dace, bluehead sucker, flannelmouth sucker, and mottled sculpin (Nesler 1997). These species generally each comprised less than 10 percent of the fish collected at a site.

Overall, the fish community appears healthy with brown trout, white suckers, and longnose suckers dominating the community. In 2008, brown trout were the dominant species near the upstream end of this reach, while at the downstream end of the reach white suckers and longnose suckers were the dominant species (CDOW 2010b, unpublished data). The trend in 2008 suggests a downstream longitudinal shift in the fish community from brown trout to suckers in this reach. Rainbow trout were relatively abundant during presence/absence surveys in the 1980s compared to their lower abundance during more recent surveys, suggesting a shift toward the current dominance by brown trout because of the impact on rainbow trout by whirling disease as documented in the upstream reaches.

PHABSIM habitat relationship curves were developed for this section of the Colorado River based on seven transects from Pumphouse downstream to OK Corral in Eagle County (Tetra Tech et al. 2010). The relationships indicate relatively high habitat availability for rainbow and brown trout adults and juveniles at flows ranging from about 400 cfs up to about 900 to 1,600 cfs, depending on the life stage. There is no CWCB minimum flow adopted for this section of the river. Environmental flow range targets were recommended at 600 to 1,000 cfs in summer and from 400 to 600 cfs in winter (Tetra Tech et al. 2010) and appear to be based on habitat availability for adult trout. A flushing flow of at least 2,500 cfs was recommended for a three-day period and a recurrence of once every 2 years (Tetra Tech et al. 2010).

PHABSIM habitat relationships were also developed using River 2D methodology at three sites within this reach, located at Pumphouse, Rancho del Rio, and Lyons Gulch (Miller and Swaim 2011). Relatively high habitat availability was reported for rainbow trout and brown trout at 500 to 1,500 cfs, 500 to 2,500 cfs, and 750 to 2,000 cfs at the Pumphouse, Rancho del Rio, and Lyons Gulch sites, respectively (Miller and Swaim 2011). Adult flannelmouth sucker habitat was reported most abundant at 1,000 to 3,000 cfs and 500 to 2,200 cfs at the Rancho del Rio and Lyons Gulch sites, respectively (Miller and Swaim 2011).

3.9.1.12 Colorado River–Eagle River to Roaring Fork River

The Colorado River from the Eagle River downstream to the Roaring Fork is classified as Aquatic Life Cold 1 (CDPHE 2010a). This segment of the Colorado River is managed as a trout fishery (CDOW 2009). Nine species were collected by the USGS in 1997 and eight species were collected in 1996 (Deacon et al. 1999). Samples were also collected in 1983 and 1993 (CDOW 2010b, unpublished data). Overall, sucker species, including white suckers, flannelmouth suckers, and bluehead suckers, are common in this reach. In addition, the smaller-bodied mottled sculpin and speckled dace are common in this reach. Brown trout, and to a lesser extent rainbow trout, comprise a portion of the fish community in this reach. No PHABSIM habitat relationships have been developed for this reach and there are no CWCB minimum flows for this reach of the river.

Benthic macroinvertebrates were also collected during the USGS study. The number of Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa (common benthic macroinvertebrates), percentage of EPT taxa, and percentage of Chironomidae metrics at the USGS Dotsero site were similar to or sometimes higher than the other mixed land use sites on the Gunnison River (Deacon et al. 1999). This indicates that water quality is adequate to support some species of sensitive insects.

3.9.1.13 Colorado River–Roaring Fork River to the Upstream Boundary of the 15-Mile Reach

From the Roaring Fork River to Rifle Creek, the Colorado River is classified as Aquatic Life Cold 1 (CDPHE 2010b) and is managed as a trout fishery (CDOW 2009). The Colorado River downstream of Rifle Creek is classified as Aquatic Life Warm 1 (CDPHE 2010b) in this reach and is managed as a warmwater fishery (CDOW 2009). The data from the study sites sampled in this reach demonstrate the longitudinal shift from a coldwater fishery to a warmwater fishery (CDOW 2010b, unpublished data).

White suckers, brown trout, and rainbow trout were the dominant species collected in the upper portion of this section of the river. Many of the rainbow trout sampled were probably stocked fish, as CDOW stocks 30,000 rainbow trout annually between Glenwood Springs and Rifle; however, some rainbow trout reproduce naturally in this reach (K. Ross, CDOW, pers. comm. 2010). The fish communities of these sites demonstrate a longitudinal shift from a coldwater community dominated by white suckers and trout in the upstream portion of the reach to a warmwater community dominated more by the native Colorado River suckers and chubs in the downstream portion of the reach. In the downstream reaches, three native species including flannelmouth suckers, bluehead suckers, and roundtail chub (a species of concern), were most abundant with small numbers of other native and nonnative species. No PHABSIM habitat relationship curves have been developed for this reach and there is no CWCB minimum flow for this section.

Three of the four federally listed endangered species in the Colorado River including the humpback chub, Colorado pikeminnow, and the razorback sucker have been collected within this reach according to the Service dataset through 2008 (Service 2010, unpublished data). Bonytail have not been collected. From 1983 through 2008, one humpback chub was collected in this reach at the Government Highline Canal fish ladder (193.7 RM [river mile, measured from the confluence with the Green River]) in 2005 (Service 2010, unpublished data). Colorado pikeminnows were collected more frequently in the study reach from 1998 through 2008, with 30 fish collected near the downstream boundary of this reach. From 1991 through 2008, two razorback suckers were collected in the study reach, both in 2008 and as far upstream as the Government Highline Canal fish ladder. Colorado pikeminnows have been stocked in the study reach in 2000, 2001, 2003, and 2004 as far upstream as Rifle, Colorado (240.7 RM).

Razorback suckers have been stocked in this reach in 1999 through 2004 and in 2007 and 2008 as far upstream as Rifle (Service 2010, unpublished data). Humpback chubs and bonytail were not stocked in this reach (Service 2010, unpublished data).

3.9.1.14 Ruedi Reservoir

Fish data were available for Ruedi Reservoir in 1997 and 2008. White suckers were the dominant species in 2008. Brown trout, lake trout, and rainbow trout each comprised 9 or 10 percent of the fish sampled in 2008. Kokanee salmon comprised 3 percent of the fish sampled and mountain whitefish comprised 1 percent of the fish sampled. Yellow perch were relatively abundant in the 2008 samples comprising 7 percent of the fish sampled. Yellow perch were illegally introduced into Ruedi Reservoir and can compete with other species for resources and, thus, their removal is encouraged by CDOW (K. Ross, CDOW, unpublished report). Lake trout were the dominant species sampled in Ruedi Reservoir in 1997, followed by white suckers. Brown trout were also relatively abundant in the 1997 sample and Snake River cutthroat trout comprised a small percentage of the fish community.

The lake trout population in Ruedi Reservoir is a self-sustaining, naturally reproducing population (K. Ross, CDOW, unpublished report). Ruedi Reservoir is stocked with 60,000 catchable rainbow trout annually and kokanee salmon are also stocked annually (K. Ross, CDOW, unpublished report; CDOW 2010b, unpublished data). During the last 10 years, cutthroat x rainbow trout hybrids and Snake River cutthroat trout have also been stocked.

3.9.1.15 Fryingpan River–Ruedi Reservoir to Roaring Fork River

The Fryingpan River study segment extends from Ruedi Dam downstream to the Roaring Fork River. This segment is classified as an Aquatic Life Cold 1 stream (CDPHE 2010a), is managed as a trout fishery, and is classified as a Gold Medal Water (CDOW 2009). Multiple sites were sampled on the Fryingpan River in several years from 2000 through 2008. The fish community was similar among years with brown trout the most abundant species (CDOW 2010b, unpublished data). Rainbow trout and mottled sculpin were the next most abundant species, while brook trout, cutthroat trout, and white suckers each comprised a small percentage of the fish sampled.

Brown trout densities were high in the Fryingpan River, consistent with its Gold Medal Water classification. The upstream portion of the Fryingpan River is known for large rainbow and brown trout that often exceed 10 pounds, with some individuals reaching 22 pounds (Nehring et al. 2000). Fish reach these sizes by feeding on opossum shrimp (*Mysis relicta*) flushed out of Ruedi Reservoir (Nehring et al. 2000). As in the Colorado River, whirling disease has been attributed to severe declines in rainbow trout recruitment in the Fryingpan River since the 1990s (Nehring et al. 2001; Nehring 2006). The parasite that causes whirling disease was first detected in the Fryingpan River in 1995 (Nehring et al. 2001).

The flow regime, as related to releases from Ruedi Reservoir, directly influences the benthic macroinvertebrate community in the Fryingpan River (Ptacek et al. 2003). Ruedi Reservoir operations result in increased thermal stability and periods of flow stability in the Fryingpan River. Two sites were sampled on the Fryingpan River in spring and fall of 2001 and 2002, and spring 2003 (Ptacek et al. 2003; Rees et al. 2003). One site was less than 1 kilometer downstream of Ruedi Dam and the other was downstream of the confluence with Taylor Creek. Both sites supported large numbers of benthic invertebrates, which were capable of supporting large and healthy fish populations (Ptacek et al. 2003). Benthic invertebrate densities and biomass were often highest at the site downstream of Ruedi Dam, but most other metrics indicated a more balanced community structure at the site downstream of Taylor Creek (Ptacek et al. 2003).

A tailwater is the reach of river immediately downstream of a dam that is influenced by

fluctuations in reservoir discharge operations (Summerfelt 1999). Deep reservoir releases, like the release from Ruedi Dam, result in the discharge of cold water that may be nutrient-rich. These areas are capable of producing abundant fish populations (Moser and Hicks 1970), as observed in the Fryingpan River. The Fryingpan River site immediately downstream of Ruedi Dam also has benthic invertebrate characteristics that are consistent with other deep-water release tailwaters (Ptacek et al. 2003). The site downstream of Ruedi Dam had a lower diversity, and increased percentages of baetid mayflies and chironomids than at the site downstream of Taylor Creek.

PHABSIM habitat relationships were developed for the Fryingpan River downstream of Ruedi Reservoir in 2001 for three hydraulically distinct habitat types (Ptacek et al. 2003). In these habitat types, habitat availability for most life stages of brown and rainbow trout is relatively high from 100 cfs up to 600 cfs, depending on the dataset. In the pool habitat types, flows up to 800 cfs provide suitable habitat availability for adult trout. A minimum baseflow near 100 cfs has been recommended to minimize the formation of anchor ice (Ptacek et al. 2003). There is no CWCB minimum flow for this section of the river.

3.9.1.16 Roaring Fork River–Fryingpan River to Colorado River

This segment of the Roaring Fork River from the confluence with the Fryingpan River downstream to the Colorado River is classified as Aquatic Life Cold 1 (CDPHE 2010a). This segment of the Roaring Fork River is managed as a trout fishery and is classified as a Gold Medal Water (CDOW 2009). Fish data were available for three study sites within the Roaring Fork study segment in 2000 and 2004 (CDOW 2010b, unpublished data). Brown trout were the dominant species of fish during the two 2004 samples in the upper portion of the river segment, comprising 70 and 68 percent of the fish sampled. Mountain whitefish were the dominant species in 2000 at the site in the lower portion of the river segment. Brown trout were the second most abundant species at this site. Rainbow trout were also relatively abundant, comprising between 5 and 18 percent of the fish sampled. Many of the rainbow trout collected are likely stocked fish, as this reach of the Roaring Fork is heavily stocked with rainbow trout by CDOW annually (CDOW 2010b, unpublished data). A few mottled sculpin, flannelmouth sucker, and largemouth bass were also collected.

Benthic invertebrates were sampled at two sites on the Roaring Fork River in spring 2001 and at three sites in fall 2001 and spring 2002 (Ptacek et al. 2003). All sites supported large numbers of benthic invertebrates and were capable of supporting large and healthy fish populations (Ptacek et al. 2003).

PHABSIM habitat relationships were developed for the Roaring Fork River downstream of the Fryingpan River confluence in 2001 at one site (Ptacek et al. 2003). Habitat availability for brown and rainbow trout were highest at flows from 150 cfs to 400 cfs. There is no CWCB minimum flow for this section of the river.

3.9.1.17 Threatened and Endangered Species

Four federally listed endangered fish are present in the lower Colorado River in Colorado, including the bonytail (*Gila elegans*), humpback chub (*Gila cypha*), Colorado pikeminnow (*Ptychocheilus lucius*), and razorback sucker (*Xyrauchen texanus*) (CDOW 2010a). Of these four species, humpback, Colorado pikeminnow, and razorback suckers are located in the analysis area (USFWS 2010, unpublished data); bonytail has not recently been collected upstream of the 15-Mile Reach. The lower Colorado River from the Colorado River bridge at Rifle, Colorado downstream to Lake Powell is designated critical habitat for the Colorado pikeminnow and razorback sucker (Federal Register 1994). Portions of this river reach are also designated critical habitat for the humpback chub and bonytail. Federally listed threatened or endangered fish species are not found in any other stream segment in the analysis area.

3.9.1.18 Nuisance Species

The Proposed Action has the potential to influence the distribution and prevalence of nuisance species. Below is a discussion of the major nuisance species that have been detected and are of concern in Colorado.

Myxobolus cerebralis, the causative agent of whirling disease, is prevalent in the Colorado River Basin. Extensive research during the 1990s demonstrated that whirling disease was the cause of major population declines in wild rainbow trout, which are particularly sensitive to whirling disease, in the Colorado, Fryingpan, and Roaring Fork rivers within the analysis area, as well as other rivers in Colorado (Nehring et al. 2000; Nehring 2006). *Myxobolus cerebralis* requires Tubifex worms to complete its life cycle (Markiw and Wolf 1983). Because *Tubifex tubifex* lives in fine sediments, sediment control is crucial in controlling production of triactinomyxons (TAMs), the infectious form of *M. cerebralis* (Nehring 2006). Windy Gap Reservoir, with its high proportion of fine sediments, has been a major source of TAMS to downstream reaches of the Colorado River (Nehring 2006). However, TAM production from Windy Gap Reservoir has been variable over time and has declined significantly due to changes in the dominant lineage of *T. tubifex* in the reservoir. Beginning in 2008 and continuing in 2009, a whirling disease-resistant strain of rainbow trout was stocked throughout the Colorado River Basin (CDOW 2010b), with the intent to increase survival and reproduction of this fish species in the future.

New Zealand mud snails (*Potamopyrgus antipodarum*), zebra mussels (*Dreissena polymorpha*), and quagga mussels (*Dreissena bugensis*) are invasive mollusks that each have the potential for detrimental ecological and economic effects. According to the USGS's nonindigenous aquatic species website (http://nas.er.usgs.gov), New Zealand mud snails have not been detected in the Colorado River Basin watershed (Benson 2011). Zebra mussel and quagga mussel veligers (larva) were collected in 2008 in Grand Lake in the Colorado River Basin, upstream of the analysis area (http://nas.er.usgs.gov). Quagga mussel veligers were also collected from Shadow Mountain Reservoir, Granby Reservoir, and Willow Creek Reservoir in 2008. Zebra and quagga mussels have not been found in recent samplings.

Didymo (*Didymosphenia geminata*) is a stalked diatom that can form thick blooms that can affect the ecological function and aesthetic appeal of rivers (Spaulding and Elwell 2007). Didymo has been reported in the western U.S. for more than 100 years, but expansive nuisance blooms have become more common recently (Kumar et al. 2009). Several studies have documented the response of macroinvertebrate communities to didymo blooms, but the effects on fish communities have not been intensively studied. Macroinvertebrate community changes may include increases in oligochaetes and chironomids and decreases in EPT taxa (Gillis and Chalifour 2009; Kilroy et al. 2008). However, species richness response was varied between and within studies, suggesting that macroinvertebrate community response to didymo blooms is complex (Spaulding and Elwell 2007; Gillis and Chalifour 2009; Kilroy et al. 2008).

The conditions that result in nuisance level blooms of didymo are not well understood, but a recent review of the literature and unpublished data suggests that low water temperatures, high hydrologic and substrate stability, high light availability, and neutral to moderately alkaline waters were associated with didymo distribution and the ability to attain nuisance levels (Kilroy et al. 2008). However, the authors acknowledge that nuisance blooms have occurred outside of the ranges of these environmental characteristics described, including in warm waters. The most suitable habitats for didymo in the United States were predicted to occur in the western U.S., in relatively cool sites at high elevations, and with a high baseflow index (Kumar et al. 2009). Didymo has been documented in the Colorado River Basin, including the Colorado River mainstem, Williams Fork River, Blue River, and Fryingpan River,

according to the most recent and extensive published dataset by Kumar et al. (2009).

The Asiatic clam (*Corbicula fluminea*) was first introduced purposely on the west coast of North America in the 1900s (Vaughn and Spooner 2006) and has been documented in Colorado in the Arkansas, Colorado, Platte, and San Juan river drainages (Cordeiro et al. 2007). The Asiatic clam has been found in the Colorado River Basin at five locations (Cordeiro et al. 2007), none of which are in the analysis area. However, the presence of this invasive species at multiple locations within the Colorado River Basin suggests it is likely the Asiatic clam is present or will be present within the analysis area in the future. The impact of Asiatic clams on native mussels in Colorado is not known; however, some studies suggest the species may compete for space and food (Strayer 1999; Cordeiro et al. 2007). These organisms are aggressive filter feeders that can reduce the amount of algae and other food needed by native organisms. They also have the potential to increase ammonia levels (Cordeiro et al. 2007), which can be detrimental to native organisms.

3.9.2 Environmental Consequences

3.9.2.1 Direct Effects

3.9.2.1.1 North Fork Colorado River–Redtop Valley Ditch to Shadow Mountain Reservoir

The Proposed Action would increase flow in the North Fork Colorado River downstream of the Redtop Valley Ditch in June of all years and in May and July in some years (Grand River Consulting 2011). The increases would usually be less than 20 cfs and less than 35 percent of historical flows. In average years, the increases in flow would be 5 percent in June and 19 percent in July. In the other months of the year, there would be no change in flow from historical conditions. There would be a minor beneficial effect on water quality (Section 3.7.2) and a negligible beneficial effect on riparian vegetation (Section 3.10.2) in this section of river.

There are no PHABSIM habitat relationships available for this section of river. However, the increases in flow would be minor in most years and of short duration. The North Fork Colorado River often dries up downstream of the Redtop Valley Ditch under the existing conditions in June and July (Grand River Consulting 2011). The Proposed Action would result in increased flows during these months. The North Fork Colorado River would sometimes still likely have no flow conditions downstream of the Redtop Valley Ditch under the Proposed Action, but these conditions would occur less often. The direct effect on game and nongame fish and macroinvertebrates would be a minor beneficial effect.

3.9.2.1.2 Shadow Mountain Reservoir

There would be a negligible change in storage contents with the Proposed Action in Shadow Mountain Reservoir. There likely would be a negligible effect on aquatic resources with the Proposed Action.

3.9.2.1.3 Stillwater Creek–Redtop Valley Ditch to Granby Reservoir

In Stillwater Creek, the Proposed Action would increase flows in June and July of all years and in May of some years (Grand River Consulting 2011). This would increase peak runoff flows up to 51 cfs in this small stream. During some years, mean monthly flows under the Proposed Action would be at least three times greater than during historical conditions. There would likely be slightly beneficial effects on water quality (Section 3.7.2) and a beneficial effect on riparian vegetation with an increase in wetlands (Section 3.10.2) in this section of stream.

There are no PHABSIM habitat relationships for this stream. Winter flows in this stream section are very low—2 to 3 cfs in January, February, and March of most years. This time of the year is likely more stressful on the fish and invertebrate community than the runoff period. Therefore, the increased flows during runoff under the Proposed Action would likely result in a negligible effect on

the fish and invertebrate community of this section of Stillwater Creek.

3.9.2.1.4 Granby Reservoir

There would be increases in storage in Granby Reservoir of up to 3 percent in late spring and summer with the Proposed Action compared to historical conditions. By the end of September, water levels would return to historical conditions. There would be no changes in other times of the year. There would be a negligible change to water quality (Section 3.7.2) and riparian vegetation (Section 3.10.2). The increased water levels, about 1 foot during the growing season for many aquatic species in the reservoir, could be beneficial but the small magnitude indicates the effect would be negligible.

3.9.2.1.5 Willow Creek–Willow Creek Reservoir to Colorado River

The Proposed Action would reduce flows in Willow Creek throughout the year (Grand River Consulting 2011). In the winter months, flow reductions would be 2 to 3 cfs, which represents up to 25 to 35 percent of the flow in most years. In the runoff period, up to 20 cfs or 24 percent of the flow would be reduced in average years. During summer months, up to 58 percent of the flow would be reduced during July of average years. There would be minor changes in water quality in this section of stream and a negligible effect on riparian vegetation.

Based on the PHABSIM relationships for brown trout for this section of Willow Creek, the post-project flows would be in the flow range that would provide high habitat availability during runoff in May and June of most years. The spring runoff flows under the Proposed Action should still meet the suggested flushing flow target of 50 cfs once every 2 years (Tetra Tech et al. 2010) during average, above average, and wet flow years. However, the reductions in winter flows would further reduce historical low habitat availability for brown trout. The Proposed Action would have a minor to moderate adverse effect on the resident fish community and likely a similar effect on the macroinvertebrate community as well.

3.9.2.1.6 Colorado River–Granby Reservoir to Windy Gap Reservoir

Flows in late July, August, and September would increase up to 50 cfs in this section of the river with the Proposed Action (Grand River Consulting 2011). Flows would increase in August and September of all years, and in July of some years. There would be no changes in flow in other parts of the year. Increases in flow represent two to three times the historical flow in some months and years. The flow increases would increase the likelihood that CWCB minimum flows would be met in August and September.

Exceedences of temperature standards have occurred in this reach downstream of Granby Reservoir in past years during July and August (Section 3.7.2). The increased flows during summer and early fall from the hypolimnion (bottom-most layer) of Granby Reservoir should decrease the likelihood of future temperature exceedences in this reach (Section 3.7.2). There would be no adverse effects on riparian vegetation (Section 3.10.2) in this section of stream.

Based on PHABSIM relationships for brown and rainbow trout, the increased flows in late summer would result in substantially higher habitat availability compared to historical flows. This, along with the improvements in water temperatures, would result in a minor to moderate beneficial effect of the Proposed Action on the resident fish and invertebrate communities in this section of the Colorado River.

Based on monthly average flows, the historical flow regime does not meet the suggested flushing flow target of at least 200 cfs once every 2 years; likely this target is met only in above average flow years. The Proposed Action would result in no changes to spring flushing flows.

3.9.2.1.7 Colorado River–Windy Gap Reservoir to Williams Fork River

Flows with the Proposed Action would be slightly reduced during most months and in most years and increased in late summer and early fall (Grand River Consulting 2011). Flows during June and July would be reduced up to 17 percent of the historical flow during drought and below average flow years. Flows during August and September would increase from 24 to 59 percent during all flow year types. Flows during the rest of the year under all flow regimes would be reduced from 2 to 9 cfs, or less than 5 percent of the historical flow. There would be negligible changes to riparian vegetation (Section 3.10.2) in this section of stream.

The changes in flows in the runoff and late summer periods would occur at flows that are within the range that maintains high habitat availability for juvenile and adult trout, based on the PHABSIM relationships, and would not change habitat availability much. The increased flows during summer and early fall from the hypolimnion (bottom-most layer) of Granby Reservoir would improve habitat conditions and may decrease the likelihood of future temperature exceedences in this reach of the Colorado River. (Section 3.7.2). The very small reductions in flow of a few cfs the rest of the year would tend to result in a negligible decrease in habitat availability for juvenile and adult trout. Overall, the altered flow regime under the Proposed Action would result in a negligible effect on aquatic resources.

In most years, the increases in flow in September would increase the likelihood that flows would be above the CWCB minimum flow of 90 cfs. The Proposed Action would not change runoff flows much and should not alter the frequency with which the suggested flushing flow of 600 cfs once every 2 years (Tetra Tech et al. 2010) is met. Under the historical and Proposed Action flow regimes, 600 cfs appears to be met in average, above average, and wet flow years.

3.9.2.1.8 Colorado River–Williams Fork River to the Upstream Boundary of the 15-Mile Reach

Based on the hydrology report (Grand River Consulting 2011), the Proposed Action would result in no direct effects on this section of the Colorado River. The hydrology with the Proposed Action would be the same as historical conditions.

3.9.2.1.9 Green Mountain Reservoir

There would be no change in storage contents with the Proposed Action in Green Mountain Reservoir most of the time. Infrequent changes would be minor. There would be negligible effects on water quality (Section 3.7.2) and riparian vegetation (Section 3.10.2). There likely would be a negligible effect on aquatic resources with the Proposed Action.

3.9.2.1.10 Blue River–Green Mountain Reservoir to Colorado River

There may be changes to hydrology in this section of the Blue River. However, the changes are expected to be infrequent, minor (typically less than 10 percent of historical flows), and unpredictable (Grand River Consulting 2011). Post-project hydrology was not simulated. There would be negligible effects on water quality (Section 3.7.2) and riparian vegetation (Section 3.10.2) in this reach. There would likely be negligible effects on aquatic resources in the lower Blue River with the Proposed Action.

3.9.2.1.11 Ruedi Reservoir, Fryingpan River, and Roaring Fork River

Because the Proposed Action would likely be implemented in the same year as the Interim 10825 Agreements and the 2012 Agreement, effects on Ruedi Reservoir and the Fryingpan and Roaring Fork rivers are discussed under *Cumulative Effects*.

3.9.2.1.12 Threatened and Endangered Species and Designated Critical Habitat

The Proposed Action would have no adverse effect on the four federally listed endangered fish and no adverse effect on designated critical habitat. The permanent 10,825 AF that would result from the

Proposed Action would be provided in lieu of water now being provided under two interim agreements. Those interim agreement included shortage provisions that have resulted in an average annual delivery of 7,044 AF over the life of the interim agreements (Table 8). The 10,825 AF of water provided by the Proposed Action would be available for release every year. Flow in the reach of designated critical habitat would not be adversely affected by the Proposed Action. Reclamation's determination is that the Proposed Action would not adversely affect either the four endangered fish or their designated critical habitat.

3.9.2.1.13 Nuisance Species

Flow regime changes have the potential to impact the distribution and abundance of nuisance species. Increased sedimentation could potentially result in an increased prevalence in whirling disease infections; flushing flows under the Proposed Action would remain similar to flows under historical conditions, indicating that sediment characteristics would also remain similar to historical conditions. Changes in flow regime are not expected to result in changes to sediment characteristics or affect the prevalence of whirling disease. Zebra mussels and quagga mussels have been collected in Grand Lake and quagga mussels have been collected in Shadow Mountain Reservoir and Granby Reservoir. Increased flows out of Granby Reservoir during summer months under the Proposed Action could increase the potential to transport these veligers downstream. However, the increased potential for transport downstream during summer months is minimal compared to the potential during the higher spring runoff flows out of the reservoir that remain the same between the historical and Proposed Action flow regimes. The Asiatic clam is present in the Colorado River Basin, but not in the analysis area, thus the Proposed Action should not influence the distribution of this nuisance species. The changes in the flow regime under the Proposed Action from historical conditions generally represent small changes in flow. These small changes are expected to have a negligible effect on nuisance species.

3.9.2.2 Cumulative Effects

3.9.2.2.1 Colorado River and Tributary Segments

There would be minor cumulative effects on hydrology in the analysis area upstream of the Blue River. Therefore, cumulative effects on the North Fork Colorado River, Stillwater Creek, Willow Creek, and the Colorado River upstream of the Blue River would be similar to the direct effects of the Proposed Action.

3.9.2.2.2 Shadow Mountain, Granby, and Green Mountain Reservoirs

There would be no additional changes in storage contents in Shadow Mountain, Granby, and Green Mountain reservoirs with cumulative conditions. Cumulative effects would be similar to direct effects.

3.9.2.2.3 Colorado River–Blue River to the Roaring Fork River

Flows with the Proposed Action and the expiration of the interim agreements would typically be reduced by less than 5 percent from historical conditions based on estimated changes in streamflow near Kremmling, downstream of the Blue River and Muddy Creek (Grand River Consulting 2011). Slight increases in flow, less than 5 percent, would occur in August and/or September of drought, average, and above average years. Slight reductions in flow, less than 5 percent of historical flows, and typically less than 1 percent of historical flows would occur the remainder of the time. There would be negligible to minor changes to water quality (Section 3.7.2) and negligible changes to riparian vegetation (Section 3.10.2) in this section of stream.

In most cases, the small changes in flow occur within the range that results in high habitat suitability for trout. The small increases and decreases in flows from historical conditions would result in negligible changes in the available habitat for trout. Overall, the altered flow regime under the Proposed Action and the expiration of the

interim agreements would result in a negligible effect on the aquatic resources.

The Proposed Action should not alter the frequency with which the suggested flushing flow of 2,500 cfs once every 2 years (Tetra Tech et al. 2010) is met. Under the historical and Proposed Action flow regimes, 2,500 cfs apparently is met in average, above average, and wet flow years.

3.9.2.2.4 Colorado River–Roaring Fork River to the Upstream Boundary of the 15-Mile Reach

There would be no cumulative effect on the sections of the Colorado River downstream of the Roaring Fork River. The cumulative effects on hydrology would be the same as direct effects.

3.9.2.2.5 Ruedi Reservoir

Cumulative effects would result in increased storage of water in Ruedi Reservoir in summer months. This is the growing season for aquatic organisms and the increased water levels, 6.5 feet, would be beneficial. Water quality, wetland habitat, and riparian vegetation are not expected to change appreciably (Sections 3.7.2 and 3.10.2). There would likely be a minor beneficial cumulative effect on aquatic resources in Ruedi Reservoir.

3.9.2.2.6 Fryingpan River–Ruedi Reservoir to Roaring Fork River

The total amount of water in this section of river would not change, but the seasonal rate of flow would be affected by a change in the amount of water released from Ruedi Reservoir for the Recovery Program. The changes would slightly reduce flow in the summer and slightly increase flow in the winter. Based on the PHABSIM relationships, the summer reductions would still result in flow in the river within the range of flows that provide high levels of habitat availability for trout. The winter increases in flow of up to 18 cfs would result in slightly higher levels of habitat availability than historical conditions. The increased winter flows with more relatively warm water from the reservoir may also help to alleviate icing conditions in the Fryingpan River (Section 3.7.2). There would be no adverse effects on wetlands and riparian vegetation during much of the growing season (Section 3.10.2). Changes in the latter part of the growing season could result in some stress to wetlands and riparian vegetation, but would not likely result in loss of wetlands or riparian habitat (Section 3.10.2). The improvements to habitat availability and icing in winter likely would have a minor beneficial cumulative effect on aquatic resources.

3.9.2.2.7 Roaring Fork River–Fryingpan River to Colorado River

The changes in flow in the Fryingpan River with reasonably foreseeable actions would also occur in the Roaring Fork River. Because the Roaring Fork River contains more water, the proportional change would be smaller. Therefore, the benefits of increased winter flows and reduced summer flows would be smaller. The changes in streamflow are not expected to adversely affect wetland or riparian vegetation (Section 3.10.2). There likely would be a negligible cumulative effect on aquatic resources in the Roaring Fork River.

3.10 Wetlands and Riparian Resources

3.10.1 Affected Environment

This section describes the existing wetlands and riparian resources in the analysis area. Wetland and riparian resources generally occur along streams and reservoir perimeters and other locations where surface or groundwater is sufficient to support the vegetation types. Wetlands and other waters identified in the analysis area are described in detail in the Wetlands, Waters, and Riparian Resources Technical Report (ERO 2010).

3.10.1.1 North Fork Colorado River

The North Fork Colorado River flows into Shadow Mountain Reservoir. Upstream of Shadow Mountain, riverine scrub-shrub and emergent wetlands occur along the banks. In areas where the

channel is not confined by landforms, emergent wetlands occur along the channel and within abandoned channel meanders throughout the floodplain. Patches of scrub-shrub wetlands continue upstream along the channel and in areas with a broad floodplain.

3.10.1.2 Stillwater Creek

Stillwater Creek, a perennial tributary to Granby Reservoir, is a low gradient meandering channel bordered by riverine palustrine emergent and scrub-shrub wetlands. While overbank flows and a stream-supported water table may provide supportive hydrology for wetlands adjacent to the channel, irrigation return flows likely create a high water table throughout the active floodplain, providing the supportive hydrology for many of the wetlands.

3.10.1.3 Area of Proposed Agricultural Dry-Up

The area proposed for agricultural dry-up consists mainly of flood-irrigated meadows bordered by areas of sagebrush shrublands and stands of lodgepole pine at higher elevations. Church Creek, a perennial stream, flows from north to south on the eastern side of the agricultural dry-up area into Willow Creek, a tributary to the Colorado River. About 62 acres of wetlands, which include about 4 acres of fens, occur within the agricultural dry-up area. Wetlands occur primarily along Church Creek and drainage swales and tributaries that flow into Church Creek. Wetlands within the agricultural dry-up area are classified as slope and riverine palustrine emergent, and slope and riverine palustrine scrub-shrub.

Fens are wetlands permanently saturated to or near the soil surface. In wetlands, including fens, influenced by surface irrigation, supporting hydrology is difficult to determine. Surface irrigation, leaking ditches, and ground water may contribute to maintenance of these fens. Fens take several thousands of years to develop, and those in the agricultural dry-up area preceded agricultural development. Streamflow in Church Creek is less likely to provide supporting hydrology for fens because the stream channel is incised for much of its length in the project area.

The agricultural dry-up study area has a long history of flood irrigation for hay production. Many of the wetlands are influenced by irrigation. Some of the wetlands are likely supported solely by the application of irrigation water. The wetland delineations did not attempt to separate wetlands that are supported solely by irrigation from wetlands that are supported by naturally occurring hydrology, or a combination of irrigation and natural hydrology. The Corps does not consider wetlands supported solely by the application of irrigation to be waters of the U.S. regulated under Section 404 of the Clean Water Act, and the proposed project would not require the discharge of dredged or fill material into wetlands in the agricultural dry-up areas.

3.10.1.4 Willow Creek

Willow Creek has a broad riparian corridor with a mix of wetlands, riparian areas, and uplands throughout the active floodplain. Riverine palustrine emergent and scrub-shrub wetlands occur and are supported by overbank flows and irrigation return flows. Fens are known to occur in the reach below Willow Creek Reservoir.

3.10.1.5 Granby, Green Mountain, and Ruedi Reservoirs

The vegetation associated with Granby, Green Mountain, and Ruedi reservoirs is typical of high elevation reservoirs. Often the banks are steep and the water level fluctuates, leaving a high water mark below which no vegetation occurs. Upland vegetation such as sagebrush and coniferous species often continues to the high water mark. Wetland and riparian vegetation consisting of willow shrublands and emergent wetlands is more likely to occur upstream of the reservoirs where water can back up because of the reservoir.

3.10.1.6 Upper Colorado River to the Head of the 15-Mile Reach

The upper Colorado River from Granby Reservoir to the head of the 15-Mile Reach changes in elevation from about 8,280 to 4,555 feet above sea level. Wetland and riparian vegetation communities along the Colorado River change according to the elevation, stream gradient, and landforms affecting the size of the active floodplain. Portions of the wetland and riparian vegetation along the Colorado River have been eliminated by roads, development, and agriculture.

Below Granby Reservoir, herbaceous and willow-dominated wetland and riparian vegetation occurs along the Colorado River and throughout the active floodplain. Wetland and riparian vegetation may occur intermittently through canyons where the floodplain is narrow.

Downstream on the Colorado River, narrowleaf cottonwood remains common as an overstory species and can occur with boxelder and red-osier dogwood. Plains cottonwood becomes more dominant below 6,000 feet in elevation. Sandbar willow and saltcedar become dominant in the shrub stratum at lower elevations.

3.10.1.7 Blue, Fryingpan, and Roaring Fork Rivers

The Blue, Fryingpan, and Roaring Fork rivers are high-elevation tributaries to the Colorado River. The mountainous setting provides various landforms from broad floodplains to narrow canyons. Wetland and riparian vegetation communities are similar to those of the upper Colorado River.

3.10.2 Environmental Consequences

3.10.2.1 Direct and Indirect Effects

3.10.2.1.1 Agricultural Dry-Up Area

In the agricultural dry-up area, about 752 acres of irrigated meadow and 92 acres of subirrigated meadow would be permanently affected by the removal of irrigation. With the removal of irrigation, much of the agricultural dry-up area would be converted to upland grasslands. About 62 acres of wetlands occur within the agricultural dry-up area. Wetlands that are supported solely by irrigation would be permanently lost; wetlands supported by a naturally occurring high water table or streamflows that existed before development of irrigated agriculture would remain. The nature of the hydrologic support for wetlands and the areal extent of wetlands that existed before development of irrigated agriculture are unknown. Some wetlands supported by natural hydrology may transition from perennially saturated to periodically saturated when irrigation was removed. Species composition also may change.

3.10.2.1.2 North Fork Colorado River

Streamflow in the North Fork Colorado River could increase in May, June, or July depending on precipitation and runoff (Grand River Consulting 2011). Increases in streamflow would result in a slight increase in stage of 0 to 0.2 feet. The increase in stage during the growing season would continue to support existing wetland and riparian vegetation. Beneficial effects on wetland and riparian vegetation from stage increases would be negligible.

3.10.2.1.3 Stillwater Creek

Average monthly streamflow in Stillwater Creek below the Redtop Valley Ditch would increase by a maximum of 295 percent, resulting in a stage increase of 0 to 1.7 feet. Stage changes may raise the water table, which would benefit riparian areas and wetlands either by providing more water to existing riparian areas and wetlands or by creating supportive hydrology for new riparian areas and wetlands. The area of riparian and wetland vegetation may increase along Stillwater Creek as a result of diversion from the Redtop Valley Ditch.

3.10.2.1.4 Willow Creek

With the decrease of irrigation return flows into Willow Creek, the stream stage is expected to decrease by 0 to 0.5 feet. Because the change in stage would be variable throughout the growing season and not a permanent decrease, the effects on

wetland and riparian vegetation would be negligible.

3.10.2.1.5 Granby and Green Mountain Reservoirs

Because of the high degree of existing fluctuation in reservoir levels and lack of significant vegetation cover, the Proposed Action would have no effect on wetland and riparian vegetation associated with Granby Reservoir or Green Mountain Reservoir.

3.10.2.1.6 Colorado and Blue Rivers

Wetland and riparian habitat along the Colorado and Blue rivers would not be adversely affected by the Proposed Action. Stage changes on the Colorado River are expected to increase between 0 and 0.1 feet, which is a small enough increase to be within natural variability. The Blue River is not expected to experience stage changes in typical years. No adverse effects on wetland and riparian vegetation would occur.

3.10.2.2 Cumulative Effects

3.10.2.2.1 Colorado River near Kremmling

Slight changes in streamflow would result in changes in stream stage of less than 0.2 feet. The cumulative effect of the Proposed Action and other reasonably foreseeable actions on wetlands, and riparian vegetation on the Colorado River below Kremmling would be negligible.

3.10.2.2.2 Fryingpan River

The timing of releases from Ruedi Reservoir would alter flows in the Fryingpan River. Moderate decreases in flow on the Fryingpan River would occur from August through October but wintertime flows would increase. From May through July, which is much of the growing season for wetland and riparian vegetation, no changes in flow and no adverse effects on wetland and riparian vegetation are expected. Changes in flow in the latter part of the growing season could alter availability of surface or ground water for plants that may result in some stress but would not likely result in loss of wetland or riparian habitat.

3.10.2.2.3 Roaring Fork and 15-Mile Reach Colorado River

Minor decreases in flow on the Roaring Fork and the 15-Mile Reach Colorado River would occur from August through October and minor increases in wintertime flows would occur. These changes in streamflow are not expected to adversely affect wetland and riparian vegetation.

3.10.2.2.4 Ruedi Reservoir

Because of the high degree of existing fluctuation in reservoir levels and lack of significant vegetation cover, the Proposed Action and other reasonably foreseeable actions would have no effect on wetland and riparian vegetation associated with Ruedi Reservoir.

3.11 Vegetation and Wildlife Resources

This section describes the existing vegetation and wildlife habitat in the analysis area and the effects on these resources from the Proposed Action. Effects on wetland and riparian habitat are described in more detail in Section 3.10.2. Effects on aquatic habitat and species are described in Section 3.9.

3.11.1 Affected Environment

3.11.1.1 Vegetation Communities

Vegetation in the agricultural dry-up areas consists of grasslands (upland, irrigated meadows, and wetlands); willow shrubland; sagebrush shrubland; and lodgepole pine forest. Wetland and riparian habitat for streams and reservoirs in the analysis area is described in Section 3.10.2

3.11.1.1.1 Upland Grasslands and Sagebrush Shrublands

Upland grasslands in the agricultural dry-up areas are generally dominated by mountain brome, smooth brome, slender wheatgrass, Timothy, yarrow, dandelion, blue-eyed grass, mountain wormwood, green gentian, and Canada thistle. Common grasses and forbs in the sagebrush

shrublands are blue grama, Idaho fescue, mutton-grass, cheatgrass, Indian paintbrush, pussy-toes, and yarrow. In the agricultural dry-up area, upland grasslands and sagebrush shrublands occur on the well-drained lower flanks of hillsides below the lodgepole pine woodlands.

3.11.1.1.2 Lodgepole Pine Forest

Lodgepole pine forest occurs on the slopes surrounding the agricultural dry-up areas. Common species in the lodgepole pine forest community include Engelmann spruce, kinnikinnik, common juniper, buffaloberry, broom huckleberry, heartleaf arnica, and Idaho fescue.

3.11.1.1.3 Irrigated Meadows and Wetlands

Sedge-dominated wetlands occur along Stillwater Creek. In the agricultural dry-up area, irrigated meadows range from dry to mesic, and wetlands occur along Church Creek, ditches, and within drainage swales. Common species in the irrigated meadows are meadow foxtail, Kentucky bluegrass, Timothy, Northwest Territory sedge, and redtop. Northwest Territory sedge and other sedges are dominant in the wetlands.

3.11.1.1.4 Riparian Habitat

A description of wetland and riparian habitat associated with streams and reservoirs in the analysis area is in Section 3.10.2.

3.11.1.2 Federally Threatened and Endangered Plant Species

The Osterhout milkvetch and Penland beardtongue, two endangered species endemic to Grand County, occur on seleniferous clay-shales between 7,400 and 7,900 feet in elevation (Spackman et al. 1997). Because the agricultural dry-up areas are above the elevational range of these species, suitable habitat is not present (CNHP 2010; Spackman et al. 1997).

3.11.1.3 Plant Species of Concern

The Colorado Natural Heritage Program (CNHP) (2010) lists two state rare plants as occurring near the agricultural dry-up areas—Bodin milkvetch and nagoon berry. Bodin milkvetch has a state ranking of S2-imperiled in the state because of rarity (6 to 20 occurrences). The nagoon berry has a state ranking of S1-critically imperiled in the state because of extreme rarity (five or fewer occurrences). The Bodin milkvetch is found along sandy or gravelly streambanks and meadows, and the nagoon berry occurs within willow carrs and along mossy streamsides between 8,600 and 9,700 feet in elevation. Both species have potential habitat along Stillwater Creek from the Redtop Valley Ditch to Granby Reservoir and Church Creek in the agricultural dry-up areas. No occurrences of these species have been documented in these areas (CNHP 2010).

3.11.1.4 Federally Threatened and Endangered Wildlife Species

Most wildlife species listed as federally threatened, endangered, or as candidate species do not have suitable habitat within the agricultural dry-up areas or other parts of the analysis area. Canada lynx is shown in the Colorado Natural Diversity Information System (NDIS) NDIS database as having potential habitat in Grand County. Federally listed fish species are discussed in Section 3.9.

3.11.1.4.1 Canada Lynx

The lynx, a federally listed threatened species, is a secretive forest-dwelling cat of northern latitudes and high mountains. In early 1999, CDOW released lynx in Colorado in an effort to reestablish breeding populations in the state. No lynx were released within Grand County. The agricultural dry-up areas provide marginal lynx habitat because of fragmentation from other potential lynx habitat and the overall lack of forest cover. Open meadows and sagebrush habitats are typically unsuitable for lynx. Forested areas surrounding the agricultural dry-up areas are mapped as potential lynx habitat by the Colorado NDIS.

3.11.1.4.2 Yellow-billed Cuckoo

The yellow-billed cuckoo, a candidate species, nests in a variety of habitats including open woodlands, parks, and riparian woodlands (AOU

1998). The western subspecies is found primarily in riparian cottonwood/willow woodlands with a dense understory (Carter 1998; Franzreb and Laymon 1993). The species is usually found at elevations less than 6,600 feet (Service 2001). Suitable habitat for the yellow-billed cuckoo occurs on the lower reach of the Colorado River in the analysis area where cottonwood/willow habitat occurs.

3.11.1.5 State-Listed Species and Rare or Imperiled Wildlife Species

3.11.1.5.1 Bald Eagle

The bald eagle is a state-listed threatened species (also protected by the Bald and Golden Eagle Protection Act) that nests and overwinters in Colorado. In Colorado, nest trees are in various forest types, from old-growth ponderosa pine to linear groups of riparian woodland. An active bald eagle nest is at Granby Reservoir, and several active and inactive nests occur along the Colorado River from Granby Reservoir to the 15-Mile Reach. The segment of the Colorado River below Granby Reservoir is used by bald eagles during winter foraging and is shown as bald eagle winter range (NDIS 2010). The agricultural dry-up areas provide limited foraging habitat and no suitable nesting or roosting habitat. In the analysis area, riparian woodlands associated with streams and reservoirs affected by hydrologic changes provide suitable nesting and roosting habitat.

3.11.1.5.2 Barrow's Goldeneye

Barrow's goldeneye is listed by the CNHP as an S2 species for breeding populations and is listed as occurring near the agricultural dry-up areas. This small diving duck is a cavity nester that can nest more than 1 mile from water (Savard et al. 1991). In Colorado, this duck winters on a variety of reservoirs and rivers, and breeds near mountain reservoirs and ponds in forested areas (Andrews and Righter 1992). Barrow's goldeneye is rare within Grand County (NDIS 2010) and previous breeding bird atlas surveys from 1998 and currently ongoing did not record any breeding Barrow's goldeneye within Grand County (Kingery 1998; BBAII 2010), although open water in the agricultural dry-up area is potential habitat for this species.

3.11.1.5.3 Boreal Owl

The boreal owl is listed as an S2 species by the CNHP, is a rare to locally uncommon resident in higher mountains, and is an accidental resident in lower mountains (Andrews and Righter 1992). Habitat for the boreal owl includes mature spruce-fir or spruce-fir/lodgepole pine forest interspersed with meadows (Palmer and Ryder 1984; Ryder et al. 1987). The CNHP lists the boreal owl as occurring in forested areas near the agricultural dry-up areas. These areas lack suitable forest habitat, and riparian communities in the analysis area are not suitable habitat for this species.

3.11.1.5.4 Boreal Toad

The boreal toad, a state endangered species, is a fairly large toad known to inhabit mountain areas in Colorado at elevations between 8,500 and 11,500 feet. Boreal toad habitat includes wetland areas, beaver ponds, slow-moving creeks and streams, kettles, and wet meadows (Hammerson 1999). Seven known breeding populations of toads are recorded in Grand County (Jackson 2010). The agricultural dry-up areas are at the lower elevational range for the boreal toad; however, suitable habitat is available within wetlands along Stillwater and Church creeks and their tributaries, and throughout the agricultural dry-up area.

3.11.1.5.5 Greater Sage Grouse

The greater sage grouse is a state species of special concern. Sage grouse depend on sagebrush year-round for food and cover (Service 2004). Sage grouse breed in early spring in open areas within sagebrush habitats. Females build nests in areas with dense cover, typically dominated by big sagebrush. Shortly after hatching, hens move chicks to early brood-rearing areas, which are often in upland sagebrush habitats with abundant forbs and insects (Schroeder et al. 1999; Connelly et al. 2004). Depending on drought conditions, broods may move to more mesic areas, including

agricultural and riparian areas adjacent to sagebrush habitats.

No sage grouse habitat mapped by CDOW (NDIS 2010) occurs in the agricultural dry-up areas. Sage grouse overall range and a production area (majority of important nesting habitat) are about 0.5 mile southwest of the agricultural dry-up area. Winter range and severe range are more than 1 mile southwest of the agricultural dry-up area while an area that supports broods is about 3.5 miles away within the overall production area. Brood areas can be associated with wet areas such as meadows, springs, ponds, and streams. Suitable brood habitat is present in the agricultural dry-up area.

3.11.1.5.6 River Otter

River otters, listed as state threatened, inhabit high-quality, perennial rivers that support abundant fish or crustaceans within many habitats ranging from semidesert shrublands to montane and subalpine forests. No suitable otter habitat occurs in the agricultural dry-up area. A 0.5-mile reach of the Colorado River, 2 miles east of the town of Hot Sulphur Springs, is a river otter concentration area. Concentration areas are where otter sightings and signs of otter activity are higher than in the overall range (NDIS 2010). Streams in the analysis area, especially the Colorado River, provide suitable river otter habitat and overall range.

3.11.1.5.7 Sandhill Crane

Sandhill cranes, listed by the state as a candidate species, is a rare fall migrant in North, Middle, and South parks, and a rare summer resident in the parks of northwestern Grand County (Andrews and Righter 1992). Migrants occur on mudflats around reservoirs, in moist meadows, and in agricultural areas. The agricultural dry-up areas and reservoirs in the analysis area provide suitable foraging habitat for the sandhill crane.

3.11.1.5.8 Wood Frog

The wood frog is listed as a state candidate species and inhabits marshes, bogs, pothole ponds, beaver ponds, lakes, stream borders, wet meadows, willow thickets, and subalpine forests bordering these mesic habitats. Willow thickets and forest stream courses are inhabited primarily after frogs have dispersed from the breeding ponds. Potential wood frog habitat occurs in wetlands and the irrigated meadows in the agricultural dry-up areas, and along streams and reservoirs throughout the analysis area.

3.11.1.6 Migratory Birds

Most bird species present in the agricultural dry-up area and other parts of the analysis area are protected under the Migratory Bird Treaty Act (MBTA). Bird species use different habitat types in the analysis area for shelter, breeding, wintering, and foraging at various times during the year. Common bird species found in mountain grassland habitats include mountain bluebird, western meadowlark, Lincoln's sparrow, savannah sparrow, and vesper sparrow. Birds within the riparian and wetland areas include mountain chickadee, song sparrow, American dipper, Wilson's warbler, and western wood-pewee (Mutel and Emerick 1984; Kingery 1998).

The golden eagle, bald eagle, osprey, Swainson's hawk, red-tailed hawk, American kestrel, and great horned owl may forage in the agricultural dry-up areas. The riparian habitat along streams and reservoirs in the analysis area provide foraging and nesting habitat for many raptors.

3.11.1.7 Large Game

3.11.1.7.1 Mule Deer, Elk, and Moose

The agricultural dry-up areas provide overall mule deer range and mule deer summer range. Mule deer are common in relatively low numbers at the agricultural dry-up areas in summer, particularly in riparian areas along the creeks. In winter, most deer move to south-facing slopes northwest of the agricultural dry-up areas. Sagebrush-covered slopes south and west of the agricultural dry-up areas provide severe winter range and a winter concentration area for mule deer (NDIS 2010).

The agricultural dry-up areas are considered overall elk range, and forested and sagebrush areas

northwest of the agricultural dry-up areas provide summer range for elk (NDIS 2010). Forested areas in portions of the agricultural dry-up area, and north and south of the agricultural dry-up areas provide winter range and winter concentration areas for elk. Elk severe winter range is on the northern periphery of the agricultural dry-up area, and portions of this area are identified as elk migration corridors.

The agricultural dry-up areas are also mapped as overall range and summer range for moose. Portions of the agricultural dry-up areas also are a concentration area, priority habitat, and winter range for moose.

3.11.1.7.2 Pronghorn

Pronghorn is a grassland species adapted to wide-open habitats. Open sagebrush and irrigated meadows in the agricultural dry-up area provide overall range for pronghorn (NDIS 2010).

3.11.1.7.3 Mountain Lion

Mountain lions are considered a game species by the CDOW and typically inhabits rocky outcroppings and ridges near the foothill and mountain areas of the state. Mountain lions prey mainly on deer, as well as elk and other ungulates in North America, and their distribution and movements correspond to their ungulate prey (Fitzgerald et al. 1994). The Colorado NDIS maps the agricultural dry-up areas as overall range for mountain lions. Mountain lions could forage in the agricultural dry-up areas especially if large mammalian prey were in the area; however, this species typically favors rocky outcroppings, not the open meadow and sage habitat in the agricultural dry-up areas.

3.11.1.7.4 Black Bear

Black bears in Colorado are most common in montane shrublands and forests, and subalpine forests at moderate elevations, especially in areas with well-developed stands of oakbrush or berry-producing shrubs such as serviceberry and chokecherry. Black bears are omnivorous, eating vegetation as well as fish, carrion, and stream algae. Black bears need forest cover for concealment, escape, and travel. Black bears are likely to occasionally pass through the agricultural dry-up areas.

3.11.1.8 Other Wildlife

Other wildlife species likely to be present in the agricultural dry-up areas include smaller mammals such as the Nuttall's cottontail, red fox, coyote, mink, ermine, badger, American beaver, and muskrat (Fitzgerald et al. 1994). Rodents common to Grand County include northern pocket gopher, deer mouse, long-tailed vole, and montane vole (NDIS 2010; Fitzgerald et al. 1994). Waterfowl such as canvasback, eared grebe, mallard, and American widgeon are commonly found in open water habitats and wet meadows. The riparian and wetland areas in the analysis area provide potential habitat for the northern leopard frog, chorus frog, and tiger salamander (NDIS 2010; Hammerson 1999).

3.11.2 Environmental Consequences

3.11.2.1 Direct and Indirect Effects

No direct effects would occur on vegetation or wildlife. Indirect effects are discussed for the agricultural dry-up area and streams and reservoirs in the analysis area.

3.11.2.1.1 Vegetation Communities

The effects on vegetation in the agricultural dry-up area and along reservoirs and streams in the analysis area are discussed in the Section 3.10.2.

3.11.2.1.2 Federally Threatened and Endangered Plant Species

The agricultural dry-up areas are above the elevational range of Osterhout milkvetch and Penland beardtongue. The Proposed Action would have no effect on these species or their habitat.

3.11.2.1.3 Plant Species of Concern

No occurrences of the nagoon berry and Bodin milkvetch have been documented in the agricultural dry-up area (CNHP 2010). The

agricultural dry-up areas are below the elevational range for the nagoon berry, and the Proposed Action would not directly or indirectly affect this species.

Wetlands and riparian habitat along Stillwater Creek and within the agricultural dry-up area that may provide suitable habitat for the Bodin milkvetch would not be directly affected by the Proposed Action. The addition of water to Stillwater Creek would likely have no effect or would have a beneficial effect on wetlands and riparian habitat. The removal of irrigation from the agricultural dry-up area would affect wetlands; this species, however, is not believed to be present and, therefore, would not be adversely affected.

3.11.2.1.4 Federally Threatened and Endangered Wildlife Species

The Proposed Action would have no effect on lynx or areas that are mapped as lynx habitat (NDIS 2010). Suitable yellow-billed cuckoo riparian habitat along the lower Colorado River would not be adversely affected by the Proposed Action.

3.11.2.1.5 State Listed Species and Rare or Imperiled Wildlife Species

The Proposed Action would have no effect on nesting or roosting habitat for the bald eagle or overall habitat for Barrow's goldeneye, boreal owl, and river otter. Species associated with riparian habitat along streams and reservoirs in the analysis area (e.g., bald eagle, river otter, boreal toad, river otter, sandhill crane, and wood frog) would not be adversely affected by the Proposed Action. The Barrow's goldeneye and boreal owl would not be affected by the Proposed Action because of the lack of suitable habitat for either species within the agricultural dry-up areas and the analysis area. The change in vegetation communities in the irrigated meadows in the agricultural dry-up area might adversely affect suitable foraging habitat for the sandhill crane; however, foraging habitat would still be present in naturally occurring wetlands. Drier conditions in the agricultural dry-up area may cause a reduction in suitable greater sage grouse brood habitat.

Previous surveys within portions of the agricultural dry-up area following standard survey protocols found no signs of amphibians, including boreal toads and wood frogs. The Proposed Action would have no adverse effect on any known populations of boreal toads or wood frogs; however, the removal of irrigation in the agricultural dry-up area would decrease the amount of suitable habitat for the boreal toad and wood frog.

3.11.2.1.6 Migratory Birds

As the irrigated and subirrigated meadow habitat in the agricultural dry-up area slowly converted into upland habitat, avian populations would change to species adapted to upland communities and the populations of more mesic species would decline. Discontinuing periodic mowing and harvesting hay meadows would eliminate inadvertent destruction of grassland nests, resulting in decreased nestling mortality.

The Proposed Action would have a negligible effect on raptor foraging habitat and no effect on known raptor nests. Removal of irrigation in the agricultural dry-up area would have an indirect effect on raptor foraging habitat. The amount of foraging habitat would not be affected by project activities; however, portions of the foraging habitat may be converted from irrigated meadow to upland grassland. The change in vegetation communities may affect prey species composition, distribution, and abundance in the affected area. Upland adapted raptors, such as red-tailed hawk and golden eagle, would potentially benefit from the conversion of irrigated meadows dominated by tall herbaceous vegetation to a more upland shortgrass habitat. The existing tall vegetation provides dense cover that hinders raptor hunting, and the change to shortgrass and shrub vegetation may make prey species more available throughout the year to avian predators (Preston 1990).

3.11.2.1.7 Large Game

The Proposed Action would have no permanent effects on large game. Removal of irrigation water in the agricultural dry-up area would result in an eventual conversion to a drier, upland vegetation

community. The agricultural dry-up area encroaches on the periphery of mule deer severe and critical winter range, and the conversion of irrigated meadows to upland vegetation would have a negligible effect on mule deer. Mule deer may benefit over the long term as shrubs and other vegetation preferred by mule deer in winter increase after the removal of irrigation and livestock, which provide competition for mule deer.

The conversion of irrigated meadows to upland vegetation would alter the foraging habitat for elk. Removing irrigation water would likely slowly decrease available forage and alter vegetation composition to less preferred plant species within the irrigated meadows, which may result in slight adverse effects on elk. Adverse effects may be offset by the removal of haying, which will allow a higher biomass of grass.

Removal of irrigation in the agricultural dry-up area would cause a reduction in moose foraging habitat. The loss of wetland habitat would especially reduce the quality of moose summer foraging habitat. While moose would forage on upland grasses, the preferred forage species would be reduced, a negligible effect.

Suitable habitat for pronghorn is primarily associated with upland shrubland and grassland habitat in the agricultural dry-up areas. The Proposed Action would convert irrigated meadows to upland vegetation preferred by pronghorn, which would be a beneficial effect.

The Proposed Action is unlikely to significantly affect the black bear and mountain lion due to the small size of the affected area and the large amount of suitable habitat available in surrounding areas.

3.11.2.1.8 Other Wildlife

A portion of the irrigated and subirrigated meadow habitat in the agricultural dry-up area would slowly convert into upland habitat and would result in a corresponding change in the small mammal and furbearer communities. Upland species would benefit from the conversion of irrigated meadows, while populations of more mesic species would likely decline. The types of species and the local distribution of species in the agricultural dry-up area would likely change as the vegetation changes through the process of natural succession.

3.11.2.2 Cumulative Effects

The Proposed Action would result in cumulative effects on the Colorado River near Kremmling, Fryingpan River below Ruedi Reservoir, Roaring Fork River near Glenwood Springs, the 15-Mile Reach of the Colorado River, and Ruedi Reservoir. The effects on vegetation associated with these water bodies would be absent or negligible; therefore, the effects on wildlife associated with wetland and riparian vegetation would be absent or negligible.

3.12 Soils and Farmland

Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops; and is also available for these uses. Farmland of statewide importance is land other than prime farmland that has a good combination of physical and chemical characteristics for the production of crops.

3.12.1 Affected Environment

3.12.1.1 Soil Types

Soils in the agricultural dry-up area are predominantly alluvial loams derived from shale or loams formed in glacial drift and colluvium. The Cimarron soils are deep (greater than 60 inches), well-drained soils found on mountainsides and fans. Permeability of Cimarron soils is slow and they have a low to moderate susceptibility to erosion. The Youga soils are deep, well-drained soils found on mountain fans, swales, and depressions. Permeability of Youga soils is moderately slow and they have a low to moderate susceptibility to erosion. The Leavitt soils are deep, well-drained soils found on fans and swales. The permeability of Leavitt soils is moderately slow and they have a moderate susceptibility to

erosion. The remaining soils in the analysis area are generally not suitable for use as cropland because they are on steep slopes and have a high susceptibility to erosion (SCS 1983).

3.12.1.2 Important Farmland

None of the soils in the analysis area are classified as "prime farmland" by the NRCS. Three soil map units in the analysis area, the Cimarron, Leavitt, and Youga soils, are classified as farmland of statewide importance.

3.12.2 Environmental Consequences

3.12.2.1 Direct and Indirect Effects

The Proposed Action would result in a permanent loss of 479 acres of farmland of statewide importance with the removal of irrigation. Under the Farmland Protection Policy Act, any federal agency involved in a proposed project that may convert farmland to nonagricultural uses must complete U.S. Department of Agriculture Form AD-1006, Farmland Conversion Impact Rating. Reclamation will complete Form AD-1006 after this EA is completed. Changes in streamflow, stream stage, or reservoir levels would not affect soils.

3.12.2.2 Cumulative Effects

The Proposed Action, when combined with reasonably foreseeable actions, would not have any cumulative effects on soils or farmland in the analysis area.

3.13 Recreation

The primary issues related to recreation resources are concerns about impacts to water-based recreation (primarily boating and fishing) opportunities resulting from changes to reservoir levels or streamflow. Land-based recreation activities would not be affected by the Proposed Action and were not analyzed for effects.

3.13.1 Affected Environment

3.13.1.1 Reservoir Recreation

3.13.1.1.1 Granby Reservoir

Water-based recreation at Granby Reservoir primarily consists of boating and fishing during the summer recreation season. Powerboating and sailboating are popular, along with canoeing and kayaking. Boating activities are supported by three public boat ramps and several private docks and marinas. Both shore and boat fishing are popular activities at Granby Reservoir, which supports rainbow, brook, mackinaw, and cutthroat trout, as well as kokanee salmon.

3.13.1.1.2 Green Mountain Reservoir

Green Mountain Reservoir is used for boating (power boating and canoeing) and fishing. There are two boat ramps and a privately operated marina at Heeney. The McDonald Flats ramp is typically not open in the spring and fall due to low water levels (USFS undated). The lake supports brown and rainbow trout and kokanee salmon.

3.13.1.1.3 Ruedi Reservoir

Water-based recreation at Ruedi Reservoir is generally limited to boating and fishing. The reservoir supports brown, lake, and rainbow trout, as well as kokanee salmon. Boating is supported by two boat ramps and associated facilities (CDOW 2008a).

3.13.1.2 River Recreation

3.13.1.2.1 Colorado River

Granby Reservoir to Kremmling

River recreation along the Colorado River between Granby Reservoir and Kremmling are dominated by fishing on both private and public lands. Most of the Colorado River in this segment is designated as a Gold Medal Water for outstanding fishing opportunities.

This reach of the river is not known to be a major boating destination.

Kremmling to State Bridge

The section of the Colorado River downstream of Kremmling is a popular boating destination, characterized by the challenging Big Gore Canyon and the meandering Pumphouse reach.

While the Big Gore Canyon reach provides limited fishing opportunities due to fast water and limited streambank access, the Pumphouse reach is popular for both bank fishing and float fishing.

State Bridge to Dotsero

This 45-mile reach of the Colorado River is dominated by Class I and II water. This reach of the river is less popular than the upstream Pumphouse run, but is still well used by both private and commercial boaters. This reach provides both bank and floatfishing opportunities (BLM 2005).

Glenwood Canyon

The Colorado River between Dotsero and Glenwood Springs is dominated by Glenwood Canyon. This section of river has four distinct boating reaches, ranging from Class I flat water to advanced whitewater sections (Class II to V rapids) (Banks and Eckardt 1999; Canoe Colorado 2009; Stafford and McCutchen 2007; Eddy Flower 2009).

The Dotsero-Shoshone reach of this section provides both bank and float fishing, while the remainder of Glenwood Canyon provides bank fishing only. This section is not known to be a major fishing destination.

Below Glenwood Springs

The long section of the Colorado River between Glenwood Springs and the 15-Mile reach (near Palisade) provides a variety of general boating and fishing opportunities where access is available. The South Canyon section of the river between Glenwood Springs and Silt is considered an exceptional fishery, resulting from cold water from the Roaring Fork River and successful stocking efforts (Mowbray, pers. comm. 2009). While many river recreational opportunities are available in this section of the Colorado River, there are no other significant boating or fishing destinations (Banks and Eckardt 1999; Stafford and McCutchen 2007).

3.13.1.2.2 Blue River

The Blue River from Green Mountain Reservoir to its confluence with the Colorado River is designated as a Gold Medal Water for its excellent fishing opportunities, is also recognized as a Wild Trout water, and provides a Class II to III kayak run (Banks and Eckardt 1999; Stafford and McCutchen 2007).

3.13.1.2.3 Fryingpan River

With easy access and a high-quality fishery, the Fryingpan River downstream of Ruedi Reservoir is a popular fishing destination designated as a Gold Medal Water. This section of river supports a productive fishery due to coldwater temperatures and abundant aquatic food sources below the reservoir. A survey published in 2002 estimated about 34,000 visitors over a 12-month period, with most (71 percent) between May 1 and September 30 (Roaring Fork Conservancy [RFC] 2002). The USFS currently has four outfitters permitted to guide on this segment of the Fryingpan River, providing a total of 1,521 service days per year. In general, about half of the guide revenue generated from this fishery occurs during the dry fly fishing season between mid-July and mid-September (USFS 2009).

Preferred flows for fishing range between 200 and 350 cfs. River flows of about 230 cfs are considered ideal (Mowbray, pers. comm. 2009), while flows exceeding about 250 cfs are considered unsafe and unsuitable for wade fishing (USFS 2009). Extreme low winter flows (below about 70 cfs) can be detrimental to fish habitat (Mowbray, pers. comm. 2009). The Fryingpan River provides limited boating opportunities (high water only) and is not a popular destination (Banks and Eckardt 1999).

3.13.1.2.4 Roaring Fork River

The Roaring Fork River between Basalt and Glenwood Springs is popular for both fishing and boating. The reach of river between Carbondale

and the Colorado River is considered a Gold Medal Water. Boating activity is generally limited to private boaters and float fishing, while bank fishing is also popular. Some commercial boating does occur—about 2,500 commercial user days were reported in 2008 (CROA 2009). The section of the Roaring Fork River between Carbondale and Glenwood Springs has Class II to III rapids and is popular for private boaters (Stafford and McCutchen 2007).

3.13.1.2.5 Wild and Scenic River Study

The BLM has evaluated several reaches of the Colorado River and Blue River within the analysis area to identify river segments for possible designation under the National Wild and Scenic Rivers Act (BLM 2007). Eligibility criteria included free-flowing streams with outstanding remarkable values for scenic, recreational, geologic, fish, wildlife, historic, cultural, and other similar values. Five segments of the Colorado River and three segments of the Blue River were determined eligible.

3.13.2 Environmental Consequences

3.13.2.1 Direct and Indirect Effects

3.13.2.1.1 Reservoir Recreation

The Proposed Action is anticipated to increase surface water elevations in Granby Reservoir by up to 1.4 feet during the summer recreation season (May-September). Lake elevations in Green Mountain Reservoir are estimated to increase by up to 1.8 feet under the Proposed Action. These changes would have negligible effects on recreation in Granby Reservoir and Green Mountain Reservoir.

3.13.2.1.2 River Recreation and Wild and Scenic River Designation

Under the Proposed Action, changes in streamflow in the Blue River and upper Colorado River (above Kremmling) would be small and infrequent, and would have a negligible effect on recreational opportunities (boating and fishing). Streamflow changes in the Blue River and upper Colorado River resulting from the Proposed Action would not affect the outstandingly remarkable values of specific river segments or their eligibility for inclusion in the National Wild and Scenic River System.

3.13.2.2 Cumulative Effects

3.13.2.2.1 Reservoir Recreation

Under the Proposed Action, in combination with the expiration of the 2012 Agreement, water levels in Ruedi Reservoir would increase during the summer recreation season by up to 6.5 feet. This increase in water elevation would result in minor benefits to recreational opportunities in Ruedi Reservoir.

3.13.2.2.2 River Recreation and Wild and Scenic River Designation

Changes in streamflow in the Colorado River below Kremmling are associated with the Proposed Action and the expiration of the interim agreements. Streamflows would typically decrease by up to 1.6 percent (5.4 percent in drought years) from May through July, and increase by up to 3.5 percent in August. Despite these small fluctuations in streamflow, changes in river stage (in any condition) would be less than 0.2 feet. The overall cumulative effect of the Proposed Action on Colorado River recreation below Kremmling would be negligible.

On the Fryingpan River, the changes in streamflow under the Proposed Action, coupled with the expiration of the 2012 Agreement, would be variable based on immediate water needs. Recognizing that preferred flows for fishing are less than 250 cfs, the Proposed Action would result in 11 fewer days when flows exceed 250 cfs in 9 out of 10 years. In addition, the Proposed Action would result in increased winter flows by about 18 cfs, which would improve low-flow conditions for the fishery. Overall, the Proposed Action would result in moderate cumulative benefits to fishing on the Fryingpan River due to an increase in preferred

flow periods and improved winter fishery conditions.

Under the Proposed Action (combined with the expiration of the 2012 Agreement), flows in the Roaring Fork River would typically be reduced by about 3.4 percent (29 cfs) from August through October, while winter flows would increase by about 18 cfs. While these changes may result in a small impact to late-season boating opportunities, they would improve late-season fishing and over-winter fishery conditions. Overall, the Proposed Action would result in negligible to minor benefits to recreation on the Roaring Fork River.

Streamflow changes in the Colorado River resulting from the Proposed Action and other reasonably foreseeable actions would be minimal, and would not affect the outstandingly remarkable values of specific river segments or their eligibility for inclusion in the National Wild and Scenic River System.

3.14 Socioeconomics and Land Use

This section provides a brief overview of existing socioeconomic conditions and evaluates potential socioeconomic effects of the Proposed Action alternative.

3.14.1 Affected Environment

3.14.1.1 Socioeconomic Conditions

3.14.1.1.1 Population

The socioeconomic analysis area of Grand, Summit, Eagle, Pitkin, Garfield, and Mesa counties was home to about 315,300 permanent residents in 2010. About 112,200 of these residents lived in the four upstream counties, Grand, Summit, Eagle and Pitkin, referred to in the remainder of this section as the resort counties. The larger share of the analysis area population (about 203,100 residents) lived in the downstream counties, Garfield County and Mesa County, referred to in this section as the west slope counties (Census 2010).

Since 1990, the population of the analysis area has grown by almost 136,700 residents, an increase of 77 percent. The population in the resort counties has grown most rapidly, reflecting an average annual increase of 3.6 percent over the 1990 through 2010 period. The west slope counties have grown more gradually, but their combined average annual growth rate of 2.5 percent still exceeded the state average of 2.1 percent for the 1990 through 2010 period. Eagle County has been the fastest growing county within the analysis area (on a percentage basis) since 1990. Pitkin County, which has sought to actively manage and limit growth, has grown the most gradually (Census 1990, 2010).

The most recent population projections from the Colorado State Demography Office (SDO) anticipate the analysis area will continue to grow more rapidly than the state as a whole. Based on the SDO projections, the analysis area population is expected to include about 612,100 residents by 2040, a cumulative increase of 94 percent from the 2010 population totals. While the average annual population growth rate for the analysis area is projected to slow to 2.2 percent per year through 2040, this growth rate would continue to exceed the projected average annual growth rate for Colorado's population as a whole (1.6 percent) (SDO 2011a).

3.14.1.1.2 Demographic Characteristics

Within the analysis area, Eagle and Summit counties had the youngest populations in 2000, with a median age of 31 years. Mesa and Pitkin counties had the oldest populations in 2000, with a median age of 38 years. The median age of Garfield County residents (34 years) and Grand County residents (37 years) in 2000 was closer to the statewide median age of 34 years (Census 2000a). More recent data from the American Community Survey (ACS) indicate the median age of Eagle County residents (now 33 years), Summit County residents (33 years), and Garfield County residents (34 years) remained slightly younger than the statewide average in 2005–2009 (36 years), while the median ages in Mesa County (38 years)

and Grand County (40 years) were older than the statewide median age (ACS 2011).

Relative to Colorado as a whole, minority residents comprised a somewhat smaller percentage of the overall analysis area's population in 2000. About 13 percent of analysis area residents in 2000 were Hispanic (compared to 17 percent statewide) and about 3 percent were non-White and non-Hispanic (compared to 8 percent statewide). Analysis area counties varied in their racial and ethnic composition in 2000. Minority residents made up 26 percent of Eagle County's population (23 percent were Hispanic), while minority residents comprised only 7 percent of Grand County's population (4 percent were Hispanic) (Census 2000a).

Recently released data from the 2010 Census indicate the proportion of the analysis area's population comprised of minority residents has increased since 2000. About 18 percent of the analysis area population was Hispanic in 2010 (the statewide proportion has also increased, to 21 percent Hispanic). The non-White and non-Hispanic population in the analysis area in 2010 remained about 3 percent of the total—similar to the proportion in 2000 (9 percent of the state's overall population was non-White and non-Hispanic in 2010). Eagle County continues to have the largest proportion of minority residents in the analysis area (33 percent of Eagle County's total population), but the proportion of minority residents in Garfield County has increased to 31 percent, also slightly higher than the state average, Grand County continues to have the smallest proportion of minority residents (10 percent of the county's total population in 2010) (Census 2010).

3.14.1.1.3 Income

The median household income in three of the four resort counties (Eagle, Pitkin, and Summit) was considerably higher than the statewide median household income in 1999. The median household incomes in Grand and Garfield counties were comparable to the statewide average, while the median household income in Mesa County was considerably lower than the statewide median in 1999 (Census 2000b).

More recent data from the 2005–2009 ACS indicate that median household incomes in all four resort counties now exceed the statewide median ($56,222). The median household income is highest in Eagle County ($69,139) and Summit County ($67,329). In the west slope counties, the median household income in Garfield County ($64,837) is higher than the statewide median, while the median household income in Mesa County ($50,611) is about 10 percent lower than the median income in Colorado (ACS 2011).

In 1999, 8.9 percent of the residents of the analysis area were living below the federally defined poverty level, a slightly lower proportion of the population than throughout Colorado (9.3 percent). Mesa County had the largest proportion of residents living below the poverty level (10.2 percent). The other five counties in the analysis area had less than 9 percent of their residents living below the poverty level (Census 2000b).

More recent ACS data indicate the incidence of poverty has increased in Colorado, with 11.9 percent of the population living below the poverty level during 2005–2009. Across the analysis area as a whole, 10.0 percent of the population lived below the poverty level in 2005–2009, including an estimated 12.2 percent of Mesa County residents. The incidence of poverty in the other analysis area counties was less than the statewide average. In Eagle County, 9.9 percent of residents lived below the poverty level during 2005–2009, while the proportions of the population living below the poverty level in Garfield, Grand, and Pitkin counties were nearly identical at 8.0 to 8.1 percent. Summit County had the smallest proportion of its population living below the poverty level at 5.2 percent in 2005–2009 (ACS 2011).

3.14.1.1.4 Employment

About 159,000 residents of the analysis area were employed in 2010. This total includes 59,000 residents of the four resort counties and 100,000

residents of the two west slope counties (CDLE 2011).

As of 2010, the unemployment rate in the analysis area had risen to 9.8 percent versus 3.0 percent prior to the recession in 2007. The statewide unemployment rate in 2010 was 8.9 percent. Mesa County had the highest 2010 unemployment rate in the analysis area at 10.6 percent, while Summit County had the lowest unemployment rate at 7.8 percent (CDLE 2011).

There are more jobs in the analysis area than employed residents. This reflects both multiple job holding (the average Colorado resident held 1.12 jobs in 2009 and residents in the resort areas tend to have a higher rate of multiple job holding than the average) and the net inflow of workers residing outside the analysis area to work at jobs within the analysis area. A total of 197,000 jobs were located in the analysis area in 2009. From 1990 through 2009, the number of jobs in the analysis area increased at an average annual rate of 3.1 percent. However, every county in the analysis area lost jobs between 2007 and 2009. The total number of jobs in the analysis area declined by about 7 percent compared to a 5 percent decrease in statewide total jobs (SDO 2009; CDLE 2011). Based on the continuing increase in the number of unemployed persons, the total number of jobs in the analysis area likely continued to decline in 2010 (data on total jobs by place of work are not yet available for 2010).

3.14.1.1.5 Economic Base

The economic base of a local economy consists of the activities that bring money into the region from outside areas. These activities then lead to other jobs among firms that supply goods and services to the economic base industries and to the employees and other residents of the region. The economic base drives economic growth and is sometimes referred to as the "economic drivers" of the community.

Within the analysis area, tourism dominates the economic base of the resort counties and represents about 70 percent of all direct basic employment in Grand, Eagle, Summit, and Pitkin counties. The west slope counties are more diversified, with an economic base that includes significant contributions from mining and energy development; agriculture, regional, and national services; and federal and state government employment, as well as a more modest contribution from tourism (13 percent of the economic base). Direct basic employment due to the spending of resident wealth accumulated outside the analysis area (such as retirees and second home owners) comprises about 19 percent of the economic base across the analysis area as a whole. Manufacturing jobs represent only about 3 percent of the analysis area economic base, but about 4 percent of the economic base in the west slope counties (SDO 2011b).

3.14.1.1.6 Economic Contribution from Fishing and Rafting

While the tourism sector in the analysis area, and particularly the resort counties, has historically been dominated by winter sports (mostly downhill skiing), other activities such as fishing, rafting, hiking, mountain biking, and camping have become increasingly important in the past few decades. The resort counties now promote a year-round experience and lifestyle that has encouraged development of second homes as well as more traditional tourist visits throughout the year.

CDOW conducts periodic surveys of anglers in Colorado and maintains a model that estimates the economic contribution from hunting, fishing, and watching wildlife to each of the state's counties and the state as a whole. The 2007 CDOW angling survey indicates anglers spent 1.9 million fishing days (one angler for one day) in the analysis area in 2007, about 18 percent of all fishing days in the state of Colorado (CDOW 2007). Trip and equipment expenditures for fishing directly and indirectly contributed about $205 million to the analysis area economy in 2007, directly supported about 1,400 jobs, and indirectly supported about 1,100 additional jobs (CDOW 2008b). Comparing the estimated direct employment related to fishing to the 44,000 direct economic base jobs from

tourism in the analysis area suggests that fishing makes up about 3 percent of the economic stimulus the analysis area receives from tourism as a whole.

A 2002 Fryingpan Valley Economic Study estimated 34,200 annual visitor days along the Fryingpan River below Ruedi Reservoir and 15,300 annual visitor days at Ruedi Reservoir. Expenditures by these visitors were estimated to produce about $3.9 million in annual economic output and to directly and indirectly support about 73 jobs in the Roaring Fork Valley (RFC 2002).

The 2010 Colorado River Outfitters Association (CROA) report indicated there were 113,000 commercial rafting user days along the Colorado River, about 1,400 user days along the lower Roaring Fork River, and about 1,200 user days along the Blue River in 2010. Together, activity on these three rivers represented about 23 percent of all commercial rafting activity in Colorado. The estimated total economic impact of commercial rafting along the Colorado River, the lower Roaring Fork River, and the Blue River (including multiplier effects) was about $34 million in 2010. The 2010 CROA report indicated that commercial rafting activity was about 7 percent less than the peak number of user days in 2007, but the number of user days did increase from 2009 to 2010, particularly on the Colorado River and Arkansas River (CROA 2010). No data are reported on private rafting activity levels or economic effects.

3.14.1.1.7 Agriculture in Grand County

In 2009, agriculture made up about 5 percent of the economic base of Grand County (SDO 2011b). The estimated market value of agricultural products produced by Grand County farms was about $9.4 million. The majority of the market value (84 percent) was from livestock production (Census of Agriculture 2007).

Grand County had 229 farms in 2007 and 143 of these farms were irrigated on some portion of the land. In total, there were a little more than 43,000 irrigated acres in the county out of a total of more than 208,000 total acres of farmland (Census of Agriculture 2007).

3.14.1.2 Environmental Justice

As described in Section 3.14.1.1.2, the proportion of minority residents within the analysis area is generally less than in the State of Colorado as a whole—with the exception of the relatively high proportion of Hispanic residents in Eagle and Garfield counties. The incidence of poverty within the analysis area is generally less than or comparable to the State of Colorado as a whole (though the incidence of poverty in Mesa County, at 12.2 percent, is slightly greater than the average statewide incidence of 11.9 percent).

3.14.1.3 Land Use

Under the Proposed Action, ditch shares currently used to irrigate lands on two ranches west of Granby Reservoir in Grand County would be used to deliver water to the reservoir to provide part of the 10825 water supply. Irrigated agriculture on these ranches would cease. These ranches are known as the E Diamond H Ranch and the Miller-Hereford Ranch. The dry-up would affect about 843 acres of irrigated meadow and 92 acres of subirrigated meadow that have been historically irrigated (Grand River Consulting 2011).

The agricultural lands that would cease to be irrigated under the Proposed Action are zoned as Forestry and Open District, which is the predominant land use zoning category throughout Grand County. Portions of the E Diamond H Ranch are within 0.5 mile or less of the western edge of lands proximate to Granby Reservoir that are currently zoned for residential development (Grand County 2009). However, at least some of the lands that comprised the E Diamond H Ranch reportedly have conservation easements that may restrict their future uses (McManus 2009).

3.14.2 Environmental Consequences

3.14.2.1 Direct and Indirect Effects

Changes in streamflow conditions along the Colorado River below Granby Reservoir and below Windy Gap would have negligible effects on recreation. The Proposed Action is also anticipated to have negligible effects on recreation at Granby Reservoir (Section 3.13).

The direct effect of the Proposed Action in increasing lake elevation at Green Mountain Reservoir is expected to have a negligible effect for recreation. Corresponding socioeconomic effects should also be negligible. The direct effect on recreation along the Blue River below the reservoir is also expected to be negligible.

The Proposed Action would dry up about 752 acres of irrigated meadow and 92 acres of subirrigated meadow in Grand County. Relative to the total of 43,000 irrigated acres in the county in 2007, this dry-up would affect about 2 percent of the county's irrigated acreage. The dry-up would result in a negligible adverse effect on the agricultural portion of the Grand County economy.

The indirect effect of the Proposed Action on land use in Grand County would be to convert the use of the E Diamond H Ranch and the Miller-Hereford Ranch to uses other than irrigated agriculture. The properties are in prime locations for future development and the county would like development to proceed according to the county's Rural Land Use Plan (Plan). Under the Plan, two-thirds of the property would remain open space, while one-third could be developed at low density (two lots per 35 acres). Grand County has entered into communications with Northern Water regarding the future use of the Miller-Hereford ranch, but no agreement has been reached (Curran, pers. comm. 2009).

The Proposed Action would not have disproportionately high or adverse human health or environmental effects on minority and low-income populations.

3.14.2.2 Cumulative Effects

There would be a negligible cumulative effect on recreation along the Colorado River below Kremmling.

The cumulative effect on recreation at Ruedi Reservoir from the Proposed Action and the expiration of the interim agreements is expected to be a minor benefit due to higher water levels. The cumulative effect on flows in the Fryingpan River is expected to be a moderate benefit due to fewer days with high flows (>250 cfs) and increased flows during the winter. The cumulative effect on recreation in the Roaring Fork River is expected to be a negligible to minor benefit.

In combination, the minor cumulative benefit to recreation at Ruedi Reservoir coupled with the moderate cumulative benefit to recreation along the Fryingpan River and the negligible to minor benefit to recreation along the Roaring Fork River would be expected to lead to a minor benefit to the recreation economy in the area. The socioeconomic effects may be most noticeable for property owners along the Fryingpan River and recreation- and visitor-related businesses in the Town of Basalt.

4.0 Consultation and Coordination

4.1 Scoping Process

Reclamation engaged in a number of public scoping outreach activities to inform the public and solicit comments. Public scoping began October 28, 2009 when Reclamation placed newspaper advertisements regarding public scoping open houses in four local newspapers. Invitations to the open houses were emailed to known stakeholders. Two public scoping open houses were held in Basalt and Granby, Colorado on November 4 and 5, 2009, respectively, and were attended by about 35 people. Reclamation, through its contractors, also conducted telephone interviews

with federal, state, and local agencies to review their needs and concerns.

Each of the 25 comment documents received during the three-week public scoping process was considered. These comments were grouped for consideration into relevant categories. Based on guidance for NEPA, key issues were determined. These key scoping issues were considered in this EA along with other important issues:

- Surface Water Hydrology (rivers and streams)–Changes in the quantity and timing of flows in the Colorado River from the Redtop Valley Ditch headgate to the 15-Mile Reach, Redtop Valley Ditch, Stillwater and Willow creeks, Blue River, Fryingpan River, and Roaring Fork River
- Surface Water Hydrology (reservoirs)–Changes in levels of Ruedi Reservoir and release schedules for reservoirs that would provide 10825 water
- Groundwater Hydrology–Anticipated yield of Redtop Valley Ditch agricultural dry-up and changes in groundwater accrual to Willow Creek
- Surface Water Quality–Effects on water quality, particularly in the Fryingpan River, Roaring Fork River, and Colorado River downstream of Glenwood Springs
- Reservoir Operations and Hydroelectric Generation–Effects on projected power production by the Ruedi and Green Mountain power plants
- Aquatic Life–Effects on game and nongame fish and macroinvertebrates in the Colorado River from the Redtop Valley Ditch headgate to the 15-Mile Reach, Stillwater and Willow creeks, Blue River, Fryingpan River, and Roaring Fork River; potential for spreading zebra and quagga mussels or whirling disease from affected reservoirs
- Wetlands, Flooding, and Riparian Resources–Effects on riparian communities due to changes in sediment transport, stream geomorphology, or recharge of alluvial aquifers along the Colorado River downstream of Granby Reservoir and along the Fryingpan River; potential for flooding along the Roaring Fork River near Basalt
- Wildlife and Vegetation–Effects on vegetation and habitat for deer, moose, elk, and greater sage grouse due to dry-up of irrigated land
- Recreation Resources–Effects on angling opportunities along the Fryingpan River; effects on angling and boating opportunities along the Colorado River; relationship to the Wild and Scenic River designation process; effects on shoreline fishing and boating opportunities at Ruedi Reservoir
- Socioeconomic and Land Use Resources–Effects on local economies due to changes in recreation resources such as angling, game populations, hunting, wildlife watching, and boating; effects on land use at the Miller-Hereford and E Diamond H ranches
- Cumulative Effects–Effects of the Proposed Action in conjunction with future Reclamation contracts, potential reduction of Xcel's Shoshone Power Plant call, and other water development projects
- Alternatives Analysis–Potential alternatives or changes or refinements to the Proposed Action
- Mitigation–Potential mitigation of significant adverse effects
- Other–Disclosing anticipated contract types, durations, and signatories; and describing authority for operation and administration of the Proposed Action

4.2 Preparers

MWH Americas, Inc., in cooperation with ERO Resources Corporation, served as a third-party contractor and prepared this EA working under the direction of the lead agency for the project, Reclamation. Grand River Consulting Corporation

conducted hydrologic analysis and modeling, surface water resources analyses, and hydroelectric generation analyses; GEI Consultants, Inc. conducted aquatic resource analyses; ERO Resources, Inc. Corporation conducted wetland, riparian, wildlife, vegetation, recreation, and cultural resource analyses; BBC Research and Consulting conducted socioeconomic and land use analyses. Table 9 provides the names of the individuals who were principally involved with preparing the EA.

Table 9. List of Preparers.

Name	Title/Role	Highest Education	Years of Experience
Bureau of Reclamation			
Carlie Ronca	Project Manager (2009)	M.S. Biology in Management of Environmental Resources	12
Will Tully	Project Manager (2010 to present)	B.S. Wildlife Management	37
Ron Thomasson	Hydrologic Engineer	B.S. Civil Engineering	22
Kara Lamb	Public Involvement Specialist	M.A. Environmental Ethics	13
MWH Americas, Inc.			
Bill Van Derveer	Project Manager (2009-May 2010)	M.S. Applied Natural Science	21
Chip Paulson	Document review	M.S. Water Resource Engineering	33
Jerry Gibbens	Water resources, groundwater, and geomorphology	M.S. Civil Engineering	19
Lesley Siroky	Assistant project management, water quality, and document production	B.S. Environmental Engineering	9
Tracy Kosloff	Water quality (2009-2010)	M.S. Environmental Engineering	9
Grand River Consulting Corporation			
Kerry Sundeen	Hydrologic modeling, water resources, and hydroelectric generation	M.S. Hydrology	32
Maria Pastore	Hydrologic modeling, water resources, and hydroelectric generation	M.S. Environmental Science / Ecology	10
ERO Resources Corporation			
Richard Trenholme	Natural Resources Lead and Project Manager (May 2010 to present)	B.S. Agronomy	32
Leigh Rouse	Wetlands and riparian resources	M.S. Botany	12
Bill Mangle	Recreation resources	M.S. Natural Resource Policy and Planning	12
Ron Beane	Wildlife	M.A. Biology	30
Moneka Worah	Vegetation	B.A. Environmental Science	7
Craig Sovka	Soil, geology, and farmland resources	B.A. Geology	18
Kay Wall	Technical editor	B.A. Behavioral Science	28
BBC Research & Consulting, Inc.			
Doug Jeavons	Socioeconomics and land use	M.A. Economics	39
GEI Consultants, Inc.			
Don Conklin	Aquatic Ecologist	M.S. Water Resource Management	29

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Appendix A: Alternatives Analysis Results

This Appendix provides a summary on the alternatives evaluated prior to this EA. Further information is provided in the "Phase 1 Report" and "Phase 2 Assessment":

- *10825 Water Supply Study Phase 1 Report: Screening of Water Supply Alternatives* (Grand River Consulting 2007).
- *10825 Water Supply Study Phase 2 Assessment: Water Supply Alternatives Summary* (Grand River Consulting 2009)

1.1 15-Mile Reach Pumpback

This alternative would pump water from the Colorado River in Grand Junction, from a site below the confluence with the Gunnison River, upstream to the beginning of the 15-Mile Reach. Pumped water would be discharged to the Colorado River immediately downstream of the Grand Valley Irrigation Company diversion dam.

This alternative was eliminated from further consideration due to water quality concerns. Both the Gunnison River and the Colorado River downstream of the Gunnison River to the state line are on the EPA's list of impaired waters for selenium. If the pumped water has elevated concentrations of selenium, the impaired water quality may affect endangered fish and other aquatic life within the 15-Mile Reach. Additional information can be found in the Phase 1 Report (Grand River Consulting 2007).

1.2 Mt. Logan Reservoir

This 10,000 ac-ft reservoir site is located on an ephemeral tributary to Roan Creek near the Town of DeBeque. A pump station from the Colorado River would be required to provide an adequate yield of water for Recovery Program purposes.

This reservoir site was eliminated from further consideration because, when compared to other alternatives, a large embankment was required for a relatively small amount of storage. There is also a natural gas pipeline located beneath the proposed dam. The warm water reservoir may introduce non-native fish to the Colorado River, in competition with the endangered fish. Additional information can be found in the Phase 1 Report (Grand River Consulting 2007).

1.3 Yank Creek Reservoir

The 5,000 ac-ft Yank Creek Reservoir site is located on North Thompson Creek, a tributary to Crystal River in the Roaring Fork watershed near Carbondale. This alternative was eliminated from further consideration primarily because the reservoir cannot supply the full 10825 water demand. Additionally, land ownership and land use patterns conflict with reservoir construction. Additional information can be found in the Phase 1 Report (Grand River Consulting 2007).

1.4 Pipeline from Ruedi Reservoir to Basalt

This delivery facility would construct a 15-mile gravity pipeline from Ruedi Reservoir to the Roaring Fork River near Basalt. The pipeline would keep any 10825 water releases made from Ruedi Reservoir out of the Fryingpan River in order to facilitate sport fishing access. The pipeline would likely carry 10825 water only during isolated periods (perhaps several weeks per year) when 10825 releases may conflict with fisherman access.

This alternative was eliminated from further consideration because of the high cost (about $40 million) and consideration that sport fishing access can likely be resolved through continued reservoir management, without large scale construction of this major facility. Potential permitting concerns and a lengthy time for implementation (perhaps 5 to 10 years to permit and construct) were also noted. Additional information can be found in the Phase 1 Report (Grand River Consulting 2007).

1.5 Pipeline and Tunnel from Ruedi Reservoir to Roaring Fork

As with the Ruedi Reservoir to Basalt pipeline, this facility would keep 10825 water out of the Fryingpan River by delivering it to the upper Roaring Fork watershed instead of flowing down the Fryingpan River. Two tunnel configurations were considered: a 12-mile tunnel with a pressurized system to lift the water 500 feet to the Salvation Ditch above Aspen; and an 18-mile tunnel to the Twin Lakes Collection System with a pressurized system to lift the water 3,100 feet. The tunnel systems would likely carry 10825 water only during isolated periods (perhaps several weeks per year) when 10825 release objectives conflict with sport fisherman access.

These tunnels were eliminated from further consideration due to cost ($100 million or more). Further, sport fishing access issues associated with use of Ruedi Reservoir can likely be resolved through continued reservoir management. Additionally, permitting and construction of a tunnel system would take a decade or more. This implementation schedule would not meet 10825 water delivery needs. Additional information can be found in the Phase 1 Report (Grand River Consulting 2007).

1.6 Webster Hill Reservoir

This 28,900 ac-ft reservoir site is located on the mainstem of the Colorado River several miles downstream of the Town of Rifle. This alternative was eliminated from further consideration because of multiple construction obstacles. The reservoir would require relocation of Interstate 70, a railroad line, numerous natural gas wells, natural gas pipelines, and many other commercial facilities. In addition, the reservoir would inundate occupied habitat of several endangered fish species.

Additional information can be found in the Phase 1 Report (Grand River Consulting 2007).

1.7 Grand Valley Lake

The Grand Valley Lake is a large scale water development concept that would be located in the vicinity of Grand Junction. As proposed, this concept would include a 200,000 ac-ft off-channel reservoir on Sink Creek, south of the Colorado River near Palisade. The reservoir would be filled by a 60-mile aqueduct from the North Fork of the Gunnison River to the reservoir. Numerous improvements to local irrigation projects would also be required.

This alternative was eliminated from further consideration because permitting and construction of this concept is questionable. Even if it was possible to permit and construct the project, it would require several decades or more, given the large size of the project, federal issues, environmental issues, and the multi-purpose nature of the project. Additionally, diverting substantial amounts of dilution flows from the North Fork of the Gunnison River may have a significant negative effect on the concentrations of selenium in the lower Gunnison River. Additional information can be found in the Phase 1 Report (Grand River Consulting 2007).

1.8 Middle Fork Reservoir

The Middle Fork Reservoir site is located on the Middle Fork of Parachute Creek. This alternative was eliminated from further analysis due to insufficient water yield (likely much less than 1,000 ac-ft/yr, and perhaps nothing in drought years). Additionally, the high elevation of the site would not make it feasible to pump water to the reservoir site from the Colorado River. Because the Middle Fork Reservoir site had these fatal flaws, it was eliminated from detailed analysis prior to publication of the Phase I Report.

1.9 Roan Creek Reservoir

The Roan Creek Reservoir site is located about five miles north of the Town of DeBeque and Interstate 70. This alternative was eliminated from further consideration due to time required to permit and

construct the reservoir (likely more than 10 years). Additional information can be found in the Phase 1 Report (Grand River Consulting 2007).

1.10 Wolcott Reservoir

The Wolcott Reservoir site is located on Alkali Creek, an ephemeral tributary to the Eagle River. The site is located about 20 miles west of Vail in a large natural basin about one mile north of Interstate 70 near Wolcott. Wolcott Reservoir would not provide water solely for Recovery Program purposes. Instead, as proposed by Eagle River water providers to Denver Water, this facility would be developed as a multiple use reservoir that would supply additional water for other west slope and east slope purposes.

This alternative was eliminated from further consideration because permitting and construction of this alternative is likely to take a decade or more, given the large size of Wolcott Reservoir, headwater issues, and the multi-purpose nature of the project. The reservoir project is controversial; the outcome of any permitting process is uncertain. Few projects of this magnitude have avoided litigation, which often further delays project implementation. Additional information can be found in the Phase 1 Report (Grand River Consulting 2007).

1.11 Shoshone Call Subordination

This alternative would have subordinated the Shoshone Power Plant water right on the Colorado River. Subordination of the Shoshone call would require coordinated operation with one or more upstream reservoirs. The water users would subordinate the Shoshone call, store this water in an upstream reservoir, and release the water in late summer for the Recovery Program.

This alternative was eliminated from detailed analysis because of lack of stakeholder support. One reason the stakeholders did not support the alternative was because the required reservoir releases would reduce the yield of one of the stakeholders in all but the driest year. Because of the lack of stakeholder support, it was eliminated from detailed analysis prior to publication of the Phase I Report.

1.12 Upper Colorado River Reservoirs

Six small reservoirs in Grand County, Strawberry Creek, Orr, Haypark, East Troublesome, Rabbit Ears, and Ute Park reservoirs, were considered to store water for the Recovery Program. All of these sites were previously reviewed by Grand County or Northern Water, and it was determined that they could not provide sufficient water yield. These reservoirs were considered between the Phase 1 Report and Phase 2 Assessments, but were eliminated before publication due to this fatal flaw.

1.13 Ruedi Reservoir

In the year 2012, an existing obligation to temporarily release 10,825 ac-ft of Recovery Program water from Ruedi Reservoir will expire. At that time, less water will be released for the Recovery Program; summer releases from Ruedi Reservoir may decrease from existing conditions, and winter releases may increase a corresponding volume.

This alternative would permanently provide the 10825 water from Ruedi Reservoir starting in 2012, and would "back fill" the temporary water supply agreement. The volume of water released from Ruedi Reservoir would remain the same as under current conditions.

This alternative was eliminated from further analysis due to issues with sport fishing access along the Fryingpan River. High flows in the Fryingpan River make it difficult for sport fishermen to safely access the river. Sport fishing provides an important economic benefit in the Basalt area. It is possible that this alternative, coupled with other releases from Ruedi Reservoir could create high flow conditions on the Fryingpan River. Additional information can be found in the

Phase 2 Assessment (Grand River Consulting 2009).

1.14 Sulphur Gulch Reservoir

The 16,000 ac-ft Sulphur Gulch Reservoir site is located in Mesa County, approximately 12 miles upstream of the head of the 15-Mile Reach. The site is located on Sulphur Gulch, an ephemeral tributary to the Colorado River. Sulphur Gulch Reservoir was not eliminated from further analysis, but was not chosen as the proposed action because permitting and construction would take a decade or more. Additional information can be found in Comparison of Water Supply Alternatives (Grand River Consulting 2009)

1.15 Ruedi / Sulphur Gulch Reservoir Combination

This alternative pairs new reservoir construction at Sulphur Gulch with the existing Ruedi Reservoir. A total of 5,412 ac-ft would be delivered from each reservoir. The Ruedi/Sulphur Gulch Reservoir combination was eliminated from further analysis because permitting and construction would take a decade or more. Additionally, Sulphur Gulch Reservoir as a stand-alone alternative was a better alternative from an environmental standpoint.

1.16 Ruedi / Buzzard Creek Reservoirs Combination

This alternative provides 5,412 ac-ft of water from Ruedi Reservoir with 5,412 ac-ft of water from Buzzard Creek Reservoir in each and every year. This alternative was eliminated from further analysis primarily due to the more significant wetland impacts of Buzzard Creek Reservoir when compared to other structural alternatives. This element would likely not be the Least Environmentally Damaging Practicable Alternative (LEDPA) when compared to other alternatives. Additional information can be found in the Phase 2 Assessment (Grand River Consulting 2009).

1.17 Ruedi / Williams Fork Reservoirs Combination

This alternative would provide different amounts of water from Ruedi and Williams Fork Reservoirs from year to year, depending upon whether it was a drier than average or wetter than average year. In above average and wet years, 2,700 ac-ft of water would be released from Williams Fork Reservoir and 8,125 ac-ft of water would be released from Ruedi Reservoir. In dry and below average years, all 10825 water would be supplied from Ruedi Reservoir, along with the release of an additional 2,700 ac-ft to compensate Denver Water for past releases from Williams Fork Reservoir.

In below average and dry years, Ruedi Reservoir would release 13,525 ac-ft of water. Because of adverse impacts to the Fryingpan River due to the increased releases from Ruedi Reservoir, this alternative was eliminated from further consideration. Further, water currently released from Williams Fork Reservoir would be released from Ruedi Reservoir in these drier than average years, resulting in lower stream flows in the upper Colorado River than would otherwise exist.

Additional information can be found in the Phase 2 Assessment (Grand River Consulting 2009).

1.18 Sulphur Gulch / Williams Fork Reservoir Combination

This alternative would provide different amounts of water from Sulphur Gulch and Williams Fork reservoirs from year to year, depending upon whether it was a drier than average, or wetter than average year. It would operate the same as Ruedi / Williams Fork Reservoir Combination, only with Sulphur Gulch releases instead of Ruedi Reservoir releases.

This alternative would decrease the amount of water in the Colorado River below the confluence with Williams Fork by 2,700 ac-ft in below average and dry years, when releases would instead be made from Sulphur Gulch. This coincides with the

years that Williams Fork Reservoir does not fill. This alternative was eliminated from further consideration because changes below Williams Fork Reservoir would either have neutral or negative impacts to aquatic conditions when compared to other alternatives. It may also require the construction of a larger Sulphur Gulch Reservoir, in order to meet the increased dry year release demands. Additional information can be found in the Phase 2 Assessment (Grand River Consulting 2009).

1.19 Ruedi Reservoir and Wolford Mountain Reservoir Enlargement

This alternative would supply 5,412 ac-ft from an enlarged Wolford Mountain Reservoir and Ruedi Reservoir would supply the other 5,412 ac-ft in each and every year. The Wolford Mountain Reservoir enlargement would be filled by a pump station from the Colorado River.

This alternative was eliminated from further analysis for multiple reasons. First the alternative cannot supply 5,412 ac-ft in dry years (such as 1977) without impacting the marketable yield of the reservoir. Second, this alternative has more significant wetland impacts on Wolford Mountain Reservoir when compared to other structural alternatives. Any alternative that utilizes Wolford Mountain Reservoir enlargement would not likely be the LEDPA when compared to Sulphur Gulch Reservoir or to non-structural alternatives. Additional information can be found in the Phase 2 Assessment (Grand River Consulting 2009).

1.20 Buzzard Creek Reservoir and Wolford Mountain Reservoir Enlargement

This alternative would use an enlarged Wolford Mountain Reservoir with Buzzard Creek Reservoir.

The Buzzard Creek/Wolford Mountain Reservoir combination was eliminated from further analysis because permitting and construction would take a decade or more. Wolford Mountain Reservoir enlargement also would likely not be the LEDPA when compared to other alternatives. Further, this alternative would reduce the dry year yield of Colorado River Water Conservation District, and did not have stakeholder support. Additional information can be found in the Phase 2 Assessment (Grand River Consulting 2009).

1.21 Lake Granby (2,700 ac-ft and Ruedi Reservoir (8,125 ac-ft)

This alternative pairs releases from two existing reservoirs. Lake Granby releases of 2,700 ac-ft would occur in late summer each year. The remaining 8,125 ac-ft of Recovery Program water would be released from Ruedi Reservoir.

This alternative was eliminated from further analysis because concurrent releases of contract water and 8,125 ac-ft of Recovery Program water from Ruedi Reservoir could cause incremental negative impacts to recreation use and aquatic habitat of the Fryingpan River. For additional information, please see the Phase 2 Assessment (Grand River Consulting 2009).

1.22 Orchard Mesa Irrigation District Improvements with Ruedi Reservoir and Lake Granby

In this alternative, releases from three existing reservoirs would provide the 10825 water:

- Lake Granby would supply releases of 2,700 ac-ft in all years
- Green Mountain Reservoir Historic User Pool (HUP) surplus water available to the Recovery Program would increase with efficiency improvements to the Orchard Mesa Irrigation District system. About 5,412 ac-ft would be available almost every year.
- Ruedi Reservoir would provide the balance of the 10825 water.

This alternative was eliminated from further consideration because in dry years, up to 8,125 ac-ft of water would be released from Ruedi Reservoir, causing potential impacts to sport fishing in the Fryingpan River. For additional information, please see the Phase 2 Assessment (Grand River Consulting 2009).

1.23 Lake Granby (2,700 ac-ft) and Sulphur Gulch Reservoir (8,125 ac-ft)

This alternative pairs releases from existing Lake Granby with new construction of Sulphur Gulch Reservoir. The Lake Granby/Sulphur Gulch Reservoir combination was eliminated from further analysis because permitting and construction would take a decade or more. Additionally, Sulphur Gulch Reservoir as a stand-alone alternative was a better alternative from an environmental standpoint. For additional information, please see the Phase 2 Assessment (Grand River Consulting 2009).

1.24 References

Grand River Consulting Corporation. 2007. 10825 Water Supply Study Phase 1 Report: Screening of Water Supply Alternatives. July.

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