MOFFAT
COLLECTION SYSTEM PROJECT

FINAL ENVIRONMENTAL IMPACT STATEMENT

Executive Summary

Photo provided courtesy of Denver Water.

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ES.1 INTRODUCTION

In 2003, the City and County of Denver, acting by and through its Board of Water Commissioners (Denver Water) notified the United States (U.S.) Army Corps of Engineers (Corps) of its intent to apply for a Department of the Army Permit (Section 404 Permit), pursuant to Section 404 of the Clean Water Act (CWA), to place fill material in jurisdictional waters of the U.S., including wetlands. The fill would be for the construction of a water storage facility associated with developing additional water supplies. The Corps determined that an analysis of the significant natural and human environmental effects of the proposed Moffat Collection System Project (Moffat Project or Project) and reasonable range of alternatives was necessary to provide for full public disclosure and to aid in decision-making.

Figure ES-1
Public and Agency Participation Key Dates

The Proposed Action and action alternatives would result in direct impacts to wetlands and other waters of the U.S. The Proposed Action would result in 1.95 acres of permanent and 0.12 acre of temporary impact to wetlands, in addition to 3.53 acres of permanent and 0.49 acre of temporary impact to other waters of the U.S. This action requires authorization from the Corps under Section 404 of the CWA.

This Environmental Impact Statement (EIS) was prepared in accordance with the National Environmental Policy Act of 1969, as amended, (NEPA) and the Corps' regulations for implementing NEPA (33 Code of Federal Regulations [CFR] 325, Appendix B). This EIS has also been formulated to address the information requirements of the Section 404(b)(1) Guidelines (40 CFR 230). The Corps, Omaha District, Regulatory Branch, is the lead Federal agency responsible for preparing the EIS. The Corps is assisted by a team of third-party contractors led by URS Corporation, working under the direction of, and in cooperation with, the Corps in accordance with December 17, 1997 guidance from the Corps Chief of Engineers regarding preparation of an EIS. Figure ES-1 provides a graphic representation of the key public and agency participation dates for the Project.

Information contained in the EIS serves as the basis for a decision regarding issuance of a Section 404 Permit. It also provides information for local and State agencies having jurisdictional responsibility for affected resources.

This Final EIS for the proposed Moffat Project was revised significantly based on comments and additional information received from agencies and the public since publishing the Draft EIS in October 2009. New studies were conducted for water quality, channel morphology, groundwater, riparian and wetland areas, aquatic biological resources, and socioeconomics. Although the Final EIS was updated in many areas in response to comments received on the Draft EIS and new data provided, the resource areas that were revised most significantly include Surface Water, Channel Morphology, Water Quality, Groundwater, and Aquatic Biological Resources. Hydrologic impacts directly or indirectly caused by an action alternative were analyzed based on a comparison of data for Full Use of the Existing System and each of the action alternatives. Full Use of the Existing System was used as the basis against which Moffat Project effects were compared because it reflects hydrologic conditions at the time the Moffat Project would come on line. Because reasonably foreseeable future actions (RFFAs) are anticipated to occur between Current Conditions (2006) and when the Moffat Project would come on line, it is appropriate to compare the action alternatives to Full Use of the Existing System as opposed to Current Conditions (2006) to identify effects that are specifically due to the alternatives since there would be effects attributable to RFFAs. The effect of Project alternatives with RFFAs were looked at to analyze total environmental effects. A "Summary" table is provided for several of the lengthier sections of this Executive Summary to provide the reader a quick overview of the topic, especially where substantial new analysis was conducted.

ES.2 COOPERATING AGENCIES (EIS CHAPTER 6)

The Corps requested that three Federal agencies with statutory authority over the proposed Project participate in the NEPA process as cooperating agencies (40 CFR 1501.6 and 1508.5), including the U.S. Environmental Protection Agency (EPA), Federal Energy Regulatory Commission (FERC), and the U.S. Forest Service (USFS). The USFS declined the Corps' request to be a Cooperating Agency in order to protect its ability to receive "intervenor" status in proceedings before FERC related to the Moffat Project. Formal Cooperating Agency agreements were executed between the Corps, FERC and EPA. Although the Corps denied a request by Grand County to be a Cooperating Agency, the Corps did grant Consulting Agency status relative to effects on county resources. After the release of the Draft EIS, the State of Colorado Department of Natural Resources also became a Cooperating Agency to facilitate Federal and State coordination under the Fish and Wildlife Coordination Act. Prior to issuance of the Final EIS, the Colorado Department of Public Health and Environment also became a Cooperating Agency. This offer was extended to facilitate Federal and State coordination for the Section 401 certification process.

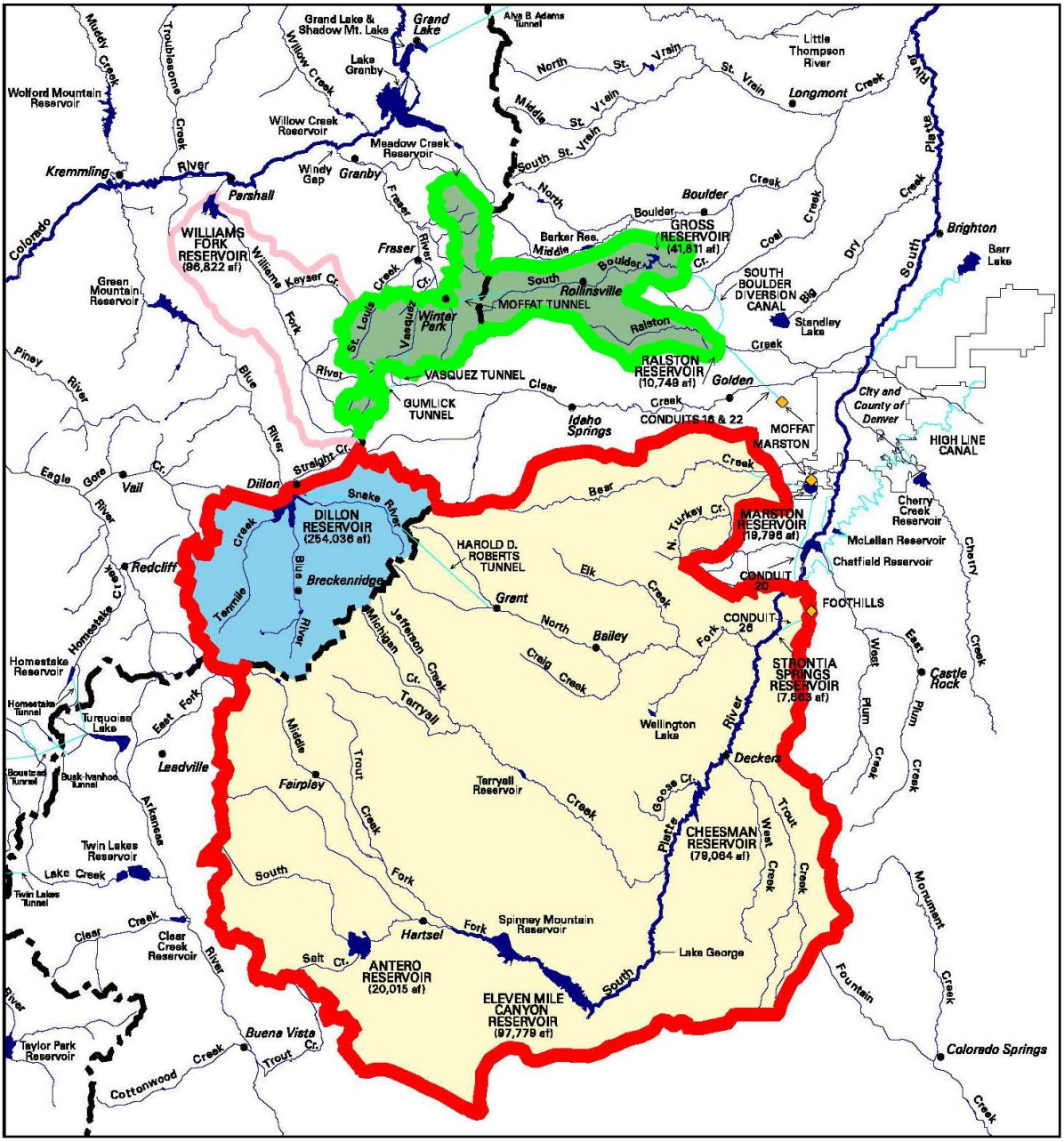
ES.3 PUBLIC AND AGENCY PARTICIPATION (EIS CHAPTER 6)

As required by NEPA, the Corps has provided for an early and open process to determine the scope of significant issues to be addressed in this EIS. Public notification regarding the proposed Moffat Project was initiated with publication of the Notice of Intent (NOI) to prepare an EIS in the *Federal Register* on September 17, 2003. Key dates associated with public and agency participation in the Moffat Project are shown in the accompanying timeline graphic. There have been many points in the NEPA process that included both public and agency participation. During the scoping period, which began with publication of the NOI, the general public, stakeholder groups, and Federal, State, and county agencies had the opportunity to meet with the Corps and Denver Water. During the public scoping process, information about the proposed Moffat Project and preliminary alternatives was presented and input was given by interested parties that assisted the Corps in the identification of key issues and concerns related to the proposed Moffat Project. Subsequent to publication of the Draft EIS, public open houses/hearings were held to explain the major findings in the analysis of Project alternatives and to provide the public and agencies the opportunity to provide verbal or written comments on the Draft EIS. Based on the comments received on the Draft EIS, additional studies were conducted and additional analysis was included in the Final EIS. Additionally, responses to comments were prepared and are included as Appendix N.

ES.4 PURPOSE AND NEED (EIS CHAPTER 1)

Denver Water's Collection System is composed of two major systems: the North System (also known as the Moffat Collection System) and the South System. These two raw water systems are geographically distinct and are not physically connected (see Figure ES-2).

Figure ES-2
Denver Water's Collection System



Denver Water developed an Integrated Resources Plan (IRP) in 1997, with an update in 2002, to analyze existing and future water supplies and customer demands. Based on the IRP and events such as the 2002 drought and forest fires in publicly-owned watersheds that provide the majority of Denver Water's supply, Denver Water identified four needs in the Moffat Collection System that required resolution.

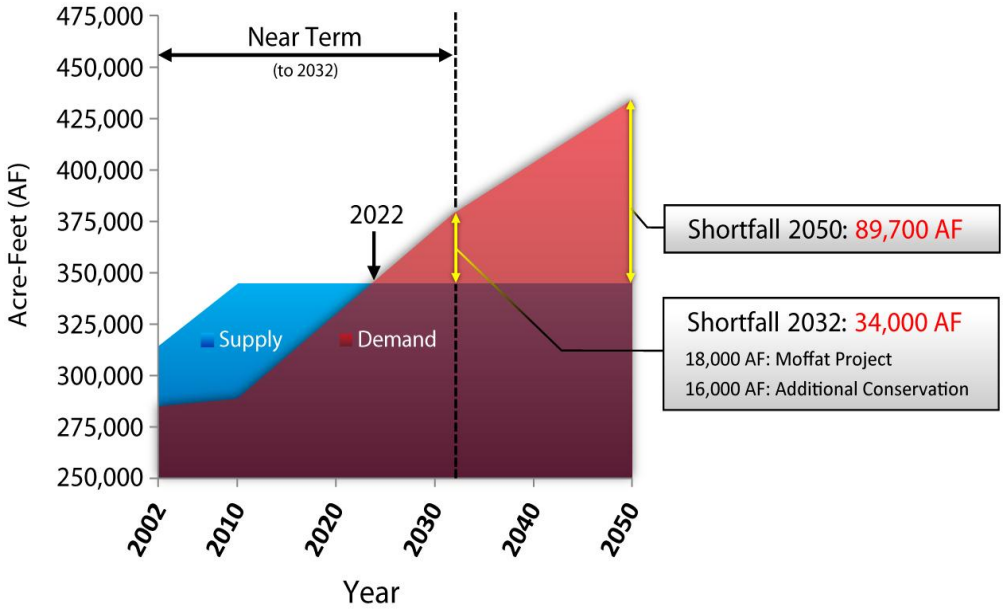
SUMMARY
PURPOSE AND NEED
• Increase **Reliability** of water supply • Reduce **Vulnerability** of water collection system • Increase **Flexibility** within system operations • Meet **Firm Yield** water service obligations

These needs are as follows:

- **The Reliability Need** – Existing water demands served by Denver Water's Moffat Collection System exceed available supplies from the Moffat Collection System during a drought, causing a water supply reliability problem. In a severe drought, even in a single, severe dry year, the Moffat Water Treatment Plant (WTP)—one of three treatment plants in Denver's system—is at a significant level of risk of running out of water.
- **The Vulnerability Need** – Denver Water's Collection System is vulnerable to man-made and natural disasters because 90 percent (%) of available reservoir storage and 80% of available water supplies rely on the unimpeded operation of Strontia Springs Reservoir and other components of Denver Water's South System.
- **The Flexibility Need** – Denver Water's treated water transmission, distribution, and water collection systems are subject to failures and outages caused by routine maintenance, pipe failures, treatment plant problems, and a host of other unpredictable occurrences that are inherent in operating and maintaining a large municipal water supply system. These stresses to Denver Water's ability to meet its customers' water supply demands require a level of flexibility within system operations that is not presently available.
- **The Firm Yield Need** – Denver Water's near-term (prior to 2032) water resource strategy and water service obligations, which have occurred since the IRP was developed, have resulted in a need for 18,000 acre-feet per year (AF/yr) of new, near-term firm yield. This need was identified after first assuming successful implementation of a conservation program, construction of a non-potable recycling project, and implementation of a system refinement program.

Figure ES-3 shows the demand versus supply relationship for Denver Water's Collection System.

Figure ES-3
Total Annual Denver Water System Demand Versus Supply



ES.4.1 Purpose and Need Statement

The Corps, exercising its independent judgment while considering Denver Water's and the public's perspectives (33 CFR 325, Appendix B.9[b][4]), evaluated and accepted the following Purpose and Need statement as the basis for defining and evaluating alternatives within the Corps' decision-making process (Corps 2004):

> *The purpose of the Moffat Collection System Project is to develop 18,000 acre-feet per year of new, firm yield to the Moffat Treatment Plant and raw water customers upstream of the Moffat Treatment Plant pursuant to the Board of Water Commissioners' commitment to its customers.*

Denver Water's need for the proposed Moffat Project is based on two major issues:

1. **Timeliness: Water Supply Shortage in the Near-Term Timeframe (Prior to 2032)** – Beginning in 2022 Denver Water predicts its average annual water demand will exceed available supplies and will grow to 34,000 AF/yr by 2032. This shortfall was determined after analyzing existing supply, projected demand, and savings from system refinements, non-potable reuse, natural replacement, and cooperative projects with other water providers. Of this near-term 34,000 AF/yr shortfall, Denver Water will rely on 16,000 AF/yr forthcoming from the implementation of additional conservation efforts. New firm yield must be identified to meet the remaining shortfall. Denver Water proposes to meet the remaining shortfall with 18,000 AF/yr of newly developed supplies.
2. **Location: Need for Water to the Moffat Water Treatment Plant and Raw Water Customers** – Approximately 90% of the available reservoir storage and 80% of the available water supplies rely on the South System. This existing imbalance in reservoir

storage and water supplies between the North and South systems has created water supply challenges that have resulted in:

- Unreliable water supply for the Moffat WTP and Moffat Collection System raw water customers
- System-wide vulnerability issues
- Limited operational flexibility of the treated water system

To address the two major issues, Denver Water is pursuing the proposed Moffat Project to provide 18,000 AF/yr of new, firm yield to the Moffat WTP. The proposed Project would address both the overall near-term water supply shortage, and the existing imbalance in water storage and supply between the North and South systems.

ES.5 ALTERNATIVES ANALYSIS (EIS CHAPTER 2)

The Council on Environmental Quality (CEQ) NEPA regulations require that an EIS "rigorously explore and objectively evaluate all reasonable alternatives," including the No Action Alternative (40 CFR 1502.14[(a] and [d]). Reasonable alternatives, as defined by the CEQ, are "those that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant." In contrast to reasonable alternatives under NEPA, the Corps' Section 404(b)(1) Guidelines define practicable alternatives as "available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purposes" (40 CFR 231.10[a]). These guidelines are the substantive environmental standards by which all Section 404 Permit applications are evaluated.

By integrating the alternatives analysis for actions subject to NEPA and the Section 404(b)(1) Guidelines early in the process, it helped ensure that the range of alternatives carried forward for detailed analysis in the EIS process met the Purpose and Need, and were practicable and reasonable.

ES.5.1 Screening

The alternative screening process for the Moffat Project was conducted in accordance with both NEPA and the Section 404(b)(1) Guidelines. The identification, verification, evaluation, and screening of all known alternatives were conducted by the Corps, with review and input from EPA and FERC as cooperating agencies and from Grand County as a Consulting Agency. The overall screening approach was performed in two phases—Screen 1 and Screen 2.

Screen 1 progressed from a broad range of 303 potential water supply and infrastructure components to 34 well-defined Project alternatives using numerous evaluation criteria related to Purpose and Need, existing technology, logistics, costs, and environmental consequences.

Screen 2 involved a more in-depth analysis of the Project alternatives using criteria focused on environmental impacts to the aquatic environment and other natural ecosystems. The results of Screen 2 were a set of five alternatives carried forward for further analysis in the EIS. After the alternatives screening process was completed, components of the five alternatives were further refined and revised as Denver Water developed additional detail

based on further investigations and engineering studies. These five alternatives represent a reasonable range of practicable alternatives that encompass a variety of potential water supplies and storage sites. Each action alternative was configured to increase the firm yield of Denver Water's system by 18,000 AF/yr, consistent with the Project Purpose and Need statement.

ES.5.2 Alternatives

The five action alternatives plus the No Action Alternative analyzed in the EIS are summarized in the table below. Refer to Chapter 2 of the EIS for detailed descriptions of the alternatives.

SUMMARY	
ALTERNATIVES	
Alternatives	**Description**
Proposed Action (Alternative 1a)	**Major Components:** Expansion of existing Gross Reservoir. **Water Supply:** 18,000 AF/yr of new firm yield would be developed, in part, by storing additional water in Gross Reservoir diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years. **Water Storage:** Expanded Gross Reservoir with an Environmental Pool for mitigation: dam raise of 131 feet (including 6 feet for the Environmental Pool); and additional storage capacity of 77,000 acre-feet (AF) (including the 5,000 AF for the Environmental Pool).
Alternative 1c	**Major Components:** Expansion of existing Gross Reservoir; construction of new Leyden Gulch Reservoir. **Water Supply:** 18,000 AF/yr of new firm yield would be developed, in part, by storing additional water in Gross and Leyden Gulch reservoirs diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years. **Water Storage:** Expanded Gross Reservoir: dam raise of 85 feet; additional storage capacity of 40,700 AF. New Leyden Gulch Reservoir: new 177-foot high earth-filled dam; new storage volume of 31,000 AF. **General:** Construction of a new Leyden Gulch Reservoir would require a 1-mile relocation of the existing South Boulder Diversion Canal, and relocation of approximately 4,000 feet of State Highway (SH) 93.

SUMMARY	
ALTERNATIVES (continued)	
Alternative 8a	**Major Components:** Expansion of existing Gross Reservoir; new diversion structure and gravel pit storage facilities along the South Platte River. New Advanced Water Treatment Plant (AWTP) and new conduit from the AWTP to the Moffat Collection System. **Water Supply:** 13,000 AF/yr of new firm yield would be developed, in part, by storing additional water in Gross Reservoir diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years. Approximately 5,000 AF/yr of new firm yield from reusable return flows in the South Platte River. **Water Storage:** Expanded Gross Reservoir: dam raise of 101 feet; additional storage capacity of 52,000 AF. Gravel pit storage facilities along the South Platte River with a storage volume of approximately 5,000 AF. **General**: Alternative 8a would require construction of a new major diversion in the South Platte River; the 36-inch pipeline from the AWTP to the Moffat Collection System would be approximately 26 miles long.
Alternative 10a	**Major Components:** Expansion of existing Gross Reservoir; new AWTP, pipelines, and approximately 81 new injection/recovery wells located at 27 separate sites to be used for deep aquifer storage and recovery of reusable return flow. **Water Supply:** 13,000 AF/yr of new firm yield would be developed, in part, by storing additional water in Gross Reservoir diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years. Approximately 5,000 AF/yr of new firm yield of reusable return flow from the existing Denver Recycling Plant. **Water Storage**: Expanded Gross Reservoir: dam raise of 101 feet; additional storage capacity of 52,000 AF. Deep aquifer storage and recovery of approximately 20,000 AF (5,000 AF of firm yield) of reusable return flows. **General:** Construction of injection/recovery wells at 27 separate sites would require approximately 36 miles of new pipelines and a new 18-mile long, 36-inch pipeline from the AWTP to the Moffat Collection System.

SUMMARY	
ALTERNATIVES (continued)	
Alternative 13a	**Major Components:** Expansion of existing Gross Reservoir; purchase and transfer of existing South Platte River agricultural water rights stored in gravel pit storage facilities; new AWTP and new conduit from the AWTP to the Moffat Collection System. **Water Supply:** 15,000 AF/yr of new firm yield would be developed, in part, by storing additional water in Gross Reservoir diverted from the Fraser and Williams Fork rivers (using the Moffat Tunnel) and South Boulder Creek in wet and average years. Purchase and transfer of South Platte River existing agricultural water rights to supply 3,000 AF/yr of new firm yield. **Water Storage:** Expanded Gross Reservoir: dam raise of 110 feet; additional storage capacity of 60,000 AF. Gravel pit storage facilities along the South Platte River with a storage volume of approximately 3,625 AF (to produce 3,000 AF/yr of firm yield). **General:** Alternative 13a would require construction of a new major diversion in the South Platte River; the 30-inch diameter pipeline from the AWTP to the Moffat Collection System would be approximately 25 miles long.
No Action Alternative	In the event a Section 404 Permit is not issued for the Moffat Project, Denver Water would continue to develop and implement its conservation, non-potable recycling, system refinements, and cooperative action projects as described in the 2002 IRP. It is assumed that even with these measures that demand would exceed supply in the near future (currently estimated to be around 2022). Denver Water would use a variety of strategies to meet the need for additional supply, including using a portion of the Strategic Water Reserve and imposing more frequent and severe mandatory water restrictions.

ES.6 TOTAL ENVIRONMENTAL EFFECTS (EIS CHAPTER 4)

The total environmental effects (cumulative) analysis for this Project evaluated past, present, and reasonably foreseeable future water- and land-based actions that continue to influence existing environmental conditions. Generally, past and present projects were included in the analysis if they overlap in geographic boundary where the effects from the Moffat Project alternatives are expected to occur. The cumulative effects analysis also included reasonably foreseeable water- or land-based actions that, when combined with one of the action alternatives, may result in a cumulative effect on the environment. Future actions were included if they overlap geographically with the Moffat Project area, could impact the same resources, and have a reasonable certainty of occurring. Many of the identified future water-based actions were included in the Platte and Colorado Simulation Model (PACSM) and were thereby included in the analysis for the Project alternatives, including the No Action Alternative. Cumulative effects were analyzed for all resources.

SUMMARY

TOTAL ENVIRONMENTAL EFFECTS

- The total environmental effects (cumulative) analysis includes the Moffat Project in combination with other past, present, and RFFAs that would impact the same environmental resources within the same geographic extent.
- Timeframes used in the hydrologic modeling for evaluation of total environmental effects included Current Conditions (2006) which reflects current administration of the Colorado and South Platte river basins, and Full Use of Denver Water's system with the Moffat Project completed and operating. This scenario includes RFFAs.

ES.6.1 Reasonably Foreseeable Future Actions, Water- and Land-based Projects and Geographic Boundaries

Cumulative effects analyses were conducted for past, present, and reasonably foreseeable future land- and water-based actions. Geographically, cumulative effects resulting from water-based actions are likely to occur on both the East and West slopes, thus, cumulative effects were evaluated within the local operational and socio-political boundaries of these activities. The effects of land-based actions are limited to the Front Range (East Slope) since no Project-related ground-disturbing activities would occur on the West Slope. Land-based actions were identified by reviewing various city and county comprehensive plans, recreation management plans, proposed transportation improvement project plans, regional population statistics, and land parcel database searches.

Reasonably Foreseeable Future Actions, Water-Based

Several water-based actions on the East and West slopes were considered in the evaluation of cumulative hydrologic effects:

East Slope

- Halligan-Seaman Water Supply Project
- Northern Integrated Supply Project (NISP)
- Denver Water Reuse Project
- City of Aurora Prairie Waters Project
- Rueter-Hess Reservoir

- Dry Creek Reservoir Project
- Chatfield Reservoir Storage Reallocation Project
- Augmentation of Lower South Platte Wells
- East Cherry Creek Valley Project
- Cache la Poudre Flood Reduction and Ecosystem Restoration Project
- Water Infrastructure and Supply Efficiency (WISE)

West Slope

- Windy Gap Firming Project (WGFP)
- Urban Growth in Grand and Summit Counties
- Reduction of Xcel Energy's Shoshone Power Plant Call
- Changes in Releases from Williams Fork and Wolford Mountain Reservoirs to Meet U.S. Fish and Wildlife Service (USFWS) Flow Recommendations for Endangered Fish in the 15-Mile Reach
- Wolford Mountain Reservoir Contract Demand
- Expiration of Denver Water's Contract with Big Lake Ditch in 2013
- Colorado Springs Utilities' Substitution and Power Interference Agreements at Green Mountain Reservoir
- 10,825 Water Supply Alternatives
- Colorado River Cooperative Agreement (CRCA)
- Fish and Wildlife Enhancement Plan

Water-based actions refer to proposed water storage and diversion, water rights changes, and Section 404 activities on Colorado's East and West slopes.

Reasonably Foreseeable Future Actions, Land-Based

Future land-based actions considered for the cumulative effects analysis included construction of residential, commercial, and industrial structures; construction and expansion of city, county, State, and Federal roads and highways; and gravel mining. The following descriptions of future land-based actions provide information on regional development trends that, in turn, provide context for Moffat Project impacts.

Climate Change

Climate change and global warming may be considered reasonably foreseeable, but currently there is no accepted scientific method for taking the general concepts associated with climate change and transforming them into incremental changes in stream flow or reservoir levels. Research on procedures to more accurately predict effects of climate change on stream flow are ongoing. Denver Water, as well as other water managers, continue to evaluate climate change scenarios in relation to water supply risk, and will continue to respond to new information as it becomes available.

Environmental Pool

Under the Proposed Action, a 77,000 AF enlargement would be constructed at Gross Reservoir. Of the 77,000 AF enlargement, 72,000 AF would be utilized to provide new firm yield to Denver Water's system and 5,000 AF would be an Environmental Pool for mitigation. The estimated ground disturbance for the Proposed Action conservatively assumed the inundation area (i.e., the area between elevation 7,282 and 7,400 feet), plus 10 feet above the expanded reservoir pool to account for potential tree removal and other construction-related activities. The additional area of inundation associated with the Environmental Pool (i.e., the area between elevation 7,400 and 7,406 feet) is within the impact area. Thus, the impact analysis of ground-disturbance associated with the Proposed Action with or without the Environmental Pool would be the same. The environmental effects discussed for surface water correspond with the 72,000 AF enlargement whereas the operations and effects associated with the Environmental Pool are discussed in Appendices H-22 and M-2 of the Final EIS, and were independently evaluated by Corps. Additional analysis conducted by the Corps for recreation and aquatic biological resources associated with the Environmental Pool are also presented in Appendices H-22 and M-2. In summary, the environmental effects of a 77,000 AF expansion are expected to be similar to the 72,000 AF expansion.

ES.6.2 Surface Water

SUMMARY
TOTAL ENVIRONMENTAL EFFECTS – SURFACE WATER
• Total environmental effects include a Moffat Project alternative along with other RFFAs that are anticipated to be on line at the time a Moffat Project alternative is implemented (Moffat Project with RFFAs). • On the West Slope, the WGFP and the Shoshone Call reduction would have the greatest cumulative effect on stream flows when added to the effects of the Moffat Project with RFFAs. • On the East Slope, projects that would have the greatest cumulative effect on South Platte River flows when added to the effects of the Moffat Project include the Denver Water Reuse Project, WISE, City of Aurora Prairie Waters Project, and NISP. • Changes in stream flow would be greatest in the Fraser and Williams Fork river basins during average and wet years. The Fraser and Williams Fork rivers would experience moderate impacts, except for several of the upper tributaries in both of those river basins where moderate to major impacts would occur in average to wet years. • More than half of the change in flow in the Colorado River below the Windy Gap diversion would be due to the combined effects of RFFAs including the WGFP and increases in Denver Water's diversions in the Fraser River Basin as its demand increases prior to implementing the Moffat Project. • In the Blue River Basin, the majority of the changes in flow are due to increases in Denver Water's diversions as their demand increases prior to implementing the Moffat Project.

SUMMARY
TOTAL ENVIRONMENTAL EFFECTS – SURFACE WATER (continued)
• Flows in South Boulder Creek upstream of Gross Reservoir would increase in average and wet years during runoff months due to Denver Water's additional diversions through the Moffat Tunnel. From Gross Reservoir downstream to the South Boulder Diversion Canal, changes in stream flow would reflect seasonal and long-term variations in water demands, hydrologic conditions and Denver Water operations of Gross Reservoir to meet those demands. • The majority of the changes in flow in the North Fork South Platte River and South Platte River would be due to increases in Denver Water's diversions as its demand increases prior to implementing the Moffat Project.

In addition to the changes in stream flows and reservoir contents that are attributable to the action alternatives and No Action Alternative, there would be effects on surface water resources due to RFFAs that are anticipated to come on line prior to Denver Water implementing a Project alternative.

In the Colorado River Basin, the WGFP and Shoshone Call reduction would likely have the greatest cumulative effect on flows when added to the effects of the Moffat Project with RFFAs. The effects of the WGFP would occur primarily in above average and wet years due to additional diversions at the WGFP diversion site on the Colorado River. The WGFP and Moffat Project with RFFAs would decrease flows in average and wet years and then primarily during the wettest months of the year. The hydrologic effects of the Shoshone Call reduction would occur primarily in dry years, because more diversions would be made in priority upstream of Shoshone, and releases from Green Mountain, Williams Fork, and Wolford Mountain reservoirs for exchange and substitution purposes would be less.

In the South Platte River Basin, most reasonably foreseeable projects rely on water supplies from trans-mountain imports or transferred agricultural water. Projects like the Halligan-Seaman Water Supply Project, which rely to a large degree on transferred agricultural rights, should not affect South Platte River flows since historical return flows must be maintained to prevent injury. Projects that would have the greatest cumulative effect on South Platte River flows when added to the effects of the Moffat Project include the Denver Water Reuse Project, WISE, City of Aurora's Prairie Waters Project, and NISP. The Denver Water Reuse Project, WISE, and Aurora's Prairie Waters Project will decrease South Platte River flows as Aurora and Denver Water make more use of their reusable return flows.

NISP would decrease flows in the Cache la Poudre River and the lower South Platte River due to NISP's reliance on the development of existing and/or new conditional water rights for diversion and exchange of native river water.

Estimated flow changes compared to Current Conditions in each affected river basin are generally described below.

In the Williams Fork and Fraser river basins, cumulative effects to surface water are considered moderate, with the exception of several upper tributaries of both those basins where moderate to major effects to stream flow could be expected during average to wet years. In general, the majority of flow decreases would be due to Denver Water's

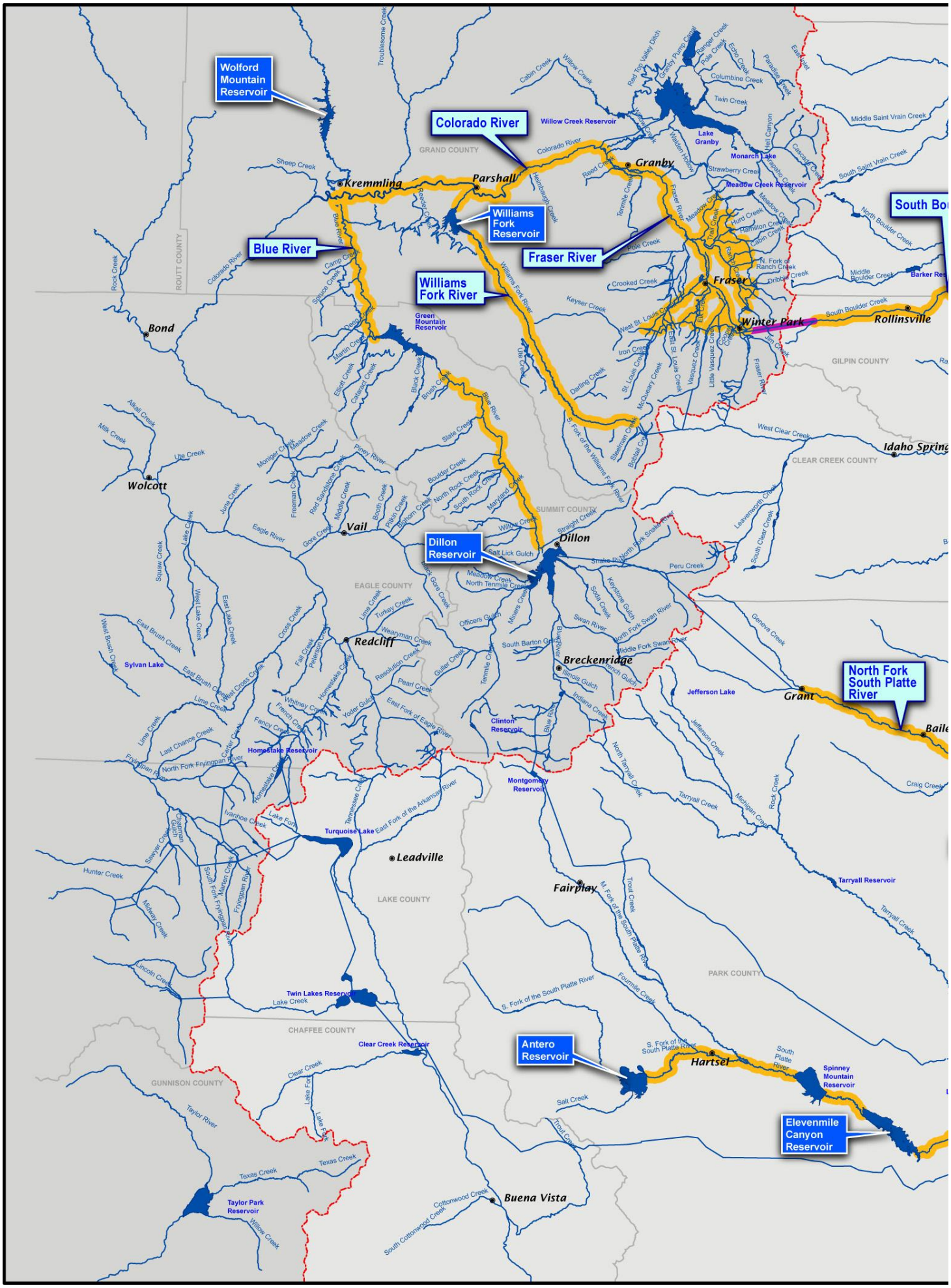
additional diversions with the Moffat Project with RFFAs with the exception of Vasquez Creek where additional diversions due to growth in municipal and industrial demands are anticipated to be significant. Average annual flows high in the Fraser River Basin below Denver Water's diversion from the Fraser River would decrease from 5,300 AF under Current Conditions to 4,900 AF (8%) under Full Use of the Existing System and 3,400 AF (35%) under the Proposed Action with RFFAs. Average annual flows at the Vasquez Creek gage would decrease from 10,500 AF under Current Conditions to 7,300 AF (30%) under Full Use of the Existing System and 5,000 AF (53%) under the Proposed Action with RFFAs. Average annual flows at the William Fork near Leal gage would decrease from 66,500 AF under Current Conditions to 65,600 AF (1%) under Full Use of the Existing System and 63,700 AF (4%) under the Proposed Action with RFFAs.

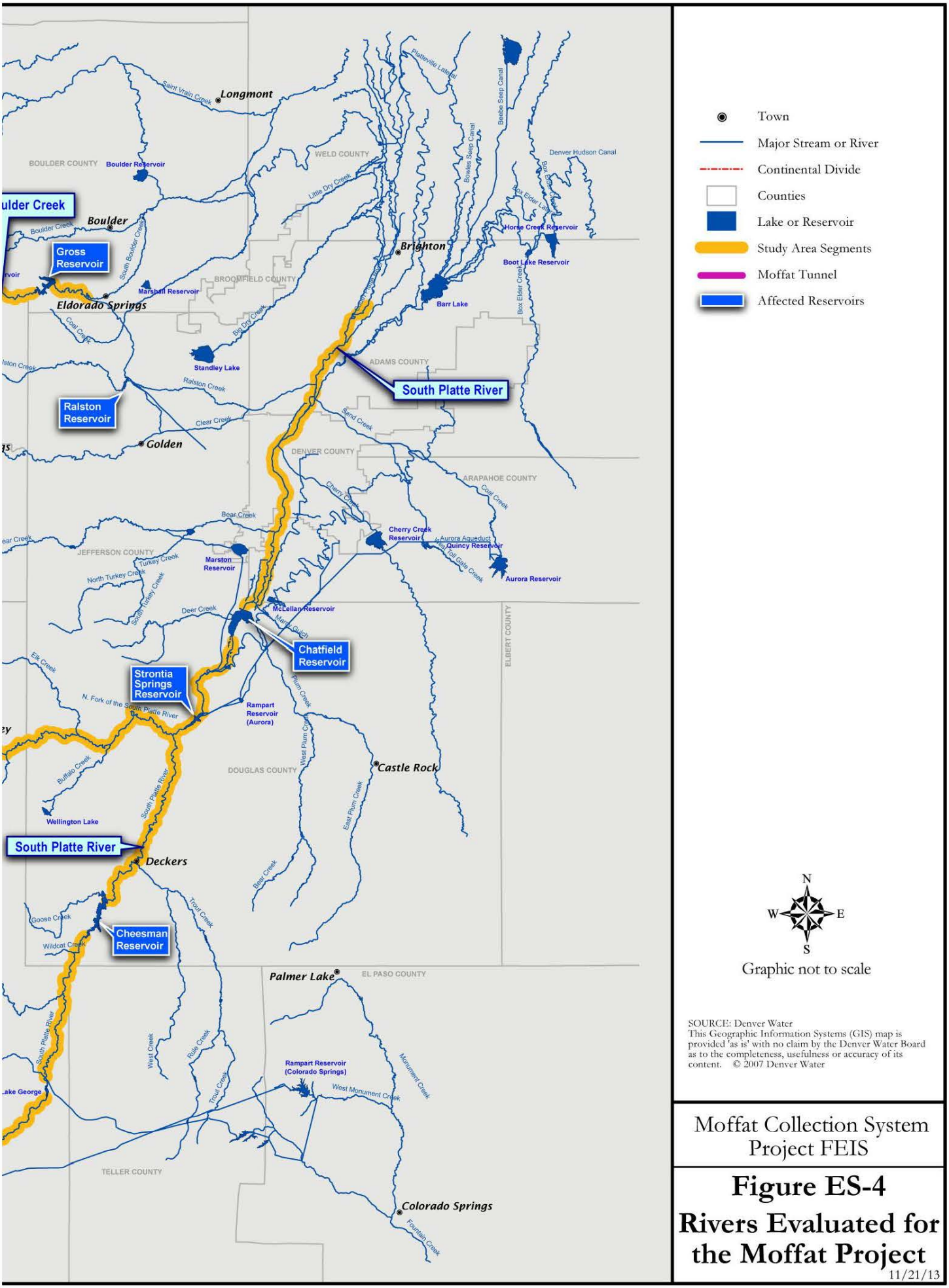
More than half of the change in flow in the Colorado River below the Windy Gap diversion would be due to the combined effects of RFFAs including the WGFP and increases in Denver Water's diversions in the Fraser River Basin as their demand increases prior to implementing the Proposed Action with RFFAs. Average annual flows in the Colorado River below Windy Gap would decrease from 155,700 AF under Current Conditions to 134,700 AF (13%) under Full Use of the Existing System and 126,800 AF (19%) under the Proposed Action. Average annual flows in the Colorado River near Kremmling gage would decrease from 699,000 AF under Current Conditions to 650,700 AF (7%) under Full Use of the Existing System and 636,300 AF (9%) under the Proposed Action with RFFAs.

In the Blue River Basin, the majority of the changes in flow are due to increases in Denver Water's diversions as their demand increases prior to implementing the Proposed Action with RFFAs. As Denver Water's demand increases prior to a Moffat Project coming on line, Denver Water would rely heavily on their Blue River supplies. Average annual flows in the Blue River below Dillon Reservoir would decrease from 124,400 AF under Current Conditions to 96,700 AF (22%) under Full Use of the Existing System and 91,900 AF (26%) under the Proposed Action with RFFAs. The average annual magnitude of flow changes below Green Mountain Reservoir would be similar to below Dillon Reservoir; however, the timing would be different due to Green Mountain Reservoir operations.

Flows in South Boulder Creek upstream of Gross Reservoir would increase in average and wet years during runoff months due to Denver Water's additional diversions through the Moffat Tunnel. The majority of the change in flow would be attributable to the Proposed Action with RFFAs. Average annual flows in South Boulder Creek at the Pinecliffe gage (above Gross Reservoir) would increase from 106,000 AF under Current Conditions to 108,800 AF (3%) under Full Use of the Existing Conditions and 119,000 AF (12%) under the Proposed Action with RFFAs. From Gross Reservoir downstream to the South Boulder Diversion Canal, changes in stream flow would reflect seasonal and long-term variations in water demands, hydrologic conditions and Denver Water operations of Gross Reservoir to meet those demands. Average annual flows below Gross Reservoir would increase from 111,500 AF under Current Conditions to 114,100 AF (2%) under Full Use of the Existing Conditions and 123,800 AF (11%) under the Proposed Action. Downstream of the South Boulder Diversion Canal changes in flow would be minor and similar to those described above for the Proposed Action with RFFAs.

Figure ES-4 shows the river segments evaluated in the Moffat Project area.


Wolford Mountain Reservoir
Colorado River
Willow Creek Reservoir
Blue River
Williams Fork Reservoir
Fraser River
Williams Fork River
Green Mountain Reservoir
Dillon Reservoir
North Fork South Platte River
Jefferson Lake
Clinton Reservoir
Homestake Reservoir
Montgomery Reservoir
Turquoise Lake
Twin Lakes Reservoir
Clear Creek Reservoir
Taylor Park Reservoir
Antero Reservoir
Spinney Mountain Reservoir
Elevenmile Canyon Reservoir
Tarryall Reservoir
Meadow Creek Reservoir
Monarch Lake
Lake Granby
Sylvan Lake
Leadville
Fairplay
Hartsel
Buena Vista
Kremmling
Parshall
Granby
Fraser
Winter Park
Rollinsville
Idaho Springs
Bond
Wolcott
Vail
Dillon
Redcliff
Breckenridge
Grant
GRAND COUNTY
ROUTT COUNTY
GILPIN COUNTY
CLEAR CREEK COUNTY
SUMMIT COUNTY
EAGLE COUNTY
LAKE COUNTY
CHAFFEE COUNTY
GUNNISON COUNTY
PARK COUNTY



SOURCE: Denver Water
This Geographic Information Systems (GIS) map is provided 'as is' with no claim by the Denver Water Board as to the completeness, usefulness or accuracy of its content. © 2007 Denver Water

Moffat Collection System Project FEIS

Figure ES-4
Rivers Evaluated for the Moffat Project

11/21/13

Flows in the North Fork South Platte River would decrease on average during winter months and increase during summer months. The majority of the changes in flow would be due to increases in Denver Water's diversions as their demand increases prior to implementing the Proposed Action with RFFAs. Average annual flows in the North Fork South Platte River below Geneva Creek gage would increase from 117,500 AF under Current Conditions to 143,800 AF (22%) under Full Use of the Existing Conditions and 148,500 AF (26%) under the Proposed Action with RFFAs. These flow changes would be translated downstream to the confluence with the South Platte River.

Flows in the South Platte River would change due to additional direct diversions and exchanges to Strontia Springs Reservoir and Conduit 20, changes in Moffat WTP operations, and the load shift between Denver Water's northern and southern WTPs. The majority of the changes in flow would be due to increases in Denver Water's diversions as their demand increases prior to implementing the Proposed Action with RFFAs. The greatest change in flow would occur below Chatfield Reservoir. Average annual flows in the South Platte River below Chatfield Reservoir would decrease from 122,200 AF under Current Conditions to 109,200 AF (11%) under Full Use of the Existing Conditions and 106,900 AF (13%) under the Proposed Action with RFFAs. Decreases in flow would be less downstream due to additional effluent returns at the Littleton-Englewood (Bi-City) Wastewater Treatment Plant (WWTP) and Metro Wastewater Reclamation District Plant (Metro WWTP). Average annual flows in the South Platte River at Henderson gage would decrease from 286,000 AF under Current Conditions to 279,300 AF (2%) under Full Use of the Existing Conditions and 283,600 AF (1%) under the Proposed Action with RFFAs.

Estimated changes in affected reservoirs and floodplains when compared to Current Conditions (2006) would be similar to the changes described above for the Proposed Action with RFFAs.

ES.6.3 Water Quality

SUMMARY
TOTAL ENVIRONMENTAL EFFECTS – WATER QUALITY
• The anticipated impacts for all three water bodies in the Three Lakes are predicted to be minor in dry and most average years, to moderate in wet years and some average years. This is based on predicted increases in Chlorophyll *a* in Grand Lake (up to a 0.6 microgram per liter [µg/L] increase in the annual average) and Shadow Mountain Reservoir (up to a 0.9 µg/L increase in the annual peaks); decreases in Secchi depth in Grand Lake (up to a 0.4 meter decrease); and decreases in dissolved oxygen (DO) concentrations in Shadow Mountain Reservoir and Granby Reservoir (up to a 0.5 milligram per liter decrease). • Gross Reservoir may experience short-term water quality impacts, including increased concentrations of methylmercury, due to inundation of new areas. The duration of such effects is uncertain. Cumulative long-term impacts to Gross Reservoir water quality are not anticipated. • The Fraser River and its tributaries would have negligible to moderate adverse cumulative effects with regard to stream temperature based on currently available data and methods.

SUMMARY
TOTAL ENVIRONMENTAL EFFECTS – WATER QUALITY (continued)
• Increases in total nitrogen and decreases in total phosphorus in the Fraser River would result in moderate to major adverse cumulative effects. These changes in nutrient concentrations are primarily attributable to changes in WWTP flow rates (with population growth) and concentrations (with anticipated changes in treatment efficiency). • The Colorado River would experience negligible to moderate adverse cumulative impacts with regard to stream temperature; however, an increase in the frequency of days in which the daily maximum or the maximum weekly average temperature exceed the standard is not anticipated based on currently available data and methods. • A minor increase in the acute and chronic low flow rates on the Blue River would occur due to increased releases from Dillon Reservoir. No impacts to the Joint Sewer Authority WWTP permit are anticipated as a result of changes in releases from Dillon Reservoir. • South Boulder Creek would experience moderate to major changes in stream temperature between Gross Reservoir and the South Boulder Creek Diversion to Ralston Reservoir. Specifically, summertime outflow temperatures from Gross Reservoir would be colder due to reservoir expansion. Other water quality effects on South Boulder Creek are expected to be short term in nature and minor to negligible. • Metal concentrations would decrease in the North Fork South Platte River during periods of increased flow from additional Roberts Tunnel diversions, and increase in lower flow periods resulting in both beneficial and adverse cumulative effects. • Negligible to minor cumulative effects on water quality in the South Platte River are anticipated.

Modified operations of existing reservoirs to meet multi-purpose water demands and non-consumptive needs may affect stream and reservoir water quality. Cumulative effects on water quality that are not related to action alternatives are not anticipated for Gross Reservoir. Cumulative impacts to the Three Lakes (Grand Lake, Shadow Mountain Reservoir, and Granby Reservoir) are predicted to be minor (in dry and most average years) to moderate, in wet years and some average years. This is based on predicted increases in chlorophyll *a* in Grand Lake (up to 0.6 µg/L increase in the annual average) and Shadow Mountain Reservoir (up to 0.9 µg/L increase in the annual peaks); decreases in Secchi depth in Grand Lake (up to a 0.4 meter decrease); and decreases in DO concentrations in Shadow Mountain Reservoir and Granby Reservoir (up to a 0.5 µg/L decrease). Note that Shadow Mountain Reservoir is currently on the Section 303(d) List for being impaired with respect to DO.

Cumulative effects on stream water quality are focused on the Fraser, Blue and Colorado rivers due to the combined effects of additional in-basin water use, average and wet year trans-basin diversions, and additional wastewater discharges. Cumulative effects in the form of moderate to major increases of nitrogen concentrations and decreases of phosphorus concentrations in the mainstem of the Fraser River are anticipated. Moderate increases of nitrogen and phosphorus concentrations in Ranch Creek and minor to negligible increases in Crooked Creek are also anticipated. All of these nutrient concentrations impacts on the Fraser River, Ranch Creek, and Crooked Creek are primarily attributable to anticipated changes in WWTP flow rates (with population growth) and

concentrations (with anticipated changes in treatment efficiency). Moderate to major cumulative effects on water temperature are anticipated in South Boulder Creek as a result of the Proposed Action. No cumulative effects are anticipated from any of the RFFAs.

Continued cooperation among in-basin water users and operators of trans-basin diversions may be key to avoiding exceeding stream standards (including potential new nutrient standards). Emerging reservoir management strategies for the Three Lakes system and for Dillon Reservoir (the latter through the provisions of the CRCA) combined with advances in WWTPs and stream temperature monitoring will tend to offset future water-quality degradation.

ES.6.4 Channel Morphology

SUMMARY
TOTAL ENVIRONMENTAL EFFECTS – CHANNEL MORPHOLOGY
• For Full Use of the Existing System, the No Action Alternative and the Moffat Project with RFFAs, there would be a decrease in flow and a corresponding decrease in sediment transport capacity and supply in the Fraser, Williams Fork, Blue and Colorado rivers when compared to Current Conditions (2006). • Sediment transport capacity and supply are predicted to increase in South Boulder Creek, the North Fork South Platte River, and Vasquez Creek upstream of Denver Water's diversion in the Fraser River Basin. • Long-term impacts are expected to be negligible as analyses suggest that sufficient flows and large, infrequent flood events would remain and continue to mobilize sediment and retain long-term channel morphology. • Negligible to moderate impacts may occur under Full Use of the Existing System, but would be less pronounced than under the Moffat Project with RFFAs and the No Action Alternative. • Negligible to moderate impacts may occur under the No Action Alternative, but would be less pronounced than under the Proposed Action with RFFAs. • Negligible to moderate impacts may occur under the Moffat Project with RFFAs. Impacts would be more pronounced than under Full Use of the Existing System or the No Action Alternative.

Potential impacts to channel morphology predicted as a result of Full Use of the Existing System, the No Action Alternative and the Moffat Project with RFFAs were evaluated utilizing a variety of physical and numeric assessment methods. Physical assessments included site observations, review of historic aerial and ground photographs, gage analysis and survey data. Numeric computations included calculation of sediment transport capacity, sediment supply and effective discharge. Predicted changes in the frequency and duration of flows that initiate mobilization of the stream bed (Phase 2 sediment transport) and peak 5- and 10-year flood flows were also evaluated. The assessment included detailed evaluation of representative sites within the Fraser, Williams Fork, Colorado, Blue and North Fork South Platte rivers, and South Boulder Creek.

Given Full Use of the Existing System, the No Action Alternative and the Moffat Project with RFFAs, decreases in flow would result in a decrease in sediment transport capacity and sediment supply along the Fraser, Williams Fork, Blue, and Colorado rivers

downstream of Denver Water's diversions. Sediment transport capacity and sediment supply are predicted to increase in South Boulder Creek and North Fork South Platte River, as well as in Vasquez Creek (within the Fraser River Basin) upstream of Denver Water's diversion due to increased flows. Areas with flow decreases would have less capacity to convey sediment; they are also predicted to have less sediment in the system. Changes in calculated effective discharge, which is related to transport capacity and supply, were found to be variable at different locations. As a general rule, the recurrence interval of effective discharge is predicted to increase in areas where flows are expected to decrease, and decrease in areas where flows are expected to increase.

The recurrence interval of Phase 2 sediment transport is generally expected to increase in areas where flow reductions are predicted and decrease in areas where flow increases would occur. An increase in recurrence interval indicates that Phase 2 transport would not occur as often. The number of years between Phase 2 transport events is predicted to either remain consistent or increase in areas where flow decreases are predicted, and remain consistent or generally decrease in areas where flow increases are predicted. In areas where flow decreases are expected, results of the Phase 2 analysis suggest that the extent and duration of localized sediment deposition may increase as the result of Full Use of the Existing System, the No Action Alternative and the Moffat Project with RFFAs. The relative frequency of Phase 2 flows, however, suggests that this sediment deposition would be temporary in nature and flows sufficient to mobilize the streambed would continue to occur. The exceptions to this are locations immediately below diversions where no bypass flows are maintained. These locations are believed to be already impacted from a channel morphology standpoint and aggradation and/or vegetation encroachment is currently occurring and is likely to continue. Additional diversions at locations with no bypass flows could exacerbate observed channel morphology impacts.

Increases in the frequency of Phase 2 flows in streams where flows are expected to increase could result in additional localized bank instability. Bank instability issues have existed historically at these locations so significant stabilization has been completed. Increased flows may result in the need for minor additional, localized stabilization.

The recurrence interval of large flow events such as the 5- and 10-year flood is generally expected to remain unchanged or increase somewhat in areas where flow decreases are predicted, and remain unchanged or decrease in areas where flow increases are predicted given the Proposed Action with RFFAs. Changes were found to be most pronounced in areas nearer the point of diversion and minimal at other locations.

Full Use of the Existing System

When compared to Current Conditions (2006), flow changes predicted for Full Use of the Existing System are less than flow changes predicted for the No Action Alternative and the Moffat Project with RFFAs. Because sediment transport and channel morphology are influenced by stream flow, changes in sediment transport capacity, sediment supply, effective discharge, Phase 2 sediment transport, and the magnitude of the predicted 5- and 10-year flood flows are predicted to be less for Full Use of the Existing System than for the No Action Alternative and the Moffat Project with RFFAs.

Full Use of the Existing System may result in additional localized sediment deposition in areas where flows would decrease and additional localized bank erosion where flows would

increase when compared to Current Conditions (2006). Negligible to moderate additional deposition and erosion may occur but are predicted to be somewhat less than for the No Action Alternative and the Moffat Project with RFFAs. Results suggest that sufficient flows, including large, infrequent flood events, would remain in areas with decreased flows to continue to mobilize sediment and retain the long-term channel morphology. Stream segments below diversions with no bypass requirements were an exception where peak flows have already been reduced to a point where insufficient flows exist to maintain channel morphology, and aggradation and/or vegetation encroachment is occurring and is likely to continue.

Increased flows in the North Fork South Platte River and South Boulder Creek are predicted to encourage bank instability. Bank instability issues have existed historically at these locations so significant armoring has been completed. Increased flows may result in the need for additional, localized stabilization. The extent of additional armoring anticipated for Full Use of the Existing System is likely to be less than for the No Action Alternative and the Proposed Action with RFFAs.

No Action Alternative

Decreases in flows in the Fraser, Williams Fork, Blue, and Colorado rivers downstream of Denver Water's diversions and increases in flows in South Boulder Creek and North Fork South Platte River as well as in Vasquez Creek (within the Fraser River Basin) upstream of Denver Water's diversion for the No Action Alternative, are expected to be greater than the Full Use of the Existing System but less than the Proposed Action with RFFAs. For this reason, changes in sediment transport capacity, sediment supply, effective discharge, Phase 2 sediment transport and 5- and 10-year peak flows are expected to be greater for the No Action Alternative than Full Use of the Existing System, but less than for the Proposed Action with RFFAs.

The No Action Alternative may result in additional localized sediment deposition in areas where flows would decrease and additional localized bank erosion where flows would increase. Negligible to moderate additional deposition and erosion may occur. Similar to Full Use of the Existing System and the Proposed Action with RFFAs, results suggest that sufficient flows, including large, infrequent flood events, would remain in areas with decreased flows to continue to mobilize sediment and retain the long-term channel morphology. Stream segments below diversions with no bypass requirements were an exception where peak flows have already been reduced to a point where insufficient flows exist to maintain channel morphology and aggradation and/or vegetation encroachment is occurring and is likely to continue. Increased flows in North Fork South Platte River and South Boulder Creek are predicted to encourage bank instability. Bank instability issues have existed historically at these locations so significant armoring has been completed. Increased flows may result in the need for additional, localized stabilization. The extent of additional armoring for the No Action Alternative is likely to be less than for the Proposed Action with RFFAs but greater than Full Use of the Existing System.

Moffat Project Alternatives with RFFAs

Decreases in flows in the Fraser, Williams Fork, Blue, and Colorado rivers downstream of Denver Water's diversions and increases in flows in South Boulder Creek and North Fork South Platte River as well as in Vasquez Creek (within the Fraser River Basin) upstream of

Denver Water's diversion are expected to be greater for the Moffat Project with RFFAs than for Full Use of the Existing System or the No Action Alternative. For this reason, changes in sediment transport capacity, sediment supply, effective discharge, Phase 2 sediment transport and 5- and 10-year peak flows are expected to be greater for the Moffat Project with RFFAs than for the No Action Alternative or Full Use of the Existing System.

The Moffat Project with RFFAs may result in additional localized sediment deposition in areas where flows would decrease and additional localized bank erosion where flows would increase. Negligible to moderate additional deposition and erosion may occur. Similar to Full Use of the Existing System and the No Action Alternative, results suggest that sufficient flows, including large, infrequent flood events, would remain in areas with decreased flows to continue to mobilize sediment and retain the long-term channel morphology. Stream segments below diversions with no bypass requirements were an exception where peak flows have already been reduced to a point where insufficient flows exist to maintain channel morphology and aggradation and/or vegetation encroachment is occurring and is likely to continue. Increased flows in North Fork South Platte River and South Boulder Creek are predicted to encourage bank instability. Bank instability issues have existed historically at these locations so significant armoring has been completed. Increased flows may result in the need for additional, localized stabilization. The extent of additional armoring for the Moffat Project with RFFAs is likely to be greater than for Full Use of the Existing System or the No Action Alternative.

ES.6.5 Groundwater

Potential total effects on groundwater were evaluated in the same manner as impacts from the Moffat Project with RFFAs and the No Action Alternative. Hydraulic modeling indicates the 2-year peak stream flows would decrease in the Fraser River, Colorado River, and Blue River. The Blue River would have the largest temporary reduction in peak stream level during the high runoff season, about 14 inches. For that relatively short period, the river width of the river would decrease by about 10 feet. The Fraser River near Winter Park would experience the next largest change -- the peak stream level would be lowered by about 9 inches and the stream width would decrease by about 4 feet during the high runoff period. At other sites along the potentially affected West Slope stream segments, the reduction in peak stream level would be even smaller, less than about 4 inches. Potentially affected stream segments on the East Slope would have very small increases in peak stream level and width, except for a segment of South Boulder Creek which would have a small decrease, about 2 inches.

The Proposed Action, in combination with other RFFAs, would not affect groundwater levels except downstream of Denver Water's diversions on the West Slope, in areas immediately adjacent to those stream segments. A short-term decline in the stream level may cause a similar decline in the groundwater level adjacent to the stream. However, groundwater recharge rates within each of the West Slope watershed areas would not change substantially during wet and average years, which would maintain groundwater levels at or very near Current Conditions. During dry years, there would be no additional water diversions by Denver Water and thus there would be no impact on groundwater resources.

On the East Slope, groundwater levels would rise slightly near the banks of the potentially affected rivers in wet and average years, but the changes would be within the range of normal seasonal fluctuations. Additional surface water diverted into these streams would be of very high quality, which would not impact groundwater. Thus for each of the potentially affected watersheds, the potential cumulative impacts to groundwater resources would be minimal or less. Any effects would limited to the areas immediately adjacent to the rivers and would only occur during wet and average runoff years, not during dry years.

ES.6.6 Vegetation

Other than the expansion of Gross Reservoir, there is expected to be a limited amount of loss or modification of vegetation in the Gross Reservoir area, and the area is expected to continue to be mostly natural vegetation. The Leyden Gulch reservoir site is within the expected growth corridor of the northwest Denver Metropolitan area, and most of the cumulative impacts would be the result of vegetation losses in future development footprints. The area around the South Platte River Facilities has already been developed and disturbed and is expected to remain in this condition. Agricultural water rights transfers, along with other ongoing development activities, would result in the conversion of irrigated cropland to fallow fields or impermeable surfaces.

ES.6.7 Riparian and Wetland Areas

Impacts to riparian and wetland resources in the Gross Reservoir study area would be the same as those described for the Moffat Project with RFFAs, because no other major development actions are planned. For the river segments, most of the total environmental effects in the Fraser Valley and on South Boulder Creek would be caused by the Moffat Project with RFFAs, while most of the cumulative changes to flows in the Colorado and Blue rivers would occur from other actions including Full Use of Denver Water's system and local growth in water use. Full use of Denver Water's existing system would also contribute to cumulative effects for the Fraser River and its tributaries.

Cumulative effects to riparian and wetland areas are expected to be minor in the other geographic areas affected by the Moffat Project with RFFAs, except for the Front Range/Weld County area where past, present, and future agricultural water right transfers would cause moderate to major cumulative effects.

ES.6.8 Wildlife

Cumulative impacts to wildlife in the Gross Reservoir study area would result almost entirely from expansion of Gross Reservoir, and there are no other RFFAs that would result in more than minor permanent loss of habitat at Gross Reservoir. There would also be moderate cumulative effects to wildlife in the Front Range/Weld County area from the loss of aquatic and mesic habitats associated with the transfer of agricultural water rights under Alternative 13a. Minor cumulative effects to wildlife may occur in other portions of the Project area from the Moffat Project with RFFAs.

ES.6.9 Special Status Species

Construction activities at Gross Reservoir would not have adverse effects to Federally listed species and therefore would not contribute to cumulative effects resulting from past actions.

Construction at Gross Reservoir may affect individuals or habitat of USFS sensitive wildlife species including northern goshawk and flammulated owl, but the Proposed Action would not cause a trend to Federal listing or loss of viability range-wide. Construction would also destroy a large portion of local populations of several Arapaho & Roosevelt National Forests (ARNF) plant species of local concern at Gross Reservoir and may affect their long-term viability on the ARNF, but are unlikely to affect overall occurrence in Colorado. Various projects and activities may affect habitat for Colorado River endangered fish species, including Full Use of Denver Water's existing system. These additional depletions have either already been addressed by previous Endangered Species Act Section 7 consultation or will be addressed by future Section 7 consultations. All projects involving depletions to habitats for Federally listed species along the Platte River in Nebraska will need to comply with the provisions of the Platte River Recovery Agreement, which addresses cumulative impacts. Continued human population growth and development may result in cumulative effects to other endangered species including Preble's meadow jumping mouse and Ute ladies'-tresses, but policies are in place that are protective of these species and their habitats.

ES.6.10 Aquatic Biological Resources

SUMMARY
TOTAL ENVIRONMENTAL EFFECTS – AQUATIC BIOLOGICAL RESOURCES
• The enlargement of Gross Reservoir and the construction of Leyden Gulch Reservoir would provide additional fish habitat creating a beneficial cumulative impact. • Reductions in high flows in the upper sections of the Fraser River upstream of St. Louis Creek would have a cumulative adverse impact to fish and invertebrates. • There would be a cumulative adverse impact to fish and invertebrates in most of the tributaries of the Fraser and Williams Fork rivers due to increased diversions. • There would be negligible cumulative impacts to fish and invertebrates in the mainstem of the Williams Fork and Colorado rivers and much of the Blue River. There would be an adverse cumulative impact in the upper section of the Blue River. • Increased flows in South Boulder Creek above Gross Reservoir and the North Fork South Platte rivers would result in adverse cumulative impacts to fish and invertebrates. • An increase in winter flows in South Boulder Creek below Gross Reservoir and more favorable winter flows in the South Platte River would have a beneficial cumulative impact to fish and invertebrates.

None to minor beneficial cumulative impacts to fish, benthic invertebrates, and their habitats are anticipated to occur for most East Slope stream segments. Exceptions include minor adverse impacts to fish and invertebrates in South Boulder Creek upstream of Gross Reservoir, and moderate adverse impacts in the North Fork South Platte River which could experience increased flows and increased concentrations of copper. Cumulative impacts to aquatic resources in West Slope streams would be negligible, except for minor to moderate adverse impacts to fish and invertebrates in the upper Fraser River, most of the tributaries of the Fraser and Williams Fork rivers, and the Blue River downstream of Dillon Reservoir to Rock Creek. The effects of the reduction in the Shoshone Call would tend to occur 1 out of every 6 or 7 years, usually in dry years, and usually in the spring. The exact

consequences to cumulative hydrology are difficult to predict. However, slight, infrequent reductions in flows during the spring, when there is usually sufficient water to sustain fish and invertebrates, would likely have no additional cumulative effect on aquatic resources as a result of the Project.

ES.6.11 Air Quality

Construction of Moffat Project with RFFAs could result in minor to moderate, short-term cumulative impacts to air quality, and could overlap with other construction or ground-disturbing activities.

ES.6.12 Recreation

Stream flow changes in the Fraser River during average flow years would result in major adverse impacts to the number of days with optimal stream flow for recreational boating use. This is somewhat moderated by the fact that the Fraser River segment has no commercial rafting, and boating use is considered low compared to other rivers in Colorado that experience a substantial amount of boating use, such as the Colorado and Arkansas rivers. A major adverse effect to recreational boating use would also occur on the Blue River. The overall cumulative effects on boating on the Colorado River would be minor. Later season flow reductions would have a minor to moderate adverse cumulative effect on boating use and a minor beneficial impact to the fishing experience on the South Platte River. Beneficial impacts to boating use would occur on South Boulder Creek (above Gross Reservoir) and on the North Fork South Platte.

The Proposed Action with RFFAs would have minor, if any, cumulative effects on recreation at Gross Reservoir. Impacts in the reservoir vicinity would be limited to the direct effects of increasing the size of the reservoir.

The recreational status of the Leyden Gulch Reservoir site would not change with construction of a reservoir; it would remain closed to public uses, including recreation. As such, there would be no cumulative effects to recreation at or near the Leyden Gulch Reservoir site.

ES.6.13 Land Use

Other than direct physical impacts to the Gross Dam and Reservoir footprint, the predominant land-based changes, disturbances, or developments that have occurred or are anticipated to occur are located east of the Front Range foothills. Overall, cumulative impacts to existing and planned land uses from the Proposed Action with RFFAs are anticipated to be negligible.

At the Leyden Gulch Reservoir site, cumulative impacts to land use may occur if planned urban development activities or transportation improvements occur in the general area. Land use in the Leyden Gulch area is currently stable, but the potential for future development is moderate to high. When combined with the impacts of ongoing urban development or transportation improvements, the land use changes resulting from construction of Leyden Gulch Reservoir would result in a cumulatively major modification of existing land use patterns. In this context, the contribution of Leyden Gulch Reservoir

would be a relative minor component of the overall change, but the degree of change would be major.

Agricultural water rights transfer under Alternative 13a would likely occur in Weld County, which is losing agricultural lands at a rapid rate. Although future agricultural land conversion is speculative, it is likely that the acreage proposed for conversion under Alternative 13a would represent a negligible to minor contribution to the overall trend.

ES.6.14 Visual Resources

Other than direct visual impacts to the Gross Dam and Reservoir footprint, the predominant land-based changes, disturbances, or developments that have occurred or are anticipated to occur are located east of the Front Range foothills, and these would have no measurable cumulative effects to visual resources near Gross Reservoir. Construction of Leyden Gulch Reservoir could result in moderate cumulative effects to visual resources due to the potential for other activities in the area such as transportation, residential, and commercial development that could result in changes in existing visual quality.

Given the high amount of visitation in some mountain communities for recreation and tourism, and as retirement destinations, flow reductions in certain times of the year may have minor, indirect effects to the overall experience for visitors and residents. For some stream segments, changes in stream flow may yield minor beneficial effects, depending on the time of year. On the Fraser River, flow reductions during low flow periods would result in major adverse cumulative effects on visual quality. Flow changes in the upper portions of the Williams Fork River during the spring would result in moderate to major adverse cumulative effects. In the fall and winter months, flow decreases would result in minor to moderate adverse cumulative impacts to visual quality on the Blue River and the North Fork South Platte River. Moderate impacts to visual quality would occur on the South Platte River in late summer. During the winter period the cumulative impact is expected to be minor and beneficial.

ES.6.15 Socioeconomics

Population increases are projected to occur in cities, towns, and rural areas of Colorado, including the Denver Metropolitan area, other areas along the Front Range and in Grand County, resulting in residential and commercial development, as well as development of associated infrastructure to support growing communities. Population growth will likely result in demographic changes to these areas, affecting characteristics such as the racial makeup and age distribution of the population, as well as home availability and price. Minor, beneficial, cumulative socioeconomic effects would be experienced throughout the region during construction of water- and land-based Project facilities due to generated employment and income, increased sales tax collections, and other economic factors. Another beneficial effect would be associated with water-based projects helping to meet the existing and future water demands of water users along the Front Range, which also supports economic activity in the region. Water providers in Grand County are expected to face some amount of future water shortage as population growth occurs.

ES.6.16 Other Resources

All other resources evaluated for cumulative effects, including geology, soils, transportation, noise, cultural/paleontological/historical resources, and hazardous materials would experience negligible to minor cumulative effects.

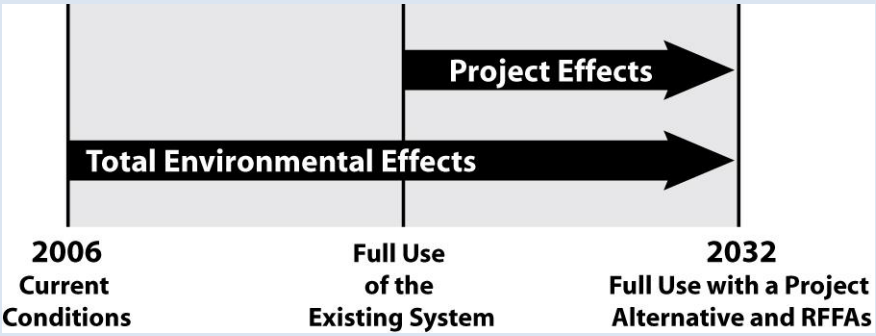
ES.7 MOFFAT PROJECT EFFECTS (EIS CHAPTER 5)

The following sections summarize the potential effects from the Moffat Project on the various resources in the Project area. See Appendix M of the Moffat Project Final EIS for conceptual mitigation components.

SUMMARY

MOFFAT PROJECT EFFECTS

- The direct and indirect impacts expected to occur as a result of implementing a Moffat Project alternative were evaluated in the EIS by comparing Full Use of the Existing System and Full Use with a Project Alternative (2032), both of which include RFFAs.
- These are impacts for which Denver Water would be accountable should a Project alternative be constructed and operated.



ES.7.1 Environmental Pool

Under the Proposed Action, a 77,000 AF enlargement would be constructed at Gross Reservoir. Of the 77,000 AF enlargement, 72,000 AF would be utilized to provide new firm yield to Denver Water's system and 5,000 AF would be an Environmental Pool for mitigation. The estimated ground disturbance for the Proposed Action conservatively assumed the inundation area (i.e., the area between elevation 7,282 and 7,400 feet), plus 10 feet above the expanded reservoir pool to account for potential tree removal and other construction-related activities. The additional area of inundation associated with the Environmental Pool (i.e., the area between elevation 7,400 and 7,406 feet) is within the impact area. Thus, the impact analysis of ground-disturbance associated with the Proposed Action with or without the Environmental Pool would be the same. The environmental effects discussed for surface water correspond with the 72,000 AF enlargement whereas the operations and effects associated with the Environmental Pool are discussed in Appendices H-22 and M-2 of the Final EIS, and were independently evaluated by the Corps. Additional analysis conducted by the Corps for recreation and aquatic biological

resources associated with the Environmental Pool are also presented in Appendices H-22 and M-2. In summary, the environmental effects of a 77,000 AF expansion are expected to be similar to the 72,000 AF expansion.

ES.7.2 Surface Water

Denver Water's PACSM, which is a water allocation daily-time-step computer model, was used as the tool to generate hydrologic information for the analysis of the Moffat Project alternatives. The model was used to generate hydrologic output, including stream flows and reservoir data. The following scenarios were evaluated using PACSM:

- Current Conditions (2006)
- Full Use of the Existing System
- Action Alternatives with RFFAs (2032) – Proposed Action (Alternative 1a) and Alternatives 1c, 8a, 10a, and 13a
- No Action Alternative

Hydrologic impacts directly or indirectly related to implementing a Project alternative are based on a comparison of hydrologic data for Full Use of the Existing System and each of the action alternatives (2032). To understand the total environmental effects of the action alternatives in combination with RFFAs, a comparison of Current Conditions and each of the action alternatives and the No Action Alternative was conducted in Chapter 4. A description of each of the model scenarios is provided below.

- **Current Conditions (EIS Chapter 3)** – The Current Conditions scenario reflects existing conditions in 2006, including demands, facilities, agreements, operations, and administration of the Colorado and South Platte river basins. Under the Current Conditions scenario, Denver Water's existing average annual demand is 285,000 AF/yr. The purpose of the Current Conditions scenario is to model Denver Water's and other existing water rights and facilities under the hydrologic conditions that existed throughout the study period (1947 through 1991). In addition, the operations of all existing reservoirs and diversion facilities are simulated for the entire study period, regardless of when they came on line.
- **Full Use of the Existing System** – The Full Use of the Existing System scenario reflects the operation of Denver Water's existing system at an average annual demand of 345,000 AF/yr. The Full Use of the Existing System is without a Moffat Project on line. Denver Water's projected demands are estimated to begin to exceed system supplies in year 2022. Under this scenario, Denver Water would maximize the yield of their existing water supplies using their current facilities and infrastructure. This scenario also includes other RFFAs that are anticipated to occur between Current Conditions and Full Use of the Existing System, which are described in Section 4.3.
- **Action Alternatives with RFFAs** – The action alternatives reflect the operation of Denver Water's system in year 2032 with a Moffat Project implemented combined with other RFFAs. Denver Water's average demand in year 2032 is estimated to be 363,000 AF/yr (379,000 AF/yr average demand less 16,000 AF/yr demand, which is anticipated to be met by additional conservation measures). Each action alternative

provides 18,000 AF/yr of new, firm yield. Model parameters and assumptions included in PACSM for each action alternative (as described in Boyle 2006d).

- **No Action Alternative** – The No Action Alternative scenario reflects the operation of Denver Water's system in year 2032 at an average demand of 363,000 AF/yr without any modifications to their existing facilities or water rights. Denver Water's average annual total supply is 345,000 AF/yr because an action alternative was not implemented. The No Action Alternative also includes other RFFAs that would occur by 2032.

The Moffat Project would result in increased diversions by Denver Water from both the Colorado and South Platte river basins. For all action alternatives, additional Denver Water diversions would occur in average and wet years and would be highly concentrated during the runoff months in May, June, and July. Typically, additional diversions would be greatest in wet years following dry-year sequences. On average, additional diversions would be greatest from the Fraser and Williams Fork river basins, then from the Blue River Basin, and least from the South Platte River and South Boulder Creek. Most of the additional diversions in the Fraser and Williams Fork river basins would occur along tributaries to those rivers. Average annual diversions through the Moffat Tunnel would increase about 2,300 AF (3%) under the No Action Alternative, 10,300 AF (15%) under the Proposed Action, and between 9,200 AF and 10,100 AF (14 to 15%) for the other alternatives compared to Full Use of the Existing System. Average annual diversions through the Roberts Tunnel would increase about 10,300 AF (11%) under the No Action Alternative, 4,800 AF (5%) under the Proposed Action, and between 4,300 AF and 5,300 AF (4 to 5%) for the other alternatives compared to Full Use of the Existing System. There would be no additional diversions in dry-years for all action alternatives, because Denver Water already diverts the maximum amount physically and legally available under their existing water rights without additional storage in their system.

SUMMARY
MOFFAT PROJECT EFFECTS – SURFACE WATER
Stream Flow • Moffat Project action alternatives would increase water diversions from the Colorado and South Platte river basins in average to wet years, primarily in the runoff months of May, June, and July. • Changes in stream flow would be greatest in the Fraser and Williams Fork river basins during average and wet years. • Changes in stream flow in the South Platte River would be relatively minor. • Flows in South Boulder Creek above Gross Reservoir would increase in average to wet years during the seasonal runoff months due to additional diversions through the Moffat Tunnel.

SUMMARY

MOFFAT PROJECT EFFECTS – SURFACE WATER (continued)

Reservoirs

- All action alternatives include an expanded Gross Reservoir. Gross Reservoir would be at its lowest level at the end of April, reach its highest level in June or July, and would be drawn down through the fall and winter.
- The load shift between Denver Water's Northern and Southern WTPs and the higher overall demand that would be met with additional storage on line would affect Dillon Reservoir contents. Under the No Action Alternative, Denver Water would need to rely more heavily on water from Dillon Reservoir.
- There would be very few and relatively small differences in contents and levels at Antero and Eleven Mile Canyon reservoirs in most years under the action alternatives. Cheesman Reservoir would be used more heavily through the summer and less during the winter.
- Alternative 1c includes a new 31,000 AF reservoir in Leyden Gulch. Leyden Gulch Reservoir would be maintained more or less at capacity except in an extended drought when it would be drawn upon.
- Alternatives 8a and 13a include reclaimed gravel pit storage along the South Platte River. The pits would typically fill with either Denver Water's reusable effluent (Alternative 8a) or agricultural water supplies (Alternative 13a) and be maintained more or less at capacity except in an extended drought when the gravel pits would be depleted.

Floodplains

- Generally, floodplain extents would the same or smaller by implementation of any of the action alternatives. One exception is on the Blue River between Dillon Reservoir and Green Mountain Reservoir. Annual peak flows associated with recurrence intervals of 5 years or more increase slightly for the action alternatives relative to Full Use of the Existing System, which would result in slightly larger floodplain extents for that reach of the Blue River.
- Effects on floodplains tend to be the same for all action alternatives, except on South Boulder Creek below Gross Reservoir because releases from Gross Reservoir vary considerably between the alternatives. All alternatives would reduce peak flows associated with specified recurrence intervals. This effect is greatest for the Proposed Action and generally decreases in proportion for alternatives with smaller Gross Reservoir capacity enlargements.
- In the Fraser and Williams Fork river basins, annual peak flows associated with recurrence intervals between 2 and 10 years tend to be smaller under the action alternatives than Full Use of the Existing System. Annual peak flows associated with higher recurrence intervals would be similar under the action alternatives compared to Full Use of the Existing System.
- Floodplains in the North Fork South Platte River and South Boulder Creek above Gross Reservoir are unchanged by the alternatives because imports through Roberts Tunnel and Moffat Tunnel are managed to stay within the channel. Floods may occur in these basins due to local snowmelt or precipitation, but not due to changes associated with the Moffat Project.

Stream Flows

For all action alternatives, changes in stream flows would be greatest in average and wet years during the runoff months, which coincide with the period that Denver Water's additional diversions would be greatest. On the West Slope, flows would decrease due primarily to Denver Water's additional diversions. On the East Slope, there would be both flow increases and decreases due primarily to the combined impacts of Denver Water's

additional diversions, a shift in seasonal operations between Denver Water's North (Moffat) and South (Foothill and Marston) WTPs, additional effluent returns at Bi-City WWTP and Metro WWTP, and additional return flows accruing to the river due to Denver Water's outdoor water usage. Estimated flow changes compared to Full Use of the Existing System in each affected river basin are generally described below and shown in Table ES-1.

Flows in the Fraser River and Williams Fork River would decrease in average and wet years during the runoff months due to Denver Water's additional diversions. Most of the additional diversions would occur along tributaries to the Fraser and Williams Fork rivers, therefore, the percentage change in flows would typically be highest along these tributaries. Moving downstream, the changes in flow volume would be larger, but the flow reductions would be smaller relative to the total stream flow. Average annual flows high in the Fraser River Basin below Denver Water's diversion from the Fraser River would decrease about 360 AF (7%) under the No Action Alternative, 1,440 AF (30%) under the Proposed Action, and between 1,350 AF and 1,420 AF (28 to 29%) for the other alternatives. Overall, flow changes would be higher along the upper tributaries to the Fraser River. Average annual flows at the Vasquez Creek gage would decrease about 480 AF (7%) under the No Action Alternative, 2,320 AF (32%) under the Proposed Action, and between 2,040 AF and 2,270 AF (28 to 31%) for the other alternatives. Average annual flows at the St. Louis Creek near Fraser gage would decrease about 420 AF (3%) under the No Action Alternative, 2,030 AF (13%) under the Proposed Action, and between 1,810 AF and 2,020 AF (12 to 13%) for the other alternatives. Average annual flows in the Fraser River at the Granby gage would decrease about 1,900 AF (2%) under the No Action Alternative, 8,400 AF (9%) under the Proposed Action, and between 7,500 AF and 8,300 AF (8 to 9%) for the other action alternatives. Average annual flows high in the Williams Fork River Basin at the Williams Fork River below Steelman Creek gage would decrease about 420 AF (5%) under the No Action Alternative, 1,910 AF (22%) under the Proposed Action, and between 1,620 AF and 1,880 AF (19 to 22%) for the other alternatives. Average annual flows in the Williams Fork River below Williams Fork Reservoir would decrease about 200 AF (less than 1%) under the No Action Alternative, 1,700 AF (2%) under the Proposed Action, and between 1,400 AF and 1,700 AF (1 to 2%) 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 WTP operations. Under the No Action Alternative, Denver Water would rely heavily on their Blue River supplies to meet a higher demand, particularly during droughts without additional storage. Average annual flows below Dillon Reservoir would decrease about 10,200 AF (7%) under the No Action Alternative, 4,800 AF (5%) under the Proposed Action, and between 4,300 AF and 5,200 AF (4 to 5%) for the other action alternatives. Average annual flows in the Blue River at the confluence with the Colorado River would decrease about 10,200 AF (4%) under the No Action Alternative, 4,800 AF (2%) under the Proposed Action, and between 4,300 AF and 5,200 AF (2%) for the other action alternatives.

Table ES-1
Comparison of Average Annual Flows, Reservoir Outflows, and Diversions at Key Locations (AF)

Location	PACSM Node[1]	Current Condi-tions	Full Use of the Existing System	Proposed Action (Alternative 1a)			Alternative 1c			Alternative 8a			Alternative 10a			Alternative 13a			No Action		
		Avg. Annual Flow	Avg. Annual Flow	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.
Fraser River Basin																					
Moffat Tunnel Diversions	N/A	63,799	66,512	76,797	10,284	15%	76,639	10,127	15%	75,674	9,162	14%	75,667	9,155	14%	76,328	9,816	15%	68,817	2,305	3%
Below Denver Water's Diversion from Fraser River	2120	5,271	4,863	3,426	-1,437	-30%	3,440	-1,423	-29%	3,509	-1,354	-28%	3,507	-1,356	-28%	3,451	-1,412	-29%	4,500	-363	-7%
Vasquez Creek Gage	2370	10,458	7,281	4,959	-2,322	-32%	5,007	-2,274	-31%	5,241	-2,041	-28%	5,241	-2,040	-28%	5,079	-2,203	-30%	6,801	-480	-7%
St. Louis Creek near Fraser Gage	2200	15,648	15,226	13,196	-2,031	-13%	13,204	-2,022	-13%	13,415	-1,812	-12%	13,409	-1,817	-12%	13,288	-1,938	-13%	14,805	-421	-3%
Fraser River at Granby Gage	2900	94,579	91,562	83,187	-8,375	-9%	83,312	-8,250	-9%	84,032	-7,530	-8%	84,025	-7,538	-8%	83,534	-8,028	-9%	89,674	-1,888	-2%
Williams Fork Basin																					
Gumlick Tunnel Diversions	N/A	8,853	9,740	11,648	1,907	20%	11,615	1,875	19%	11,370	1,630	17%	11,357	1,616	17%	11,526	1,786	18%	10,155	415	4%
Williams Fork near Leal Gage	3750	66,446	65,558	63,651	-2,796	-4%	63,683	-2,763	-4%	63,928	-2,518	-4%	63,942	-2,505	-4%	63,772	-2,674	-4%	65,143	-1,303	-2%
Williams Fork Reservoir Outflow	3950	87,715	96,664	94,963	-1,701	-2%	95,008	-1,656	-2%	95,236	-1,428	-1%	95,258	-1,405	-1%	95,066	-1,598	-2%	96,453	-211	<1%
Colorado River Mainstem																					
Colorado River below Windy Gap	1350	155,653	134,685	126,767	-7,918	-6%	126,868	-7,817	-6%	127,628	-7,057	-5%	127,618	-7,066	-5%	127,123	-7,561	-6%	132,912	-1,772	-1%
Colorado River near Kremmling Gage	5020	698,958	650,723	636,349	-14,373	-2%	636,113	-14,610	-2%	637,978	-12,745	-2%	637,944	-12,779	-2%	637,118	-13,605	-2%	638,639	-12,084	-2%
Muddy Creek Basin																					
Wolford Mountain Reservoir Outflow	1600	63,540	63,824	63,878	54	<1%	63,878	54	<1%	63,879	54	<1%	63,881	57	<1%	63,880	56	<1%	63,930	106	<1%
Blue River Basin																					
Roberts Tunnel Diversion	4240	69,676	96,939	101,775	4,836	5%	102,191	5,252	5%	101,281	4,342	4%	101,321	4,382	5%	101,461	4,522	5%	107,254	10,315	11%
Dillon Reservoir Outflow	4250	124,392	96,668	91,881	-4,787	-5%	91,485	-5,183	-5%	92,374	-4,294	-4%	92,329	-4,339	-4%	92,186	-4,482	-5%	86,485	-10,183	-11%
Blue River at Mouth	4800	306,163	278,089	273,279	-4,810	-2%	272,898	-5,191	-2%	273,775	-4,314	-2%	273,724	-4,365	-2%	273,588	-4,501	-2%	267,882	-10,207	-4%

Table ES-1 (continued)
Comparison of Average Annual Flows, Reservoir Outflows, and Diversions at Key Locations (AF)

Location	PACSM Node[1]	Current Condi-tions	Full Use of the Existing System	Proposed Action (Alternative 1a)			Alternative 1c			Alternative 8a			Alternative 10a			Alternative 13a			No Action		
		Avg. Annual Flow	Avg. Annual Flow	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.	Avg. Annual Flow	Diff.	Percent Diff.
South Boulder Creek Basin																					
South Boulder Creek at Pinecliffe Gage	57120	106,043	108,752	119,036	12,993	12%	118,878	12,835	12%	117,913	11,870	11%	117,907	11,863	11%	118,567	12,524	12%	111,056	5,013	5%
Gross Reservoir Outflow	57140	111,454	114,079	123,757	9,678	8%	123,815	9,736	9%	122,776	8,697	8%	122,773	8,694	8%	123,363	9,284	8%	116,378	2,299	2%
South Boulder Creek near Eldorado Springs Gage	57180	46,680	46,330	45,345	-985	-2%	45,310	-1,020	-2%	45,330	-1,000	-2%	45,332	-998	-2%	45,337	-993	-2%	46,091	-239	-1%
North Fork South Platte River Basin																					
North Fork South Platte below Geneva Creek Gage	50700	117,494	143,778	148,480	4,702	3%	148,878	5,100	4%	148,005	4,226	3%	148,043	4,265	3%	148,180	4,402	3%	153,685	9,907	7%
South Platte River Mainstem																					
South Platte below Chatfield Reservoir	51290	122,191	109,221	106,854	-15,337	-13%	106,705	-15,486	-13%	106,803	-15,388	-13%	106,802	-15,388	-13%	106,712	-15,479	-13%	105,046	-17,145	-14%
South Platte at Henderson Gage	58440	285,978	279,342	283,614	4,272	2%	283,537	4,195	2%	282,036	2,693	1%	282,662	3,320	1%	285,029	5,686	2%	281,256	1,914	1%

Notes:

Diff. = Difference in average annual flow between the alternative and Full Use of the Existing System. A positive difference denotes an increase in flow, whereas a negative difference denotes a decrease in flow.

[1]Nodes in PACSM represent locations of stream flow gages, diversions, reservoirs, upstream and downstream extents of instream flow or bypass requirements, imports to a basin, baseflow gains, and return flows.

Alternatives Descriptions

- Proposed Action (Alternative 1a) – Gross Reservoir Expansion (Additional 77,000 AF with the Environmental Pool for mitigation)
- Alternative 1c – Gross Reservoir Expansion (Additional 40,700 AF)/New Leyden Gulch Reservoir (31,300 AF)
- Alternative 8a – Gross Reservoir Expansion (Additional 52,000 AF)/Reusable Return Flows/Gravel Pit Storage (5,000 AF)
- Alternative 10a – Gross Reservoir Expansion (Additional 52,000 AF)/Reusable Return Flows/Denver Basin Aquifer Storage (20,000 AF)
- Alternative 13a – Gross Reservoir Expansion (Additional 60,000 AF)/Transfer of Agricultural Water Rights/Gravel Pit Storage (3,625 AF)
- No Action Alternative – The No Action Alternative assumes that Denver Water would not receive approval from the U.S. Army Corps of Engineers to implement the Moffat Project. The No Action Alternative would require Denver Water to use a combination of strategies to meet the need for additional water supply, including using a portion of its Strategic Water Reserve and imposing mandatory restrictions to help reduce demand during drought periods.

Avg. = average
N/A = not applicable
PACSM = Platte and Colorado Simulation Model

Flows in 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 below the Windy Gap diversion gage would decrease about 1,800 AF (1%) under the No Action Alternative, 7,900 AF (6%) under the Proposed Action, and between 7,100 AF and 7,800 AF (5 to 6%) for the other action alternatives. Average annual flows in the Colorado River near Kremmling gage would decrease about 12,100 AF (2%) under the No Action Alternative, 14,400 AF (2%) under the Proposed Action, and between 12,700 AF and 14,600 AF (2%) for the other action alternatives. The cumulative decrease in flow in the Fraser, Williams Fork, and Blue river basins is slightly higher than the flow decrease that occurs at the Kremmling gage due to changes in Windy Gap diversions. In certain situations, Denver Water's additional diversions would result in a reduction in Windy Gap diversions thereby reducing the decrease in flow along the Colorado River.

Flows in South Boulder Creek upstream of Gross Reservoir would increase in average and wet years during the runoff months due to Denver Water's additional diversions through the Moffat Tunnel. Average annual flows in South Boulder Creek at the Pinecliffe gage (above Gross Reservoir) would increase about 2,300 AF (2%) under the No Action Alternative, 10,300 AF (9%) under the Proposed Action, and between 9,200 AF and 10,100 AF (8 to 9%) for the other action alternatives.

From Gross Reservoir downstream to the South Boulder Diversion Canal, changes in stream flow would reflect seasonal and long-term variations in water demands, hydrologic conditions and Denver Water operations of Gross Reservoir to meet those demands. In general, flows would be higher during winter months as water would be moved out of Gross Reservoir and into Ralston Reservoir in response to the WTPs load shift. Increases in outflow from Gross Reservoir would generally be greatest in dry years because Denver Water would typically draw more water from their North System storage as a drought begins. Flows during the summer would be lower on average under the action alternatives than both Full Use of the Existing System and No Action because Foothills and Marston WTPs would meet a greater portion of the overall demand during these months and as a result, Gross Reservoir releases would decrease. Average annual flows below Gross Reservoir would increase about 2,300 AF (2%) under the No Action Alternative, 9,700 AF (8%) under the Proposed Action, and between 8,700 AF and 9,700 AF (8 to 9%) for the other action alternatives. Downstream of the South Boulder Diversion Canal, flows would generally decrease in wet years because Denver Water would divert more native South Boulder Creek water. Average annual flows in South Boulder Creek near the Eldorado Springs gage would decrease about 200 AF (1%) under the No Action Alternative and 1,000 AF (2%) under the Proposed Action and other action alternatives.

Flows in the North Fork South Platte River would decrease on average during winter months and increase during summer months. While flows would increase on average during summer months, there would be no change in the maximum flows compared to Current Conditions. Flow changes in the North Fork South Platte River would be driven primarily by the load shift in WTP operations. Diversions through the Roberts Tunnel during winter months would be lower on average, which would result in equivalent lower flows in the North Fork South Platte River in these months. Summer diversions through Roberts Tunnel would generally be higher, and consequently flows in the North Fork South

Platte River would be higher on average from May through September. Average annual flows in the North Fork South Platte River below Geneva Creek gage would increase about 9,900 AF (7%) under the No Action Alternative, 4,700 AF (3%) under the Proposed Action, and between 4,200 AF and 5,100 AF (3 to 4%) for the other action alternatives.

Flow changes in the South Platte River would be relatively minor and vary by location. In general, stream flows would change due to additional direct diversions and exchanges to Strontia Springs Reservoir and Conduit 20, changes in Moffat WTP operations, and the load shift between Denver Water's northern and southern WTPs. In addition, the demand that would be met with additional storage on line is higher under the action alternatives; therefore, effluent returns at Bi-City WWTP and Metro WWTP and return flows accruing to the river due to Denver Water's outdoor water usage would increase. Average annual flows in the South Platte River at Henderson gage would increase about 1,900 AF (1%) under the No Action Alternative, 4,300 AF (2%) under the Proposed Action, and between 2,700 AF and 5,700 AF (1 to 2%) for the other action alternatives.

Reservoirs

For all action alternatives, changes in Denver Water's diversions, the load shift between Denver Water's northern and southern WTPs and the higher overall demand that would be met with additional storage on line would result in changes in reservoir contents and levels. Estimated changes in each affected reservoirs compared to Full Use of the Existing System are summarized below:

1. Williams Fork Reservoir contents would generally be lower under all alternatives, primarily due to additional diversions at Gumlick Tunnel and exchanges to reservoirs in the Denver Water system. The maximum monthly average reservoir elevation change would be a decrease of 1 foot under all the alternatives.
2. The load shift between Denver Water's northern and southern WTPs and the higher overall demand that would be met with additional storage on line would affect Dillon Reservoir contents. The maximum monthly average reservoir elevation change would be a decrease of 3 feet under all the action alternatives, and 7 feet under the No Action Alternative. Under the No Action Alternative, Denver Water would rely more heavily on their Blue River supplies to meet a higher demand, particularly during droughts.
3. Under the Proposed Action, Gross Reservoir's volume would increase by 77,000 AF with the Environmental Pool (as described earlier) to 118,811 AF, well over twice its current volume. Under Alternatives 1c, 8a and 10a, and 13a, Gross Reservoir's volume would increase by 40,700 AF, 52,000 AF, and 60,000 AF, respectively. Operations under all the action alternatives would be similar. Gross Reservoir would be at its lowest level at the end of April, reach its highest level in June or July, and would be drawn down through the fall and winter. Under Full Use of the Existing System, the Moffat WTP does not operate in the winter months; therefore, contents increase on average from December through February. However, under the action alternatives, Gross Reservoir contents would drop steadily through the winter because Moffat WTP would be operating at a minimum of 30 million gallons per day. Differences in reservoir contents under the action alternatives are greatest in wet years following a drought, when the enlarged capacity of Gross Reservoir would be able to fill. Under the No Action Alternative, Gross Reservoir average end-of-month contents would be

consistently lower than Full Use of the Existing System in all months and would be drained to the minimum pool more frequently.

4. Under Alternative 1c, a new 31,300 AF reservoir would be constructed at Leyden Gulch. Leyden Gulch Reservoir would be maintained more or less at capacity except in an extended drought when it would be drawn upon. Monthly average, dry, and wet end-of-month contents are approximately 28,000 AF to 31,000 AF or up to 3,000 AF below capacity.
5. There would be very few and relatively small differences in operations at Wolford Mountain Reservoir in most months under the action alternatives. The maximum monthly average reservoir elevation change would be a decrease of less than 1 foot under all the alternatives.
6. There would be very few and relatively small differences in contents and levels at Antero and Eleven Mile Canyon reservoirs in most years under the action alternatives. The maximum monthly average elevation change at Antero Reservoir would be a decrease of less than 1 foot. The maximum monthly average elevation change at Eleven Mile Canyon Reservoir would be an increase of less than 1 foot under the action alternatives and a decrease of less than 1 foot under the No Action Alternative.
7. The shift in treatment plant operations during the winter and the higher demand level met under the action alternatives would affect Cheesman Reservoir contents. In general, Cheesman Reservoir would be used more heavily through the summer and less during the winter. The maximum monthly average water level elevation in the reservoir would decrease by about 4 feet under all the alternatives.
8. Alternatives 8a and 13a include approximately 5,000 AF and 3,625 AF of storage, respectively, in reclaimed gravel pits adjacent to the South Platte River. The pits would typically fill with either Denver Water's reusable effluent (Alternative 8a) or agricultural water supplies (Alternative 13a) when it is available. The gravel pits would generally only be depleted in advanced stages of a drought.

Floodplains

More water would be exported from the Fraser, Williams Fork, and Blue river basins under the alternatives as compared to the Full Use of the Existing System scenario. As a result, it is expected that flood flows and areas of inundation would decrease in the affected river basins on the West Slope under the alternatives.

On the East Slope, more water would be imported to South Boulder Creek and the North Fork South Platte River. However, Denver Water plans to regulate Roberts Tunnel and Moffat Tunnel diversions so there would be no change in the maximum stream flow experienced as a result of Denver Water's operations. Because Denver Water limits their diversions into these basins, there would be no increase in flood flows and floodplain boundaries that could be attributed to the alternatives. Gross Reservoir is currently not operated to provide flood control along South Boulder Creek and that would not change under any of the alternatives. An enlarged Gross Reservoir would generally be able to capture flows that would be spilled under Full Use of the Existing System, therefore, flood flows and the floodplain extent below Gross Reservoir would be smaller under the action

alternatives at times Gross Reservoir is able to capture additional South Boulder Creek flows.

Along the South Platte River mainstem above the confluence with the North Fork South Platte River, annual peak flows would generally be at the same level or smaller under the alternatives. From this information, it can be inferred that the floodplain extent would not be significantly altered in the upper South Platte River. At the South Platte River at Denver gage, annual flood flows under the alternatives are very similar to Full Use of the Existing System since changes in stream flows are expected to be relatively minor. Peak flows associated with more frequent flood events would occasionally increase slightly; however, changes to the floodplain extent in this reach of the river are not considered significant since the increases in peak flows are minor.

ES.7.3 Water Quality

SUMMARY
MOFFAT PROJECT EFFECTS – WATER QUALITY
• Gross Reservoir may experience short-term water-quality impacts, including increased concentrations of methylmercury, due to inundation of new areas. The duration of such effects is uncertain. Long-term adverse impacts to Gross Reservoir water quality are not anticipated. • Negligible impacts are anticipated for the Three Lakes, and no discernible water quality impacts are expected for other potentially affected reservoirs. • Effects on stream temperature would range from negligible to moderate in the Fraser River Basin. • Minor to negligible nutrient concentration increases due to the action alternatives are anticipated in the Fraser River. These project-related anticipated changes are small relative to changes anticipated due to population growth, increased WWTP flows, and anticipated changes in WWTP treatment efficiency. • South Boulder Creek would experience moderate to major changes in stream temperature between Gross Reservoir and the South Boulder Creek diversion to Ralston Reservoir. Specifically, summertime outflow temperatures from Gross Reservoir would be colder due to reservoir expansion. Other water quality effects on South Boulder Creek are expected to be short term in nature and minor to negligible. • Metal concentrations would decrease in the North Fork South Platte River during periods of increased flow from additional Roberts Tunnel diversions and increase in lower flow periods. • Under the No Action Alternative, there would be minor impacts to Chatfield Reservoir. • Under the No Action Alternative, there would be negligible to minor impacts to stream temperature in the Fraser River Basin.

Action Alternatives

Potential effects of the action alternatives on water quality of reservoirs and streams in the Project area are constrained by limitations on Moffat Project stream diversions during dry years and low flow periods when potential water quality degradation is most sensitive. No discernible water quality changes are expected for Williams Fork, Dillon, Wolford Mountain, Antero, Eleven Mile Canyon, Cheesman, Strontia Springs, and Chatfield

reservoirs. Impacts to the Three Lakes (Grand Lake, Shadow Mountain Reservoir, and Granby Reservoir) from the action alternatives compared to Full Use of the Existing System are predicted to be negligible. The expansion of Gross Reservoir, however, may cause minor, temporary increases in organic matter concentrations due to inundation of new areas. Inundation of new areas may also result in temporary increased concentrations of mercury in fish tissue in the reservoir. Gross Reservoir is currently on the Monitoring and Evaluation List for mercury concentrations in fish tissue (CDPHE 2012a). These effects are anticipated to diminish over time, though the duration of the effect is uncertain. No adverse long-term water quality impacts to Gross Reservoir are anticipated.

Effects on stream temperature range from negligible to moderate for different reaches of the Fraser River. Ranch Creek is expected to have a moderate potential for increasing the frequency that temperature standards are approached or potentially exceeded. Reaches of the Fraser River near Fraser and Granby would experience a slight potential for increasing the frequency that temperature standards are approached or potentially exceeded. Stream temperature changes on the Colorado River are expected to be negligible.

Increases in concentrations of chemical and biological water quality parameters attributable directly to action alternatives would be negligible to minor in the Fraser, Blue, and North Fork South Platte rivers and there would be no impact to negligible impact in the Williams Fork and South Platte rivers. Increased discharges of wastewater in the Blue River in October of wet years may or may not impact water quality in the Blue River depending on treatment processes and effectiveness. No changes in permit limits for Blue River discharges are anticipated because the acute low flow level is not expected to change due to the action alternatives. Changes in the concentrations of copper, iron, and nickel are anticipated to occur in the North Fork South Platte River under all action alternatives. The concentration of these parameters is anticipated to increase during periods of reduced deliveries from the Roberts Tunnel and decrease during periods of increased deliveries through the Roberts Tunnel. Water quality changes in South Boulder Creek are not anticipated between the Moffat Tunnel discharge point and Gross Reservoir. South Boulder Creek, however, would experience moderate to major changes in stream temperature between Gross Reservoir and the South Boulder Creek diversion to Ralston Reservoir. Specifically, summertime outflow temperatures from Gross Reservoir would be colder due to reservoir expansion.

No Action Alternative

No water quality impacts are expected for Dillon, Williams Fork, Wolford Mountain, Antero, Eleven Mile Canyon, Gross, and Strontia Springs reservoirs under the No Action Alternative. Chatfield Reservoir would experience minor impacts due to increased phosphorus loadings from greater deliveries through the Roberts Tunnel. No impact or negligible impacts to water quality in Grand Lake, Shadow Mountain Reservoir, and Granby Reservoir are anticipated under the No Action Alternative.

Effects on stream temperatures range from negligible to minor for two reaches of the Fraser River. Ranch Creek is expected to have a minor potential for increasing the frequency of approaching or exceeding stream standards. Areas near Fraser and Granby along the Fraser River would have a negligible potential for increasing the frequency of approaching or exceeding the stream standard. Stream temperature changes on the Colorado River would

also be negligible. No impacts to other water quality parameters are expected to occur in the Fraser, Williams Fork, North Fork South Platte, and Colorado rivers. Water quality impacts in the Blue River under the No Action Alternative would be similar to those described under the Proposed Action. In South Boulder Creek, no water quality impacts are expected under the No Action Alternative. Increased discharges of wastewater in the Blue River in October of wet years may or may not impact water quality in the Blue River depending on treatment processes and effectiveness. No changes in permit limits for Blue River discharges are anticipated because the acute low flow level is not expected to change under the action alternatives. Water quality impacts in the South Platte River at Chatfield Reservoir are anticipated to be minor in spite of an increase in annual water deliveries through the Roberts Tunnel that would marginally increase phosphorus loading into the Chatfield watershed.

ES.7.4 Channel Morphology

SUMMARY
MOFFAT PROJECT EFFECTS – CHANNEL MORPHOLOGY
• The No Action Alternative and Proposed Action with RFFAs would result in a decrease in flow and a corresponding decrease in sediment transport capacity and supply in the Fraser, Williams Fork, Blue and Colorado rivers when compared to Full Use of the Existing System. • Sediment transport and supply are predicted to increase in South Boulder Creek, the North Fork South Platte River, and in Vasquez Creek in the Fraser River Basin when compared to Full Use of the Existing System. • Long-term impacts are expected to be negligible as analysis results suggest that sufficient flows, and large, infrequent flood events would remain and continue to mobilize sediment and retain long-term channel morphology. • Negligible to moderate impacts may occur under the No Action Alternative, but would be less pronounced than under the Proposed Action with RFFAs. • Overall impacts due to changes in flow and sediment characteristics are expected to be negligible to moderate for the Proposed Action with RFFAs.

Potential impacts to channel morphology predicted as a result of the No Action Alternative and the Proposed Action with RFFAs were compared with anticipated channel morphology for Full Use of the Existing System. The analyses utilized the same evaluation of physical and numeric assessment methods completed when evaluating impacts relative to Current Conditions (2006) described in Chapter 4. The assessment included detailed evaluation of Representative sites within the Fraser, Williams Fork, Colorado, Blue and North Fork South Platte rivers, and South Boulder Creek.

Under the No Action Alternative and Proposed Action with RFFAs, decreases in flow would result in a decrease in sediment transport capacity and supply along the Fraser, Williams Fork, Blue, and Colorado rivers downstream of Denver Water's diversions when compared to Full Use of the Existing System. Sediment transport capacity and supply are predicted to increase in South Boulder Creek and North Fork South Platte River as well as in Vasquez Creek (within the Fraser River Basin) upstream of Denver Water's diversion due to increased flows. These results suggest that areas with flow decreases would have

less capacity to convey sediment; they are also predicted to have less sediment in the system as sediment supply increases as flow increases and decreases as flow is reduced. Changes in calculated effective discharge, which is related to transport capacity and supply, were found to be variable at different locations. As a general rule, the recurrence interval of effective discharge is predicted to increase in areas where flows are expected to decrease and decrease in areas where flows are expected to increase.

The recurrence interval of Phase 2 sediment transport is generally expected to increase in areas where flow reductions are predicted and decrease in areas where flow increases would occur. An increase in recurrence interval indicates that Phase 2 transport would not occur as often when compared to Full Use of the Existing System. The number of years between Phase 2 transport events is predicted to either remain consistent or increase in areas where flow decreases are predicted and remain consistent or generally decrease in areas where flow increases are predicted. In areas where flow decreases are expected, results of the Phase 2 analysis suggest that the extent and duration of localized sediment deposition may increase as the result of the No Action Alternative and the Proposed Action with RFFAs. The relative frequency of Phase 2 flows, however, suggests that this deposition would be temporary and flows sufficient to mobilize the streambed would continue to occur. The exception to this is locations immediately below diversions where no bypass flows are maintained. These locations are believed to be already impacted from a channel morphology standpoint and aggradation and/or vegetation encroachment is occurring and is likely to continue. Additional diversions could exacerbate observed impacts below the diversions where no bypass flows are maintained. Increases in the frequency of Phase 2 flows in streams where flows are expected to increase (i.e., South Boulder Creek, North Fork South Platte, and Vasquez Creek above Denver Water's diversion) could result in additional localized bank instability. Bank instability issues have existed historically at these locations so significant armoring has been completed. Increased flows may result in the need for minor additional, bank stabilization.

Proposed Action with RFFAs

Potential impacts to channel morphology resulting from the Proposed Action with RFFAs follow the trends of decreased flows and related sediment transport capacity in the Fraser, Williams Fork, Blue, and Colorado rivers downstream of Denver Water's diversions and increases in flows and transport capacity in South Boulder Creek and North Fork South Platte River as well as in Vasquez Creek (within the Fraser River Basin) upstream of Denver Water's diversion. The magnitude of change to flows is expected to be greater for the Proposed Action with RFFAs than for the No Action Alternative. For this reason, changes in sediment transport capacity, sediment supply, effective discharge, Phase 2 sediment transport and 5- and 10-year peak flows are expected to be more pronounced for the Proposed Action with RFFAs.

The Proposed Action with RFFAs may result in additional localized sediment deposition in areas where flows would decrease and additional localized bank erosion where flows would increase. Negligible to moderate additional deposition and erosion may occur and are predicted to be somewhat greater for the Proposed Action with RFFAs than for the No Action Alternative. Similar to the No Action Alternative, results suggest that sufficient flows, including large, infrequent flood events, would remain in areas with decreased flows to continue to mobilize sediment and retain the long-term channel morphology. Stream

segments below diversions with no bypass requirements were an exception where peak flows have already been reduced to a point where insufficient flows exist to maintain channel morphology and aggradation and/or vegetation encroachment is occurring and is likely to continue.

Increased flows in North Fork South Platte River, Vasquez Creek above Denver Water's diversion and South Boulder Creek are predicted to encourage bank instability. Bank instability issues have existed historically at these locations so significant armoring has been completed. Increased flows may result in the need for additional bank stabilization. The extent of additional minor armoring for the Proposed Action with RFFAs is likely to be greater than for the No Action Alternative.

No Action Alternative

Potential impacts to channel morphology resulting from the No Action Alternative follow the trends of decreased flows and related sediment transport capacity in the Fraser, Williams Fork, Blue, and Colorado rivers downstream of Denver Water's diversions and increased in flows and transport capacity in South Boulder Creek and North Fork South Platte River as well as in Vasquez Creek (within the Fraser River Basin) upstream of Denver Water's diversion. Changes to flows are not expected to occur to the same magnitude given the No Action Alternative when compared to the Proposed Action with RFFAs. For this reason changes in sediment transport capacity, sediment supply, effective discharge, Phase 2 sediment transport and 5- and 10-year peak flows are not expected to be as pronounced for the No Action Alternative.

The No Action Alternative may result in additional localized sediment deposition in areas where flows will decrease and additional localized bank erosion where flows will increase. Negligible to moderate additional deposition and erosion may occur but are predicted to be somewhat less for the No Action Alternative than for the Proposed Action with RFFAs. Similar to the Proposed Action with RFFAs, results suggest that sufficient flows, including large, infrequent flood events, would remain in areas with decreased flows to continue to mobilize sediment and retain the long-term channel morphology. Stream segments below diversions with no bypass requirements were an exception where peak flows have already been reduced to a point where insufficient flows exist to maintain channel morphology and aggradation and/or vegetation encroachment is occurring and is likely to continue. Increased flows in North Fork South Platte River, South Boulder Creek, and Vasquez Creek upstream of Denver Water's diversion are predicted to encourage bank instability. Bank instability issues have existed historically at these locations so significant armoring has been completed. Increased flows may result in the need for additional, bank stabilization. The extent of additional minor armoring for the No Action Alternative is likely to be less than for the action alternatives.

ES.7.5 Groundwater

SUMMARY
MOFFAT PROJECT EFFECTS – GROUNDWATER
• An enlarged Gross Reservoir would result in increased groundwater levels around the reservoir. • There would be a decreased hydraulic gradient upstream of Gross Reservoir. • Similar impacts would occur at the proposed Leyden Gulch Reservoir site under Alternative 1c. • There would be negligible effects to groundwater near affected West Slope streams as groundwater recharge is mainly attributable to snowmelt in upland areas, causing groundwater to flow toward and into streams from uplands. • Under the No Action Alternative, impacts to groundwater near the West Slope streams would be greater in dry years than the action alternatives.

Action Alternatives

All of the action alternatives include an enlarged Gross Reservoir component, which would increase groundwater levels in the area due to rising reservoir levels that would increase seepage. Additionally, there would be a decrease in hydraulic gradients in groundwater immediately upstream of Gross Reservoir for all action alternatives. Reservoir seepage and groundwater mounding effects, similar to those described for raising Gross Reservoir would occur at the proposed Leyden Gulch Reservoir site.

For all the action alternatives, stream flows in each of the potentially affected, West Slope stream segments would decrease, but only during average and wet years. Groundwater levels immediately adjacent to these stream segments would likely decline by an amount similar to the stream level changes because the groundwater and surface water flow systems are directly interconnected. Groundwater recharge occurs throughout the watersheds and is mainly attributable to snowmelt infiltrating the land surface in upland areas. This physical process results in groundwater levels being higher in the areas of higher land surface elevation, which causes groundwater to flow downhill from the uplands toward the streams. Even in the areas along the potentially affected stream segments, any of the Project alternatives would have only very small effects on groundwater levels because the Denver Water stream diversions would occur only during the seasonal high snowmelt period when both upland groundwater recharge and stream flows are highest.

None of the action alternatives include water diversions from the West Slope streams during dry years, or during the low-flow seasons of wet and average water years. For this reason, and because groundwater flows toward and into the streams from uplands, the predicted stream flow changes would cause very small effects on groundwater. The maximum expected change in groundwater level caused by any of the alternatives would not be discernable from natural variability in the groundwater system. Also, no groundwater quality changes are anticipated because there are no physical changes planned for any of the Denver Water's diversion structures. Alternatives 8a, 10a, and 13a include reusable water components, which would reduce the West Slope stream diversion amounts, and further diminish the potential effects on groundwater.

Under Alternative 1c, it is possible that unknown contaminants from Rocky Flats could, if present, be mobilized from the shallow soil within the reservoir footprint by construction of the Leyden Gulch Reservoir. However, seepage of good quality water out of the proposed reservoir would provide natural attenuation of the potential contaminants by dilution and natural flushing.

Alternative 10a would not degrade existing groundwater quality because the reusable water would be treated to meet all water quality standards prior to injection into the Denver Basin aquifers. The gravel pit components of Alternatives 8a and 13a would be designed and constructed with slurry walls to prevent groundwater quality impacts. Similarly, Conduits M and O would be designed and constructed as closed pipelines to prevent impacts to groundwater quality.

The net long-term effect on groundwater levels due to the Denver Water wells under Alternative 10a would be small and generally not discernable to other groundwater users in the area. Groundwater in wells within the vicinity of the Denver Water wells may fluctuate in response to injection and withdrawal pumping. The conversion of agricultural water rights to municipal or other non-irrigation uses under Alternative 13a would result in less groundwater recharge in localized areas that are no longer irrigated.

No Action Alternative

West Slope streams would be narrower and shallower as a result of increasing diversions of stream flow to meet higher demands. Groundwater inflows to these streams would continue to support the base flow of the streams during the low runoff seasons. Groundwater levels would continue to rise during the snowmelt season and fall during the dryer seasons, as is the case under Current Conditions (2006). However, the magnitude of groundwater level changes during the dry season, and during dry years, would be larger under the No Action Alternative because Denver Water would have no provision for additional reservoir storage. Without adding more reservoir storage capacity as contemplated in these action alternatives, Denver Water would need to divert more water from West Slope streams during dry periods to meet the expanding water demands of increasing population. This may entail additional stream water diversions during low-runoff periods and during dry years. Compared to the Proposed Action, increasing diversions during low flow periods would cause larger impacts to groundwater and streams.

On the East Slope, the Moffat Collection System components would remain the same under the No Action Alternative as those currently in use. However, due to the higher future demands and without additional storage capacity, the water levels and volumes of water stored in the reservoirs would be lower than average more often. More frequent low reservoir levels would decrease the seepage from the reservoirs and cause groundwater levels to decline overall, which could cause a long-term adverse impact to the local groundwater resource near the reservoirs.

ES.7.6 Geology

Action Alternatives

Geologic impacts resulting from the action alternatives are primarily associated with the reservoir components. The expansion of Gross Reservoir and the construction of Leyden

Gulch Reservoir may slightly increase the potential for reservoir-induced seismicity. Potential issues related to geologic resources would be addressed through geotechnical and seismic studies in the design and construction phases. Both reservoir sites may be susceptible to potentially unstable slopes and reservoir rim instability as a result of erosion, seepage, wave action, and water level fluctuations. A hogback occurs east of the proposed Leyden Gulch Reservoir Dam. This geologic feature contains clay mine workings that would need to be stabilized during relocation of SH 93. A dam safety analysis would be conducted for any new dam or modification to an existing dam, and designs would be reviewed by Federal and State agencies.

No Action Alternative

No direct geologic impacts are anticipated to occur under the No Action Alternative since there would be no construction activities. Operational activities at Gross Reservoir; however, may potentially create unstable slopes and reservoir rim instability as a result of erosion, seepage, wave action, and water level fluctuations.

ES.7.7 Soils

Action Alternatives

Soils would be permanently and temporarily disturbed from construction of proposed Project components and inundation at the reservoir sites. Approximately 465 acres of soils would be permanently impacted (89 acres of temporary impacts) from the Proposed Action. Smaller Gross Reservoir expansions associated with Alternatives 1c, 8a, 10a, and 13a would create less permanent and temporary soils impacts. Approximately 389 acres of permanent soil loss (176 acres of temporary impacts) would result from the construction of Leyden Gulch Reservoir and associated facilities. The South Platte River Facilities under Alternatives 8a and 13a would result in 6 acres of permanent soil loss (11 and 12 acres of temporary impacts, respectively) associated with construction of an AWTP and ancillary facilities; direct impacts to soils resulting from the gravel pit storage lakes were not quantified since ground-disturbing activities are assumed to be previously completed prior to Denver Water acquisition. Approximately 19 acres of permanent soil loss (25 acres of temporary impacts) would result from construction of the Denver Basin Aquifer Facilities under Alternative 10a. Minimal direct impacts to soils would result from Conduits M and O, the gravel pit pipelines, and the Denver Basin distribution pipelines since a majority of construction would occur within existing roadways.

The reservoir sites would experience fluctuating water levels that could create stresses and erode shoreline slopes. Additionally, the Leyden Gulch Reservoir site contains moderately to highly expansive soils that would be mitigated for in design and construction. Areas that are temporarily disturbed would be reclaimed with vegetation. Limitations at the reservoir sites for vegetation re-establishment include steep slopes, shallow depths to bedrock, and areas of erodible soils.

No Action Alternative

There are no ground-disturbing activities associated with the No Action Alternative; thus, no direct impacts to soils would occur. Shoreline impacts associated with fluctuating water levels at the reservoir sites would be the same as described for the action alternatives.

Under the Combination Strategy, reservoir levels would fluctuate less, particularly in dry years, but would also create similar impacts as described from the action alternatives.

ES.7.8 Vegetation

SUMMARY
MOFFAT PROJECT EFFECTS – VEGETATION
• The clearing of vegetation at Gross Reservoir would result in approximately 465 acres of permanent vegetation loss under the Proposed Action. Vegetation loss at Gross Reservoir would be slightly less under the other action alternatives. • Construction of Leyden Gulch Reservoir (Alternative 1c) would result in approximately 389 acres of permanent vegetation loss. • The transfer of agricultural water rights (Alternative 13a) would impact approximately 3,900 acres of irrigated land and impact pastureland and cropland. • There would be no direct impacts to vegetation under the No Action Alternative.

Action Alternatives

Vegetation would be permanently and temporarily disturbed from construction of proposed Project components. Approximately 465 acres of vegetation would be permanently impacted (89 acres of temporary impacts) by the Proposed Action. Tree clearing would affect about 400 acres and approximately 200,000 trees over 4 inches in diameter. It is not likely to increase the spread of mountain pine beetle. Construction activities would affect about 5 acres of two globally rare foothills riparian shrub communities, and about 1 acre of USFS mapped old growth ponderosa pine. Smaller Gross Reservoir expansions associated with Alternatives 1c, 8a, 10a, and 13a would create less permanent and temporary impacts to vegetation. Most of the impacts at Gross Reservoir would occur in the ponderosa pine/Douglas fir communities. Approximately 389 acres of permanent vegetation loss (176 acres of temporary impacts) would result from the construction of Leyden Gulch Reservoir and associated facilities. The vegetation types at the Leyden Gulch Reservoir site that would be affected are predominantly grass/forb rangeland with small inclusions of cottonwoods, herbaceous riparian, snowberry/shrub mix, disturbed rangeland, and disturbed soil areas. The South Platte River Facilities under Alternatives 8a and 13a would result in approximately 6 acres of permanent vegetation loss (11 and 12 acres of temporary impacts, respectively). Vegetation communities that would be affected by Alternatives 8a and 13a include disturbed areas colonized by weedy species, disturbed rangeland, forest riparian, shrub riparian, and herbaceous riparian. Approximately 18 acres of permanent vegetation loss (21 acres of temporary impacts) would result from construction of the Denver Basin Aquifer Facilities under Alternative 10a. Affected vegetation within Denver Parks' properties primarily consists of lawns, trees, and ornamental vegetation typical of parks and golf courses. Minimal direct impacts to vegetation would result from Conduits M and O, the gravel pit pipelines, and the Denver Basin distribution pipelines since a majority of construction would occur within existing roadways. Transfer of agricultural water rights under Alternative 13a would primarily affect irrigated croplands (approximately 3,900 acres) used for pasture, as well as growing alfalfa, corn, hay, sugar beets, and other

crops. Construction and operation of the Project components may introduce or spread noxious weeds in disturbed areas.

Operation of the reservoir sites and gravel pits may also affect vegetation. For instance, the drawdown area at Gross Reservoir would continue to be relatively barren because of large annual fluctuations in water level. The shoreline areas at the proposed Leyden Gulch Reservoir and the gravel pits, however, are likely to establish vegetation, including riparian and wetland plant species.

No Action Alternative

There would be no direct vegetation impacts as a result of the No Action Alternative. However, indirect impacts to vegetation resources would occur at Gross Reservoir as a result of more frequent and prolonged drawdowns. The area between the normal water elevation and the minimum drawdown level would remain barren of vegetation, but would be increasingly susceptible to noxious weed infestations.

With the exception of mandatory restrictions imposed during drought periods, vegetation resources in the vicinity of Project components and throughout the greater service area would remain largely unchanged under the No Action Alternative. Non-native lawn species, trees, and ornamental landscaping would be impacted by mandatory restrictions resulting in temporary stresses to irrigation-dependent vegetation. Under mandatory drought restrictions, all outdoor watering is prohibited, including trees, shrubs, and high-use public turf areas. Mortality, although impossible to quantify, is likely in some irrigation-dependent areas.

ES.7.9 Riparian and Wetland Areas

SUMMARY
MOFFAT PROJECT EFFECTS – RIPARIAN AND WETLAND AREAS
• There would be permanent impacts to wetlands under Alternatives 1a (Proposed Action), 8a, and 10a that would range from 1.95 to 6.15 acres. Under Alternative 13a, which involves the transfer of agricultural water rights, there would be an estimated impact to 83.87 acres. • Changes in stream flows associated with all action alternatives would have negligible to minor effects on riparian habitat. • Under the No Action Alternative, there would not be direct impacts to wetlands or riparian habitat. Indirect effects to riparian vegetation from stream flow changes would be minor on the Blue River and have no effect to negligible effects on other streams.

Action Alternatives

Wetlands, other waters of the U.S., and riparian areas would be directly impacted by the Project. Permanent impacts would occur if these areas are destroyed or if their function were permanently altered as a result of the Project. Direct permanent impacts would result from clearing, excavating, inundation, filling, and/or other grading that would modify existing functions. Additionally, transfer of agricultural water rights under Alternative 13a would adversely affect wetlands and other water features in ditches and ponds and in wetlands sustained by leakage, overflows, and/or return water flows. Riparian areas along streams are not likely to be affected by agricultural transfers. Table ES-2 summarizes the

potential direct permanent impacts to wetlands, other waters of the U.S., and riparian areas for each Project alternative.

Table ES-2
Total Permanent Impacts to Wetlands,
Other Waters of the U.S. and Riparian Areas (acres)

Resource Type	Proposed Action (Alternative 1a)	Alternative 1c	Alternative 8a	Alternative 10a	Alternative 13a
Wetlands	1.95	6.15	1.77	1.75	83.87
Other Waters of the U.S.	3.53	3.12	3.20	3.16	11.40
Riparian Areas	4.08	3.45	3.62	3.62	3.88

Indirect permanent impacts to wetlands and riparian zones include constriction of stream flow from open cut trenching, erosion resulting from sedimentation, hydrologic modifications as a result of earthwork in adjacent areas, off-highway vehicle use, or noxious weed invasion.

Temporary impacts are primarily associated with construction activities and generally do not have long-term impacts on hydrology and/or function. Construction impacts may include cutting vegetation and covering to facilitate construction activities, or temporarily placing fill into a wetland area. The topography and hydrology of temporarily effected areas would be re-established after construction. Table ES-3 summarizes the potential temporary impacts to wetlands, other waters of the U.S., and riparian areas for each Project alternative.

Table ES-3
Total Temporary Impacts to Wetlands,
Other Waters of the U.S. and Riparian Areas (acres)

Resource Type	Proposed Action (Alternative 1a)	Alternative 1c	Alternative 8a	Alternative 10a	Alternative 13a
Wetlands	0.12	13.43	0.4	0.19	0.42
Other Waters of the U.S.	0.49	2.04	1.18	2.19	1.72
Riparian Areas	0.04	1.36	0.08	0.59	0.14

Changes in stream flows associated with the action alternatives would cause the area covered by 2-year flows to decrease in the Fraser River and its tributaries, Colorado River, Blue River and South Boulder Creek below Gross Reservoir; and to increase in South Boulder Creek above Gross Reservoir and North Fork South Platte River, compared to Full Use of the Existing System. Decreases in the 2-year flow could result in a gradual narrowing of the stream banks, which would decrease flows that would support wetlands within the banks. However, sediment deposition may be temporary and may be removed by longer term floods. Impacts would be confined to a wetland fringe where it currently exists along the edge of the channel. Herbaceous wetland vegetation affected by less frequent or prolonged flooding would likely change in composition and become more

mesic. The affected area would be relatively narrow and is not likely to lead to the death of shrubs or trees. Changes are likely to be very slow in most areas because the reductions in the 2-year flow would be relatively small compared to the rooting zone of most of the affected vegetation (willow and alder shrubs). Changes would be minor along the Fraser River, St. Louis Creek, Blue River and South Boulder Creek below Gross Reservoir, and negligible at other sites. Tributaries of the Fraser River and Williams Fork where diversions occur would have reduced flows during runoff, and extension of the periods when the streams are fully diverted (for those without bypass flows). This would have negligible to minor effects to riparian habitat.

Changes in 5- and 10-year flows would result in minor effects to riparian habitat on the Fraser River and South Boulder Creek below Gross Reservoir, and negligible or no effects at other sites. Changes in the channel width associated with changes in the 5- and 10-year flows would be relatively small at all locations and would affect relatively narrow areas along the banks.

The action alternatives would have no or negligible impacts to fens in the Fraser and Williams Fork valleys.

No Action Alternative

No direct permanent impacts to wetlands, other waters of the U.S., or riparian habitats would occur under the No Action Alternative because there would be no ground-disturbing activities.

Depleting the Strategic Water Reserve Strategy would generally create minor impacts to streams in the Project area. Changes would be higher than the Proposed Action on the Blue River, but the same or less at all other sampling sites. Effects to riparian vegetation would be minor along the Blue River, and would be negligible or none at the other sites. Changes in flow are unlikely to adversely affect riparian and wetland habitats along the South Platte River, because flow changes would generally be small on both an annual average and monthly basis. Changes in 5- and 10-year flows under the No Action Alternative would be less than under the Proposed Action and other action alternatives, and would result in changes in flow elevations of less than 2 inches and changes in channel width of less than 2 feet at all sites. Effects on riparian and wetland vegetation would be negligible.

No additional impacts on wetland and riparian vegetation would result from implementing the Combination Strategy. During a drought, stream flows could decrease in some streams because less water would be released from storage. Changes in stream flow between the two No Action Alternative strategies are not expected to be significant.

ES.7.10 Wildlife

SUMMARY
MOFFAT PROJECT EFFECTS – WILDLIFE
• Construction of Gross Reservoir would impact crucial elk habitat and may change elk migration corridors in the area causing a moderate impact. • Non-crucial habitat for other big game species would be impacted at Gross Reservoir. • Construction of Gross Reservoir would have a negligible to moderate impact to USFS Management Indicator Species. • Construction of Leyden Gulch Reservoir would impact elk winter range and elk concentration areas, and non-crucial habitat for other big game species. • Changes in stream flow would have negligible impacts on moose or elk distribution and population. • The No Action Alternative would not have a noticeable effect on wildlife habitat or species.

Action Alternatives

Wildlife present in the Gross Reservoir area include big game and other mammals, raptors, migratory birds, reptiles and amphibians, and fish. In general, Gross Reservoir would experience loss of three types of elk crucial habitats (elk severe winter range, migration corridors, and concentration areas), loss of non-crucial habitat for other big game species (i.e., mule deer, black bear, and mountain lion), and habitat fragmentation due to the inundation of South Boulder Creek and Winiger Gulch. Year-round construction activities at the dam and nearby areas would temporarily displace big game from the eastern side of the reservoir. Permanent loss of portions of the migration corridor would likely cause changes in elk migration patterns, and would be a moderate impact. Small areas of wetland and riparian vegetation would also be affected. Direct impacts to wildlife would result from loss or degradation of habitat and mortality from ground-disturbing activities. Indirect impacts consist of permanent or temporary displacement of wildlife. Table ES-4 compares direct permanent and temporary impacts to wildlife habitats by alternative at Gross Reservoir.

Table ES-4
Direct Impacts to Wildlife Habitat in Gross Reservoir Study Area by Alternative

Wildlife Habitat	Acres of Impact to Wildlife Habitat									
	Proposed Action (Alternative 1a)		Alternative 1c		Alternative 8a		Alternative 10a		Alternative 13a	
	P	T	P	T	P	T	P	T	P	T
Ponderosa Pine	169.9	7.4	109.7	10.8	133.8	8.6	133.8	8.6	150.8	7.9
Ponderosa Pine/Douglas-fir mix	253.0	42.5	162.7	54.2	195.4	49.8	195.4	49.8	223.2	46.0
Grassland/ forb mix	32.9	2.1	20.1	2.1	24.6	2.1	24.6	2.1	29.5	2.1
Disturbed/ unvegetated	8.9	3.6	8.6	3.9	8.8	3.7	8.8	3.7	8.8	3.7
Open Water	0.0	33.7	0.0	33.7	0.0	33.7	0.0	33.7	0.0	33.7
Talus slope/ rock outcrop	0.4	0.0	0.4	0.0	0.4	0.0	0.4	0.0	0.4	0.0
Total	**465.1**	**89.3**	**301.5**	**104.7**	**363.0**	**97.9**	**363.0**	**97.9**	**412.7**	**93.4**

Notes:
The area of temporary impacts goes up as the area of permanent impacts go down, because the smaller reservoir size means that smaller portions of the temporarily affected areas would be inundated after construction. With a larger reservoir size, more of the areas of temporary impact are considered permanent because they are in the reservoir pool. With a smaller reservoir size, more areas of impact would be left exposed and considered temporary. Temporary impacts do not represent the entire area of impact, but the residual amount that would not be also affected permanently.
P = permanent
T = temporary

Habitats affected by construction and operation of the proposed Leyden Gulch Reservoir include grassland/forb mix, foothills deciduous shrub, wetlands, rural residential (deciduous trees, ornamental plantings), open water (South Boulder Diversion Canal), and disturbed/unvegetated. In general, the Leyden Gulch Reservoir site would experience a loss of elk winter range and concentration areas and loss of non-crucial habitat for big game. Specific wildlife impacts include the loss of 7.2 acres of black-tailed prairie dog colonies and temporary construction disturbance to nesting red-tailed hawks. Construction and operation of the proposed Leyden Gulch Reservoir, however, would be beneficial to water birds. Table ES-5 summarizes the acres of direct temporary and permanent impacts to wildlife habitats at the Leyden Gulch Reservoir site.

Table ES-5
Direct Impacts to Wildlife Habitat at the Leyden Gulch Reservoir Site

Wildlife Community	Acres of Direct Impact	
	Permanent	Temporary
Cottonwood	0.0	8.7
Foothills deciduous shrub	2.1	4.6
Wetland	6.2	14.7
Open Water	0.1	1.3
Rural Residential	0.1	0.3
Grass/Forb mix	374.8	143.5
Disturbed/Unvegetated	5.7	3.3
Total	**389.0**	**176.4**

Construction of the South Platte River Facilities would result in relatively minor impacts. The gravel pits would be excavated when Denver Water acquires them, so no additional ground disturbance or subsequent adverse impacts to wildlife would occur. Filling and operation of the gravel pit reservoirs would provide a beneficial impact to wildlife because approximately 5,000 AF of open water habitat would be created for waterfowl, shorebirds, migratory birds, as well as for amphibians and reptiles. Construction of the AWTP adjacent to Worthing Pit would result in a permanent impact to 4 acres of habitat and temporary disturbance to 7 acres. However, the site of the AWTP is not good quality wildlife habitat due to the lack of vegetation. Temporary disturbance to nesting raptors in the area may occur during construction activities. Transfer of agricultural water rights under Alternative 13a would increase upland grassland habitats. Therefore, prairie dog towns are likely to expand.

The action alternatives would affect several types of wildlife habitats inventoried by the USFS at Gross Reservoir. In forested habitats (forested corridors, interior forest, inventoried and developing old growth), both permanent and temporary impacts would remove the habitat and would be considered a long-term impact. Project impacts would affect the local availability of several types of habitat, but would have a minor effect over a larger area.

Construction and operation of Gross Reservoir would have negligible to moderate impacts to the various USFS Management Indicator Species. Impacts to elk would be moderate and to deer would be minor. Impacts to pygmy nuthatch, hairy woodpecker, mountain bluebird, would reduce the local populations but have a minor effect on regional populations. It would have a negligible effect on populations of golden crowned kinglet, warbling vireo, and Wilson's warbler and no impacts to impacts to Rocky Mountain bighorn sheep or boreal toad in the Gross Reservoir area.

Potential Conservation Areas (PCAs) identified by the Colorado Natural Heritage Program and Environmental Conservation Areas (ECAs) identified by Boulder County would be directly impacted by the action alternatives. The largest expansion of Gross Reservoir would impact approximately 4% of the Winiger Gulch PCA, and 7% of Winiger Ridge ECA. Temporary disturbance of approximately 1% of Rocky Flats PCA for construction staging and spoil storage would occur at the Leyden Gulch Reservoir site. Alternatives 8a,

10a, and 13a would temporarily disturb portions of the South Platte River PCA and Greenway, but would not result in adverse effects to wildlife.

Impacts to wildlife from changes in river flows would not have a noticeable impact on wildlife habitat or wildlife species, because changes in flow would have minimal impacts on wetland and riparian habitats. Changes in stream flows in the Fraser River, Williams Fork, and their tributaries would have negligible effects on moose and elk distribution and population. The Proposed Action would have no or negligible effects to PCAs and State Wildlife Areas that occur downstream of the diversions.

No Action Alternative

The No Action Alternative would not result in any changes to wildlife habitat because no ground-disturbing activities would occur. Changes in operation of the existing system would result in changes in stream flows in the Project area, which would result in only minor changes to wetland and riparian habitat. Therefore, similar to the action alternatives, implementation of the No Action Alternative would not have a noticeable effect on wildlife habitat or species.

ES.7.11 Special Status Species

SUMMARY
MOFFAT PROJECT EFFECTS – SPECIAL STATUS SPECIES
• The expansion of Gross Reservoir would not likely adversely affect greenback cutthroat trout. • Activities at Gross Reservoir may affect local populations of northern goshawk, flammulated owls, American three-toed woodpeckers, and olive-sided flycatchers, but there would be no effect to regional populations. • Actions under the action alternatives would not affect USFS Region 2 sensitive plant species, but would affect several USFS species of local concern. • Stream flow changes would adversely affect Colorado River system endangered fish. • The risk of entrainment of greenback cutthroat trout at diversion structures would increase during periods of increased stream diversions, and is likely to adversely affect greenback cutthroat trout in four West Slope streams. • Flow changes in the South Platte River Basin would contribute to adverse effects on Platte River system threatened and endangered species. • The No Action Alternative would result in impacts similar to the Proposed Action to fish in the Colorado and South Platte River systems.

Action Alternatives

Federal and State Species

One Federally listed species, greenback cutthroat trout, has the potential to occur at Gross Reservoir but would not be impacted under any of the action alternatives. Construction activities associated with the proposed Leyden Gulch Reservoir, the South Platte River Facilities, and Conduits M and O may temporarily impact nesting burrowing owls.

Flow changes in the Fraser, Williams Fork, Colorado, and Blue rivers would likely adversely affect Colorado River system endangered fish species (Colorado pikeminnow,

bonytail chub, humpback chub, and razorback sucker) and have minimal effects to bald eagle, river otter, and boreal toad. Flow changes in South Boulder Creek, North Fork South Platte River, and the South Platte River would contribute to adverse effects on Platte River system threatened and endangered species including whooping crane, piping plover, least tern, pallid sturgeon, and western prairie fringed orchid. Minor flow changes in the Project area are unlikely to result in adverse changes to riparian habitat occupied by Preble's meadow jumping mouse along the South Platte River between Waterton Canyon and Chatfield Reservoir or along South Boulder Creek. Denver Water currently participates in the South Platte River Recovery Program and the Upper Colorado River Recovery Program to aid in the recovery of several of these species. The USFWS issued a Biological Opinion on December 6, 2013 concurring with these determinations and requiring continued participation in the recovery programs.

Flow changes in the tributaries of the Fraser and Williams Fork rivers are unlikely to adversely affect greenback cutthroat trout because of increased entrainment during periods of increased stream diversions. However, the conservation populations upstream of the diversions would not be affected. The Corps is currently consulting with USFWS on these effects and appropriate conservation measures.

Other Special Status Species

Activities at Gross Reservoir may affect local populations of northern goshawk, flammulated owl, American three-toed woodpecker and olive-sided flycatcher, but is unlikely to affect regional populations. Other sensitive animal species, including bald eagle, American peregrine falcon, black swift, dwarf shrew, fringed myotis, Townsend's big-eared bat, and northern leopard frog are unlikely to be affected. The action alternatives would not affect any USFS Region 2 sensitive plant species, but would affect several ARNF plant species of local concern. For several of these species, inundation would destroy a large portion of the known populations in the Gross Reservoir area, and could affect the viability of these species on the ARNF. Construction of the proposed Leyden Gulch Reservoir site would impact 7.2 acres of black-tailed prairie dog towns and reduce habitat for hawk, sensitive butterflies, and northern leopard frog. The South Platte River Facilities would temporarily displace or disturb snowy egret and white-faced ibis. Beneficial impacts to several species, however, would occur under all action alternatives from creation of new open water and shoreline habitat. Construction of the gravel pit pipelines, the aquifer distribution pipelines, and Conduits M and O would temporarily disturb or displace common garter snake and northern leopard frog at stream and riparian crossings. Transfer of agricultural water rights under Alternative 13a would reduce habitat for common garter snake and northern leopard frog, but likely expand black-tailed prairie dog towns, providing more habitat for burrowing owls and foraging ferruginous hawks. Several special status species may occur along the river segments but are unlikely to be affected because flow changes would not noticeably affect availability of suitable habitat for aquatic or riparian species.

No Action Alternative

Under the No Action Alternative, there would be no direct or indirect impacts to special status species from construction of new facilities, but changes in operation of the existing system would result in changes in stream flow in areas occupied by special status species.

Four Federally listed endangered fish species (Colorado pikeminnow, bonytail chub, humpback chub, and razorback sucker) occur in the Colorado River. Flow reductions in the Colorado River resulting from the No Action Alternative would be very similar to the impacts associated with the action alternatives. Similarly, flow changes that would occur downstream in the Platte River in Nebraska would impact several Federally listed species. Similar to the action alternatives, minor flow changes in the Project area are unlikely to result in adverse changes to riparian habitat occupied by Preble's meadow jumping mouse along the South Platte River and South Boulder Creek.

ES.7.12 Aquatic Biological Resources

SUMMARY
MOFFAT PROJECT EFFECTS – AQUATIC BIOLOGICAL RESOURCES
• The enlargement of Gross Reservoir and the construction of Leyden Gulch Reservoir would provide additional fish habitat. • Reductions in high flows in the upper sections of the Fraser River would have a minor adverse impact to fish and invertebrates and a negligible to moderate beneficial impact in the lower reaches. • There would be a minor adverse impact to fish and invertebrates in most of the tributaries of the Fraser and Williams Fork rivers due to increased diversions. • There would be negligible impact to fish and invertebrates in the mainstem of the Williams Fork, Colorado, and Blue rivers. • Increased flows in upper South Boulder Creek and the North Fork South Platte rivers would result in a minor adverse impact to fish and invertebrates. • An increase in winter flows in South Boulder Creek below Gross Reservoir and more favorable winter flows in the South Platte River would have a minor beneficial impact to fish and invertebrates.

Action Alternatives

Most of the impacts to aquatic resources in the Project area would be subsequent to changes in stream flow or reservoir operation, and generally related to the ability of the stream to support aquatic life. Direct impacts would be very limited and temporary, and would include disturbances of short sections of streams during construction.

Construction of Conduits M and O, the gravel pit pipelines, and the aquifer distribution pipelines would have temporary, direct adverse impacts on aquatic resources at stream crossings. The enlargement of Gross Reservoir and the creation of a new Leyden Gulch Reservoir and gravel pit lakes, however, would provide more habitat for fish and invertebrates and may provide opportunities for additional species of fish to become established.

There would be no changes to water quality, riparian vegetation, or channel geomorphology in the Fraser, Williams Fork, Colorado, Blue, South Platte rivers and South Boulder Creek that would affect the suitability of habitat for fish and other aquatic biological resources. Reductions in high flows would have minor adverse impacts to fish and invertebrates in the upper sections of the Fraser River above St. Louis Creek under the action alternatives.

However, lower peak flows would increase habitat availability for fish and invertebrates in the middle section of the river between St. Louis Creek and the head of the canyon near Tabernash. There would be minor adverse impacts for fish and invertebrates in most of the Fraser and Williams Fork tributaries due to increased diversions and channel narrowing. There would be negligible impacts on the mainstem of the Williams Fork, Colorado, and Blue rivers. Increases in runoff flows would have minor adverse impacts to fish and invertebrates in South Boulder Creek upstream of Gross Reservoir. Downstream of Gross Reservoir, the increases in winter flows and reductions in runoff flows would have a beneficial impact to fish and invertebrates in South Boulder Creek but this would be dampened by cooler water temperatures. More favorable winter flows would have a beneficial impact to fish and invertebrates in the South Platte River. Increases in runoff flows would have a minor adverse impact to fish and invertebrates in the North Fork South Platte River.

No Action Alternative

Under the No Action Alternative, there would be an adverse impact to the fish and invertebrate communities of Gross Reservoir since the expansion would not occur and drawdown to the minimum pool would occur approximately 50% more often than under the action alternatives.

There would be negligible impacts to fish and invertebrates in the Fraser, Williams Fork, Colorado, and Blue rivers, and South Boulder Creek and in many of the Fraser tributaries. However, under certain conditions, bypass flows in the Fraser and Blue rivers may not be met which could further reduce flows compared to Full Use of the Existing System during periods of low habitat availability for fish and invertebrates. If bypass flows are not met, there would be an adverse impact to aquatic resources in these affected river segments.

The No Action Alternative would have negligible impacts on the fish and invertebrate communities in the Williams Fork River. The No Action Alternative, however, would divert more water from the Williams Fork tributaries and some of the Fraser tributaries in some months resulting in adverse impacts to fish and invertebrates. Changes in flows in the North Fork South Platte River would result in adverse impacts but increases in flow in a section of the South Platte River would be beneficial.

ES.7.13 Transportation

Action Alternatives

The temporary indirect impacts to traffic operations at Gross Reservoir during construction activities would be passenger vehicle delays due to queuing behind slower-moving haul and supply vehicles on two-lane roads, and queuing at intersections where large vehicle turn movements are more difficult. The frequency (times per day) and duration (total minutes) of traffic delays, and the numbers of people affected by them, pose no significant indirect impacts. Additional traffic associated with vegetation removal was not evaluated in the EIS because the amounts would vary depending on which disposal options would be selected. No change from Current Conditions (2006) in maintenance and operation trips for the dam and reservoir are anticipated once construction activities are complete.

Although some recreational areas would be inundated under the action alternatives, public access to Gross Reservoir would not be changed. Vehicle access would remain unchanged via the existing north and south public access points. During construction, recreational access in the area of the dam would be limited. The north side of the reservoir would still be accessible by Flagstaff Road (County Road 77) from Boulder.

Unlike the expansion of Gross Reservoir, transporting borrow material from off-site locations would not be required to construct a new Leyden Gulch Reservoir. Construction-related traffic would primarily consist of workers commuting to and from the construction site. Approximately 4,000 feet of SH 93 would be permanently relocated under Alternative 1c; the existing SH 93 would remain in service while the realignment is constructed.

Passenger vehicle delays and higher than average volumes of commuter traffic during peak construction would affect local roads in the Denver and Brighton area during construction of Alternatives 8a, 10a, and 13a.

No Action Alternative

Since no construction activities would occur under the No Action Alternative, no direct or indirect impacts to transportation resources are anticipated. Traffic associated with operations and maintenance of existing facilities would remain unchanged.

ES.7.14 Air Quality

Action Alternatives

Short-term direct air quality impacts under the action alternatives are related to construction activities. All action alternatives would result in emissions of dust and combustion products during construction activities. Construction emissions include exhaust emissions from heavy-duty construction equipment, exhaust emissions from construction workers' vehicles and delivery vehicles, and fugitive dust emissions. Under the Proposed Action, average annual emissions of carbon monoxide (CO) and oxides of nitrogen (NO_x) are greater than the conformity *de minimis* levels of 100 tons per year. For Alternatives 1c, 8a, 10a, and 13a the combined average annual emissions of CO, NO_x, and particulate matter less than 10 microns in diameter (PM_{10}) are greater than the conformity *de minimis* levels of 100 tons per year. All action alternatives would undergo a general conformity analysis to ensure that the region remains in compliance with the National Ambient Air Quality Standards.

No Action Alternative

There are no ground-disturbing activities associated with the No Action Alternative; thus no impacts to air quality are anticipated.

ES.7.15 Noise

Action Alternatives

Any Project-related impacts from noise are anticipated to be temporary and direct. Indirect impacts from noise are not anticipated.

At the reservoir sites, off-site and on-site construction-related noise was evaluated. The proposed activities associated with the enlargement of Gross Reservoir and the construction of Leyden Gulch Reservoir are not predicted to exceed relevant standards or guidelines. On-site construction noise may periodically exceed the EPA noise threshold of 70 A-weighted decibel scale (dBA) for public exposure, but the public would not be exposed to these levels on a continuous basis. Temporary off-site noise impacts would be related to construction traffic.

Intermittent noise impacts associated with construction activity occurring within the urban portions of Conduits M and O would be negligible in the context of the Denver Metropolitan area. The rural portions of Conduits M and O are likely to be more affected by temporary construction noise than the more developed areas. Similarly, short-term noise impacts during construction of the Denver Basin Aquifer Facilities would be negligible in the urban context of Denver. Minimal noise-related impacts would result from construction of the gravel pits. The AWTP component of Alternatives 8a, 10a, and 13a would be equipped with sound mitigation features to comply with applicable local noise ordinances.

No Action Alternative

There are no ground-disturbing activities associated with the No Action Alternative; thus, no noise impacts are anticipated.

ES.7.16 Recreation

SUMMARY
MOFFAT PROJECT EFFECTS – RECREATION
• The expansion of Gross Reservoir would directly impact several existing recreation sites adjacent to the reservoir, which are proposed to be relocated to continue current uses. • Access restrictions may occur in some areas of Gross Reservoir during construction. • An expanded Gross Reservoir would provide a larger reservoir for recreation use. • Changes in stream flow would result in negligible to minor impacts to boating opportunities on the Colorado and South Platte rivers and lower South Boulder Creek. • Flow changes in the Fraser and Blue rivers would result in moderate to major impacts to boating opportunities due to a decrease in the number of recreation use days. • Under the No Action Alternative, reduced reservoir water levels would have an adverse impact on recreation activities.

Action Alternatives

All action alternatives would have direct and indirect impacts on both current and future recreation opportunities at Gross Reservoir. Seven of the nine developed recreation areas within the Project area would be inundated under the action alternatives and would need to be relocated to allow for the continuation of their current uses. Forsythe Falls, a popular hiking destination, would be inundated by the enlarged reservoir, causing a major, long-term effect. In addition to restrictions and closures of areas, impacts to the recreation experience may occur from visual and sound disturbances during construction of an enlarged reservoir. During construction, access to some areas of shoreline, on-water access, and associated parking areas may be restricted. Some of these areas would need to be

relocated upon inundation. Increased surface area and extended shoreline may result in the creation of additional recreation opportunities. A larger reservoir available for boating and additional fishing access may be an attraction for recreationists in the area.

The construction of a new reservoir at Leyden Gulch would have little impact on existing recreation since the site is currently undeveloped rangeland with no developed recreation opportunities or public access. There would be a temporary impact to road bicyclists who utilize SH 93 due to its realignment and the reservoir construction; primarily a result of increased heavy traffic. Denver Water has indicated that no recreation opportunities would be provided at Leyden Gulch Reservoir and public access to the site would be prohibited. Therefore, there would be no change in the current recreational character at the Leyden Gulch Reservoir site.

Construction of the South Platte River Facilities under Alternatives 8a and 13a would impact the existing recreation opportunities at the Worthing Pit. As a result of the removal of the pit as a recreation resource, water skiing as well as the existing trailers used as seasonal residences, would no longer be permitted. Construction of the South Platte River Facilities would also temporarily disturb bicyclists on Brighton Road.

Construction of well sites as part of the Denver Basin Aquifer Facilities under Alternative 10a would result in the permanent removal of small acreages of land within existing City and County of Denver developed parks and golf courses. This may impact the visitor experience due to presence of well houses.

No long-term impacts to recreation are expected as a result of constructing Conduits O and M under Alternatives 8a, 10a, and 13a. The delivery pipelines would be within existing road right-of-way (ROW) and would not significantly interfere with any potential future recreation activities. Construction of these pipelines may create a temporary disturbance to bicyclists who use the same roadways where the pipelines would be buried. Crossings of waterways would require construction via an open cut on the channel, temporarily precluding recreational use of the river for activities such as kayaking while construction is ongoing. It would also preclude recreational fishing in the immediate vicinity of the open cut during construction.

Implementation of any of the action alternatives would result in negligible to minor adverse long-term effects to boating on the Colorado and South Platte rivers and lower South Boulder Creek (Gross Reservoir through Eldorado Canyon). Implementation of any of the action alternatives would result in moderate to major long-term effects to boating on the Fraser and Blue rivers as a result of the reduction in number of available use days. Minor to moderate beneficial long-term effects on boating in the upper South Boulder Creek (Pinecliffe to Gross Reservoir) would occur from an increase in flows in summer months and moderate to major beneficial long-term effects would occur on the North Fork South Platte River. However, due to the proposed reservoir expansion, inundation of 0.47 mile of a popular recreational whitewater kayaking run would be considered a major long-term impact.

Generally, no negative impacts to fishing would occur, although possibly some improvements to the quality of fishing on some segments.

Flow changes under the action alternatives on the Fraser River would result in visual or aesthetic impacts in May, June, and July of average and wet years. Although the stream flows would not drop to the level of dry year flows, the difference would be noticeable and adverse. This may have an indirect impact on the overall recreation experience that is somewhat dependent on scenery.

No Action Alternative

The implementation of using the Strategic Water Reserve in combination with mandatory restrictions would be less intense than if either strategy were implemented alone; however, use of the Strategic Water Reserve alone may still affect recreation.

Reductions in reservoir contents in Antero, Eleven Mile Canyon, and Cheesman reservoirs under the No Action Alternative may have an impact on recreation at each facility due to lower water levels. Lowered water levels would limit shoreline recreation activities, such as fishing, and may render boat ramps inoperable. The lower water levels would also have a negative impact on the recreational experience for other activities, such as hiking, camping, and day use due to the potential unsightly nature of reduced water levels during peak use periods.

Dillon Reservoir would be used more heavily and would have a negative impact on recreation by limiting shoreline recreation activities, such as fishing, and may render boat ramps inoperable. The lower water levels would also have a negative impact on the recreational experience for other activities, such as hiking, camping, and day use due to the potential unsightly nature of reduced water levels during peak use periods.

Gross Reservoir would be drained to the minimum pool more frequently under the No Action Alternative. Decreases of this magnitude would have an impact on recreation by limiting shoreline recreation activities, such as fishing, which are particularly popular at Gross Reservoir. Car top boating would likely also be impacted as it would make access to the waterline more difficult. The lower water levels would also have a negative impact on the recreational experience for other activities, such as hiking, camping, and day use due to the potential unsightly nature of reduced water levels during peak use periods.

There are no ground disturbing activities under the No Action Alternative and generally only minor changes in stream depletions. Therefore, impacts on river segments and associated recreational use associated with the No Action Alternative are similar to those previously described under the action alternatives above.

As related to recreation at municipal parks, pools, golf courses, and other areas where water is required, Denver Water has described emergency water use restrictions that may be instituted as part of its drought response that would likely be part of the combination strategy. However, because of emergency water use restrictions, only minor effects would result in fewer visitors to parks and recreation areas with fountains due to the reduced visual appeal and overall park experience.

ES.7.17 Land Use

SUMMARY
MOFFAT PROJECT EFFECTS – LAND USE
• Construction-related activities would result in minor land use impacts at Gross Reservoir and the Leyden Gulch Reservoir site. • The expansion of Gross Reservoir would result in minor land use impacts. • The inundation of Leyden Gulch would result in minor losses of grazing opportunities and impacts to future trail alignments. • The South Platte River Facilities would not conflict with existing or planned land uses. • Minor impacts from construction and use of city parks would occur at the Denver Basin Aquifer Facilities.

Action Alternatives

Impacts to land use would occur if the Project conflicts with adopted planning goals or policies, terminates or has a major impact on existing land uses, or results in changes that would interfere with planned land uses in the area.

Overall, impacts to existing land uses at or adjacent to Gross Reservoir are expected to be minor. Recreation is the primary non-water-storage use at Gross Reservoir. Construction activities would have site-specific direct land use impacts, primarily relating to recreation access and use areas. Construction-related activities would also temporarily impact adjacent land uses from increased noise levels, dust pollution, and possibly ground vibrations from quarrying activities. There would be no impacts to Boulder County Open Space properties. Management of USFS lands within and adjacent to Gross Reservoir are subject to Management Area 3.5 direction, Forested Flora and Fauna Habitats. Management objectives in this area emphasize maintaining and improving wildlife and plant habitats and promoting recreational use in the Winiger Ridge area during summer and fall. Conflicts with USFS management direction include minor, permanent impacts to wildlife and plant habitats and temporary impacts to recreational objectives for the duration of Project construction. Generally, land use within the Gross Reservoir area is stable with only minor development or changes planned, such as individual residential building/improvement permits. There would be no impacts to planned land uses as a result of the action alternatives.

Temporary land use impacts at the Leyden Gulch Reservoir site would occur during construction activities and may include increased noise, dust, and traffic. The new reservoir would be constructed immediately south of the Union Pacific Railroad; there would be no impacts to the railroad under Alternative 1c. The inundation of the Leyden Gulch Reservoir would also result in minor losses of livestock grazing opportunities. Residential land uses in nearby developments would not be impacted by Project construction; however, these residences would be affected by altered views. Land use in the Leyden Gulch Reservoir area is currently stable, but the potential for future development is moderate to high. Additionally, portions of the Leyden Gulch Reservoir site are identified as a "potential open space preservation area" containing two trails. Construction of a new reservoir in Leyden Gulch may impact the future alignment of these trails.

The South Platte River Facilities would not conflict with existing or planned land uses. Gravel pit storage under Alternatives 8a and 13a would be located at existing gravel extraction lakes in areas currently characterized by industrial and agricultural uses. As such, there would be minimal impacts to existing land uses. Structure design criteria, such as sound mitigation and architectural styling would ensure that the AWTP would have no adverse impact on existing or future land uses and would be consistent with current county zoning.

In general, the Denver Basin Aquifer Facilities would result in minor, adverse, long-term impacts to city properties. Short-term construction impacts may include noise, dust, and temporary street closures. Long-term, permanent impacts to uses of these city parks are expected to be minor and primarily related to diminished recreational experiences or aesthetics.

Construction of Conduits M and O would result in temporary adverse impacts. Because the conduits would be constructed in existing streets and ROWs, lane closures and traffic detours would be necessary to accommodate construction activities. Reduced or modified access may temporarily affect retail and commercial land uses along the conduit alignments.

Under Alternative 13a, some of the lands that could no longer be irrigated due to the removal of water rights might remain in dryland cultivation or some other agricultural use. However, these uses are less productive than irrigated farmland. This fact, when combined with urban development pressures, would indicate that conversion of these lands to non-agricultural uses is the most likely outcome.

No Action Alternative

There would be no direct, measurable impacts to land use as a result of the No Action Alternative.

ES.7.18 Visual Resources

SUMMARY
MOFFAT PROJECT EFFECTS – VISUAL RESOURCES
• Long-term direct impacts to visual resources at Gross Reservoir would include changes in scale to the shoreline, reservoir elevation, and dam profile; permanent inundation of scenic areas; relocation of existing facilities and roads; disturbed areas undergoing restoration; a permanently modified quarry site; and a new auxiliary spillway. Methods such as rock-staining and rock sculpting to mimic the surrounding natural landforms may minimize the visual impacts of the quarry site. • Construction of a new reservoir and dam at Leyden Gulch would result in a change in visual environment by obstructing views, converting a natural-appearing setting to a more developed condition, and potentially degrading scenic features; however, this could also result in improvement to the open, rangeland character of the region. • There would be negligible to minor impacts to visual resources or aesthetics in the Colorado, Williams Fork (lower reaches), or Blue rivers. • Visual impacts to South Boulder Creek above Gross Reservoir would be minor and beneficial. • Minor to moderate adverse visual impacts to stream appearance and characteristics are expected in all winter months of all years as a result of flow reductions on the North Fork South Platte River.

Action Alternatives

The extent to which the action alternatives would affect visual resources depends on the amount of visual contrast created between the proposed Project facilities and the existing landscape character. The resource would be impacted if visual change in the landscape had a negative impact on existing viewpoints, high quality scenery, or impacted the view from the setting of visually-sensitive land uses. Impacts would also occur if the predicted visual contrast created by each action alternative would be consistent with management guidelines for each affected area. In general, all action alternatives would create direct, temporary effects to visual resources during construction activities.

Post-construction impacts at Gross Reservoir include short-term effects in disturbed areas until reclamation efforts lessen visual contrasts. Long-term direct impacts to visual resources at Gross Reservoir would include changes in scale to the shoreline, reservoir elevation, and dam profile; permanent inundation of scenic areas; relocation of existing facilities and roads; disturbed areas undergoing restoration; a permanently modified quarry site; and a new auxiliary spillway. The new shoreline and recreational use areas would retain the existing, valued landscape character. An effective reclamation effort at the quarry would reduce visual impacts to a level that would be consistent with a scenic integrity objective of "High." Conversely, an inability to effectively implement these mitigation measures would result in a major permanent impact that would be visible to boaters, adjacent residential areas, and from other viewpoints surrounding the reservoir. The auxiliary spillway would not be compliant with management guidelines (i.e., the USFS ARNF Plan) and would be considered a major impact.

The visual character and scenic attributes of the Leyden Gulch Reservoir would unavoidably change due to a new water storage feature. The most visible primary components of the new reservoir would include the earthfill dam, dam spillway structure and outlet works, relocation of SH 93, an increase in reinforced or impervious surfaces, new access roads, site fencing, service lighting, aboveground wood-post transmission line, and ongoing restoration of three staging areas. Construction of a new reservoir and dam at Leyden Gulch would result in a marked change in visual environment by obstructing views, converting a natural-appearing setting to a more developed condition, and potentially degrading scenic features. Therefore, it would not be compliant with existing management and policy guidance, and would be considered a long-term impact. The proposed reservoir, however, would appear compatible with and potentially be an improvement to the open, rangeland character of the region which already consists of scattered open water storage facilities.

Utilizing available water storage capacity in previously constructed gravel pits would improve the scenic quality of the Alternatives 8a and 13a study area, which would result in minor beneficial long-term visual improvements. Visual contrast resulting from the construction of a new AWTP would be negligible since buildings of similar scale and architecture currently exist within the study area. Construction of the AWTP and associated facilities would create short-term contrasts to existing visual resources, but would not conflict with the scenic management guidelines for the area.

Under Alternative 10a, adverse impacts from the visual contrast created by well clusters would vary based on their placement within each park as well as the size and type of park.

Generally, the smaller parks and special interest locations (such as sculpture parks or memory gardens) would experience adverse impacts to visual character. Larger parks that offer a variety of built amenities or a diversity of topography and vegetation for screening would experience only minor impacts. Building architecture for the AWTP would be designed to be consistent with the surrounding area, which is dominated by heavy industrial and manufacturing uses. No visual contrast would result from the new facilities as industrial buildings of similar scale and architecture currently exist within the area.

Transfer of agricultural water rights under Alternative 13a would primarily affect irrigated croplands. Generally, the types of visual impacts would be expected to include conversion of irrigated cropland to dryland cultivation and/or urban development. Either scenario has the potential to affect scenic character in the area. The conversion to dryland agricultural uses or pasture grasslands would likely result in an increase in noxious weed infestations and urban development would create contrasts with the otherwise rural or scenic qualities. Some emergent wetlands would also convert to grassland when water sources are removed. These changes are likely to be perceived by viewers as an adverse impact on visual resources.

There would be negligible to minor impacts to visual resources or aesthetics in the Colorado, Williams Fork (lower reaches), and Blue rivers under the action alternatives.

Overall, visual impacts to South Boulder Creek above Gross Reservoir would be minor and beneficial. Immediately below Gross Reservoir, reservoir outflow changes would be significantly higher under the action alternatives in winter months creating a major, adverse effect on stream appearance and characteristics. Downstream (near Eldorado Springs gage), the Proposed Action would result in no perceptible impacts to stream appearance or other visual resources and aesthetics.

Minor to moderate adverse visual impacts, including impacts to stream appearance and characteristics, are expected in all winter months of all years as a result of flow reductions on the North Fork South Platte River. Flow changes on the South Platte River, with the exception of immediately below Chatfield Reservoir, would be imperceptible to the casual observer.

No Action Alternative

Since there would be no ground-disturbing activities under the No Action Alternative, there would be no direct impacts to visual resources. Minor indirect impacts, however, to visual resources would occur at Gross Reservoir as a result of more frequent and prolonged drawdowns that would create unattractive visual contrasts for observers, particularly recreationists.

With the exception of mandatory restrictions imposed during drought periods, visual resources would remain relatively unchanged under the No Action Alternative. Under mandatory drought restrictions, lawn watering would be prohibited. Subsequently, visual resources may be impacted due to the temporary die-back or browning of vegetation cover.

ES.7.19 Cultural/Historical/Paleontological Resources

Coordination with the Colorado State Historic Preservation Officer, USFS, and cities and counties within the Project area, was initiated in the fall of 2005 to discuss the Area of Potential Effects, analysis methodologies, and to gather information on specific concerns.

In compliance with 36 CFR 800 and 33 CFR Part 325 Appendix C (including the April 25, 2005 Corps' Interim Guidance), in October 2003 and December 2007 and January 2008, 46 Federally recognized American Indian Tribes with an established interest in the area and the commissions on Indian affairs for the states of Colorado, Oklahoma, South Dakota, Utah, and Wyoming, were notified of the Moffat Project and invited to participate in Tribal Consultation, at their discretion. In addition, efforts were made in January 2008 to contact each of the 46 tribes by telephone. Consultation with an American Indian Tribe recognizes the government-to-government relationship between the Federal government and sovereign tribal groups, and Federal agencies must be sensitive to the fact that historic properties of religious and cultural significance to one or more tribes may be located on ancestral, aboriginal, or ceded lands beyond modern reservation boundaries.

Of the tribes from whom the Corps directly requested comments about the Project, the Northern Arapaho Tribe, Northern Cheyenne Tribal Council, Cheyenne-Arapaho Tribes of Oklahoma, the Southern Ute Indian Tribe, Ute Mountain Tribe, and their associated Tribal Historic Preservation Officers responded and expressed interest in providing input and participating in all phases of the Moffat Project. An offer was made to these Tribes to act as concurring parties to the Programmatic Agreement in 2009 (refer to Appendix L).

Action Alternatives

Prehistoric and historic sites and traditional cultural properties are considered significant if they are listed in or eligible for listing in the National Register of Historic Places. All action alternatives would permanently affect the Gross Dam and Reservoir, and a portion of the Resumption Flume. These impacts are considered to be an adverse effect and treatment of this effect would be required before construction begins. Eighteen significant sites are located within the Leyden Gulch Reservoir site. Alternative 1c would have temporary impacts to three significant cultural and historic sites and permanent impacts to six significant cultural and historic sites. The Denver Basin Aquifer Facilities would permanently impact 16 historic sites. Construction of Conduit O would temporarily impact three significant cultural and historic sites and permanently impact two significant historic sites. Construction of Conduit M would temporarily impact one significant historic site and permanently impact three significant historic sites. No significant cultural or historic sites are anticipated to be impacted by the South Platte River Facilities.

It is not anticipated that the enlargement of Gross Reservoir or construction of the South Platte River Facilities, Denver Basin Aquifer Facilities, and Conduits M and O would impact paleontological resources. Although no paleontological resources were identified at the Leyden Gulch Reservoir site, the area is underlain by the Pierre Shale, which is characterized as Class I (i.e., area has good potential for containing vertebrate, invertebrate, or plant fossils) for paleontological resources.

The table provided below summarizes the historic and cultural sites that could potentially be permanently affected by a proposed alternative component.

SUMMARY		
MOFFAT PROJECT EFFECTS – PERMANENT IMPACTS TO CULTURAL AND HISTORIC SITES		
Site Type	**Impact Type**	**Proposed Mitigation Measures**
Gross Reservoir (All Alternatives)		
Gross Dam and Reservoir	Permanent/Major	Treatment prior to construction
Resumption Flume	Permanent/Major	Treatment prior to construction
Leyden Gulch Reservoir Site (Alternative 1c)		
South Boulder Diversion Canal	Permanent/Moderate	Preparation of Historic Context for Moffat Collection System
Clear Creek-Ralston Canal	Temporary/Negligible	None
Prehistoric Open Camp	Permanent/Major	Data Recovery
Prehistoric Open Camp	Permanent/Major	Data Recovery
Historic Artifact Scatter	Permanent/Major	Archival Research and Data Recovery
Historic Artifacts and Features	Permanent/Major	Archival Research and Data Recovery
Abandoned Clay Mine	Permanent/Major	Archival Research, Level I Documentation, Data Recovery
Ralston Dam Spillway	Permanent/Negligible	None
Denver Basin Aquifer Facilities (Alternative 10a)		
Riverside Cemetery	Permanent/Negligible	Sensitive siting of treatment plant
City Park	Permanent/Negligible	Sensitive siting or use of well vaults
Alamo Placita Park	Permanent/Negligible	Sensitive siting or use of well vaults
Congress Park	Permanent/Negligible	Sensitive siting or use of well vaults
Cranmer Park	Permanent/Negligible	Sensitive siting or use of well vaults
Highland Park	Permanent/Negligible	Sensitive siting or use of well vaults
Washington Park	Permanent/Negligible	Sensitive siting or use of well vaults
Sloan's Lake Park	Permanent/Negligible	Sensitive siting or use of well vaults
Downing Street Parkway	Permanent/Negligible	None
East 4th Avenue Parkway	Permanent/Negligible	None
East 6th Avenue Parkway	Permanent/Negligible	None
East 7th Avenue Parkway	Permanent/Negligible	None
East 17th Avenue Parkway	Permanent/Negligible	None
Monaco Street Parkway	Permanent/Negligible	None
Montview Boulevard Parkway	Permanent/Negligible	None
Speer Boulevard Parkway	Permanent/Negligible	None
Conduits M and O (Alternatives 8a, 10a, and 13a)		
Gardner Ditch	Permanent/Negligible	None
South Boulder Diversion Canal	Permanent/Moderate	Level II Documentation
Railroad Segment	Permanent/Negligible	None

No Action Alternative

The operational changes associated with the No Action Alternative are not anticipated to impact cultural, historical or paleontological resources.

ES.7.20 Socioeconomics

SUMMARY
MOFFAT PROJECT EFFECTS – SOCIOECONOMICS
• The enlargement of Gross Reservoir would result in positive, but negligible impacts through the addition of construction jobs and associated spending. Construction of the Leyden Gulch Reservoir would have similar positive, but negligible impacts. • Construction of other facilities associated with the action alternatives, such as the South Platte River Facilities, conduits, and Denver Basin Aquifer Facilities would have temporary, negligible positive impacts. • The majority of additional employment and business activity generated under all action alternatives would occur primarily in the Denver Metropolitan area. • Capital and operation and maintenance (O&M) costs would vary substantially by alternative; financial impacts, including customer monthly water costs, would range from minor under the Proposed Action, to moderate to major under Alternatives 10a and 13a, respectively. • The No Action Alternative would result in long-term, permanent impacts, with customers potentially experiencing periodic raw water and treated water shortages.

Action Alternatives

Overall, the majority of socioeconomic impacts resulting from an enlargement of Gross Reservoir would be temporary and associated with the construction period. Generally, temporary impacts as a result of a Gross Reservoir enlargement would be positive in nature, but negligible, and would include the addition of new jobs during the construction period (between 187 to 222 full-time employees, depending on the alternative), resulting in an increase in annual employment-related income (ranging from approximately $11 to $13 million per year of construction). Denver Water would expend money on materials and supplies during construction, much of it in the Denver Metropolitan area and surrounding counties. Purchases made by Denver Water for labor and materials plus spending by persons employed as a result of constructing Gross Reservoir would amount to economic output ranging from approximately $52 to $63 million per year, depending on the alternative.

Temporary impacts as a result of construction of a new Leyden Gulch Reservoir would be similar to those described for Gross Reservoir. An additional 499 full-time equivalent positions would be generated during the construction period, as well as an additional $29 million in annual employment-related income. Denver Water would spend additional monies on non-labor costs, much of which would be for materials and supplies, during the construction period. Additional purchases made by Denver Water on labor and materials related to a new Leyden Gulch Reservoir, plus spending by additional persons employed, would amount to an economic output of $95 million per year during the Leyden Gulch Reservoir construction period.

In addition to a Gross Reservoir enlargement, Alternatives 8a, 10a, and 13a would result primarily in temporary impacts associated with construction of the South Platte River Facilities, Denver Basin Aquifer Facilities, and Conduits O and M. Alternative 13a also includes the acquisition of agricultural water rights. An average of between 172 and 481 new jobs would be created as a result of each of these components during the

construction period, resulting in approximately $9 to $27 million in annual employment-related income. Denver Water would spend additional monies on non-labor costs, much of which would be for materials and supplies, during the construction period. Purchases made by Denver Water on labor and materials, plus spending by persons employed, would amount to an economic output ranging from $22 to $111 million per year during the construction period for each of these components.

The total employment, income and economic output generated by each alternative are summarized in the following table.

SUMMARY MOFFAT PROJECT EFFECTS – EMPLOYMENT, INCOME AND ECONOMIC OUTPUT					
Socioeconomic Considerations	**Proposed Action (Alternative 1a)**	**Alternative 1c**	**Alternative 8a**	**Alternative 10a**	**Alternative 13a**
Gross Reservoir					
Total Employment	213	187	218	217	222
Total Income (millions)	$12.6	$10.9	$13.0	$13.0	$12.4
Total Economic Output (millions)	$62.1	$52.1	$63.2	$63.2	$61.8
Leyden Gulch Reservoir					
Total Employment	N/A	499	N/A	N/A	N/A
Total Income (millions)	N/A	$29.0	N/A	N/A	N/A
Total Economic Output (millions)	N/A	$95.9	N/A	N/A	N/A
South Platte River Facilities					
Total Employment	N/A	N/A	264	N/A	221
Total Income (millions)	N/A	N/A	$15.2	N/A	$11.6
Total Economic Output (millions)	N/A	N/A	$76.1	N/A	$52.1
Denver Basin Aquifer Facilities					
Total Employment	N/A	N/A	N/A	481	N/A
Total Income (millions)	N/A	N/A	N/A	$27.0	N/A
Total Economic Output (millions)	N/A	N/A	N/A	$111.0	N/A
Conduit O/Conduit M					
Total Employment	N/A	N/A	198	194	172
Total Income (millions)	N/A	N/A	$12.1	$10.9	$8.9
Total Economic Output (millions)	N/A	N/A	$38.8	$22.7	$33.0
Water Rights Acquisition					
Total Employment	N/A	N/A	N/A	N/A	0
Total Income (millions)	N/A	N/A	N/A	N/A	0
Total Economic Output (millions)	N/A	N/A	N/A	N/A	$35.6

SUMMARY MOFFAT PROJECT EFFECTS – EMPLOYMENT, INCOME AND ECONOMIC OUTPUT (continued)					
Socioeconomic Considerations	**Proposed Action (Alternative 1a)**	**Alternative 1c**	**Alternative 8a**	**Alternative 10a**	**Alternative 13a**
Total					
Total Employment	213	686	679	892	615
Total Income (millions)	$12.6	$39.9	$40.3	$50.8	$32.9
Total Economic Output (millions)	$62.1	$148.0	$178.1	$196.9	$182.5

Note:
N/A = not applicable

Under all action alternatives, the majority of additional employment and business activity would occur in the Denver Metropolitan area; impacts to employment and business activity in Grand County would be negligible. For all action alternatives, the positive impacts to revenues of public entities from increased sales tax collections would be negligible. Impacts to expenditures of public entities would be related to road and bridge maintenance and would be negligible. Several public service providers would experience negligible or minor increases in demands during the construction period. Denver Water and its customers would experience a long-term positive impact from a more reliable water supply. All action alternatives would result in minor to major rate and tap fee increases for Denver Water customers. None of the action alternatives are expected to impact demographic or housing conditions, with the exception of a small number of homes surrounding Gross Reservoir, which would experience negligible to minor temporary impacts related to the presence of construction activities.

Capital costs for construction were developed from feasibility-level designs of the components for each action alternative. These costs include materials, supplies, labor, contractor mobilization, and contractor overhead. Contingency factors and engineering costs are also incorporated into capital costs. Fixed annual O&M costs are those associated with physically maintaining the Project facilities, operational costs including the cost of power, and the routine replacement of mechanical equipment. The estimated costs are indexed to January 2006 conditions. Capital and O&M costs associated with each alternative are summarized in the following table.

SUMMARY MOFFAT PROJECT EFFECTS – ESTIMATED COSTS OF EACH ACTION ALTERNATIVE (2006)					
Costs	**Proposed Action (Alternative 1a)**	**Alternative 1c**	**Alternative 8a**	**Alternative 10a**	**Alternative 13a**
Total Capital Construction Costs	$139,878,000	$293,748,000	$362,007,000	$393,198,000	$426,738,000
Present Worth of Annual O&M (for an 80-year period, discounted at 3%)	$8,788,000	$18,483,000	$147,712,000	$181,476,000	$118,417,000
Total Present Worth Cost	**$148,666,000**	**$312,231,000**	**$509,719,000**	**$574,674,000**	**$545,155,000**

Financial impacts, including customer monthly water costs and system development charges, would occur with all action scenarios, ranging from minor under the proposed action to moderate to major under Alternatives 10a and 13a. Denver Water's ability to borrow would be adversely affected under those latter scenarios.

No Action Alternative

Long-term and permanent socioeconomic impacts would result from the No Action Alternative. Increased chances of a major system failure through the treated water or raw water systems may result in a loss of trust in Denver Water on the part of individual water customers and Denver Metropolitan area institutions. This could result in a change in Denver Water's management structure and responsibilities. Denver Water may also experience an increase in expenditures related to planning for and responding to system failures.

In dry years, customers may experience periodic raw water and treated water shortages. The cities of Arvada and Westminster and the North Table Mountain Water and Sanitation District would be especially vulnerable to raw water shortages. Raw water customers would attempt to acquire temporary supplies when shortages are likely to occur. However, these supplies may not be readily available or may be more expensive during dry periods.

Severe and more frequent mandatory watering restrictions, including surcharges, may result in a reduced quality of life and place financial burdens on customers. Though still infrequent, mandatory restrictions would reduce production, employment, and other business activity in the Denver Metropolitan area.

Minor water rate increases may result. Even with these increased water rates, Denver Water would collect less in total revenue as a result of reduced sales during periods of watering restrictions.

Reduced recreational economic benefits may result from Gross Reservoir due to more frequent drawdown, likely resulting in decreased visitation. The reduced desirability of the Gross Reservoir Primary Impact Area as a place to live or own a home would reduce property values in this area.

The No Action Alternative would have no direct and clearly discernible costs to Denver Water since facility construction or purchases would not occur. It is possible that additional operational costs for pumping or treatment might occur under the No Action Alternative, but such costs would be episodic and unpredictable. By depleting the Strategic Water Reserve and instituting water restrictions with greater frequency and severity, Denver Water and its customers would experience some indirect costs.

ES.7.21 Hazardous Materials

Action Alternatives

Direct impacts may result from construction-related activities in areas where contaminated soil or groundwater occur. An example of an indirect impact from a hazardous material site would be reduced landfill capacity due to disposal of large volumes of contaminated soil. Direct impacts as a result of use, storage, and disposal of hazardous materials would be managed in compliance with State and Federal regulations, and would result in low potential for adverse impacts.

For all action alternatives, no direct or indirect impacts associated with hazardous material sites were identified within the Gross Reservoir study area. Seven hazardous material sites were identified adjacent to and within the Leyden Gulch Reservoir site. The sites have a low or unknown potential for an environmental release.

Related to the South Platte River Facilities associated with Alternatives 8a and 13a, eight sites with a high potential for an environmental release were identified within and adjacent to Worthing and South Tower gravel pits. Under Alternative 8a, no impacts associated with hazardous material sites were identified near the North Tower Gravel Pit. Under Alternative 13a, one site with a moderate potential for impact to the Challenger Gravel Pit was identified, however, no report of any release or violations were documented.

The Denver Basin Aquifer Facilities and Conduits O and M associated with Alternatives 8a, 10a, and 13a are expected to have a high number of hazardous waste sites associated with the urban location of many of the alternative components. If Alternative 8a, 10a, or 13a is selected and permitted by the Corps, any hazardous waste sites would be dealt with in accordance with Federal, State, and local regulations.

No Action Alternative

No ground-disturbing activities would result from the No Action Alternative. Therefore, no hazardous material impacts are anticipated.

ES.8 MITIGATION

ES.8.1 Explanation of Appendix M in the Final EIS

The Corps has completed its preliminary independent evaluation of Project impacts for the five alternatives and the No Action Alternative; this information is described in Chapter 5 of the Final EIS. Included in Chapter 5 are general mitigation and monitoring recommendations discussed at the end of each resource impact analyses discussion.

Appendix M-1 of the Final EIS contains Denver Water's Conceptual Mitigation Plan. Appendix M-2 of the Final EIS contains the Corps' evaluation of the operation of the

Environmental Pool. The Corps will evaluate Denver Water's Conceptual Mitigation Plan and require detailed mitigation as part of a subsequent Section 404 Permit, if issued. The final detailed Mitigation Plan submitted to the Corps by Denver Water may include the following information:

- **Objectives** – A description of the resources, the amount of affected resources, the amount of mitigation, and the method of compensation.
- **Site Selection** – A description of the methods used to select mitigation sites and the proposed location of mitigation sites.
- **Baseline Information** – A description and photographs of existing conditions of proposed mitigation sites.
- **Mitigation Work Plan** – Detailed specifications and work descriptions for proposed mitigation, which will include as appropriate: geographic boundaries, construction methods, grading plans, erosion control measures, re-vegetation and planting specifications, and schedules.
- **Maintenance Plan** – A description and schedule of maintenance needed to ensure the mitigation is properly functioning.
- **Performance Standards** – Standards and criteria used to determine if the mitigation has been successfully implemented and is achieving the objectives.
- **Monitoring Requirements** – A description of what will be monitored to determine if performance criteria are met, and a schedule for monitoring and reporting.
- **Long-term Management Plan** – A description of how the mitigation will be managed after the performance standards are met to ensure the long-term viability of the mitigation.
- **Adaptive Management** – A description of how unforeseen changes in site conditions, possible inability to fully implement the proposed mitigation for the Moffat Project, or the inability to fully meet performance standards will be addressed.
- **Financial Assurances** – A description of sufficient financial assurances to ensure a high level of confidence that mitigation will be successfully completed.

ES.8.2 Concurrent Planning Documents Relevant to Mitigation in the Final EIS

In an effort to inform decision-makers of current Moffat Project-related and relevant planning initiatives, three recent documents are included in Appendix M. Denver Water states that it intends to follow Colorado water law and the administration of the State Engineer in implementing the Moffat Project. Pursuant to Colorado Revised Statute (C.R.S.) 37-60-122.2, Denver Water prepared a Fish and Wildlife Mitigation Plan (Appendix M-3 of the Final EIS) to mitigate potential impacts of the Moffat Project on the State's fish and wildlife resources. Denver Water also prepared a Fish and Wildlife Enhancement Plan (Appendix M-4 of the Final EIS) to enhance fish and wildlife resources beyond the levels that currently exist or that would exist with the Moffat Project. In June 2011, the Colorado Wildlife Commission unanimously approved the Fish and Wildlife Mitigation Plan and authorized Colorado Parks and Wildlife (formerly Colorado Division

of Wildlife) to enter into an Intergovernmental Agreement with Denver Water to implement the Fish and Wildlife Enhancement Plan. In July 2011, the Colorado Water Conservation Board adopted the Fish and Wildlife Mitigation Plan. The Fish and Wildlife Mitigation Plan is the official State position on mitigation of impacts to fish and wildlife resources. Denver Water and 17 West Slope parties have developed a comprehensive agreement known as the CRCA. This multi-party agreement provides a framework for a wide range of actions to benefit water supply and the environment on both sides of the Continental Divide. To summarize:

- Moffat Project, Fish and Wildlife Mitigation Plan (Appendix M-3 of the Final EIS), prepared for the Colorado Wildlife Commission, by Denver Water, June 9, 2011. The Fish and Wildlife Mitigation Plan will be potentially enforceable by a Section 404 Permit, if issued by the Corps.
- Moffat Project, Fish and Wildlife Enhancement Plan (Appendix M-4 of the Final EIS), prepared for the Colorado Wildlife Commission, by Denver Water in Partnership with the Municipal Subdistrict, Northern Colorado Water Conservancy District, June 9, 2011. The Fish and Wildlife Enhancement Plan is a voluntary effort by Denver Water to improve existing conditions in the Colorado River and is not based on Moffat Project impacts identified in the Final EIS. The Corps views the Fish and Wildlife Enhancement Plan as an RFFA that it considers in the overall decision process for the Moffat Project.
- Colorado River Cooperative Agreement (CRCA) (Appendix M-5 of the Final EIS), September 26, 2013. The CRCA is a voluntary effort by Denver Water to improve existing conditions in the Colorado River and is not based on Moffat Project impacts identified in the Final EIS. The Corps views the CRCA as an RFFA that it considers in the overall decision process for the Moffat Project.

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